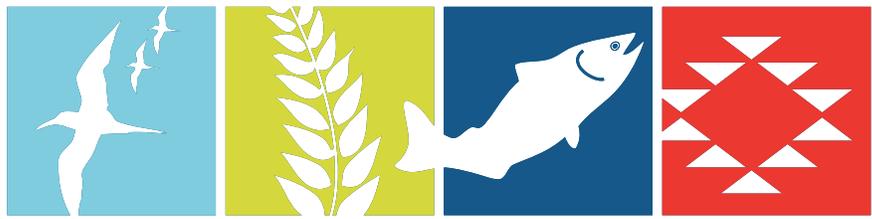


# Klamath Facilities Removal Public Draft Environmental Impact Statement/ Environmental Impact Report



State Clearinghouse  
# 2010062060



U.S. Department  
of the Interior



CA Department  
of Fish & Game

September 2011

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# Klamath Facilities Removal Public Draft Environmental Impact Statement/ Environmental Impact Report

State Clearinghouse # 2010062060



## **Mission Statements**

### **United States Department of the Interior**

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitment to island communities.

### **California Department of Fish and Game**

The Mission of the Department of Fish and Game is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public.

**Klamath Facilities Removal  
Draft Environmental Impact Statement/Environmental Impact Report**

**Siskiyou County, California  
Klamath County, Oregon**

Lead Agencies: U.S. Department of the Interior, through the Bureau of Reclamation (Reclamation), and California Department of Fish and Game (CDFG), Sacramento, California.

**State Clearinghouse # 2010062060**

**ABSTRACT**

This Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) evaluates the potential impacts of the removal of the four PacifiCorp<sup>1</sup> dams on the Klamath River as contemplated in the Klamath Hydroelectric Settlement Agreement (KHSAs). The Klamath Basin Restoration Agreement (KBRA), as well as the transfer of Keno Dam, will be treated and analyzed as a connected action. Together, these two agreements attempt to resolve long-standing conflicts in the Klamath River Basin, located in southern Oregon and northern California. The KHSAs and KBRA provide for the restoration of native fisheries and sustainable water supplies throughout the Klamath River Basin. Specifically, the KHSAs established a process for a Secretarial Determination. This process includes studies, environmental review, and a decision by the Secretary of the Interior regarding whether removal of J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams (1) will advance restoration of salmonid (salmon, steelhead, and trout) fisheries of the Klamath Basin, and (2) is in the public interest, which includes but is not limited to, consideration of potential impacts on affected local communities and Tribes.

This EIS/EIR has been prepared according to requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Direct, indirect, and cumulative impacts resulting from the project alternatives on the physical, natural, and socioeconomic environment of the region are addressed.

Comments on this document must be submitted by November 21, 2011. Reclamation and CDFG will consider comments on the Draft EIS/EIR received during the 60-day review period.

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<sup>1</sup> PacifiCorp refers to the current utility and all previous owners/names.

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- Q Aesthetics/Visual Resources Technical Report
- R Recreation Data Input
- S Transportation and Circulation Analysis Data
- T 2020 Traffic Volume Projections
- U Noise and Vibration Impact Analysis

## Abbreviations and Acronyms

AADT	Annual Average Daily Traffic
AB	Assembly Bill
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AF	Acre Feet
AFA	Aphanizomenon flos-aquae
AIP	Agreement in Principle
AIRFA	American Indian Religious Freedom Act
APE	Area of Potential Effects
AQMA	Air Quality Maintenance Area
ASDSO	Association of State Dam Safety Officials
ASR	Aquatic Scientific Resources
AUM	Annual Unit Month
AWS	Auxiliary Water Supply
B	Beneficial
BA	Biological Assessment
BB	Black Bullhead
BCoCs	bioaccumulative chemicals of concern
BEP	Business Emergency Plan
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMI	Benthic Macroinvertebrates
BMP	Best Management Practice
BOD	Biological Oxygen Demand
BOE	Board of Equalization
BP	Before Present
BSLVs	Bioaccumulation screening level values
BTs	Bioaccumulation Triggers
CAA	Federal Clean Air Act
CAAQS	California Ambient Air Quality Standards
Caltrans	California Department of Transportation
CARB	California Air Resources Board

CAS	California Climate Adaption Strategy
CASGEM	California Statewide Groundwater Elevation Monitoring
CBOD	Carbonaceous biochemical oxygen demand
CCA	California Coastal Act
CCR	California Code of Regulations
CEC	California Energy Commission
CDC	California Department of Conservation
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	Cubic feet per second
CH <sub>4</sub>	methane
CHHSLs	California Human Health Screening Levels
CNDDDB	California Natural Diversity Database
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
CO <sub>2</sub> e	Carbon Dioxide equivalent
COPCO	California Oregon Power Company
CPUC	California Public Utilities Commission
CRFD	Coleston Rural Fire Protection District
CRHR	California Register of Historical Resources
CRS	Congressional Research Service
CSSC	California Department of Fish and Game Species of Special Concern
CUPAs	Certified Unified Program Agencies
CWA	Clean Water Act
CWC	California Water Code
CZMA	Coastal Zone Management Act
dB	decibels
dBA	A-weighted decibels
DC	direct current
DPW	Department of Public Works
DDE	1,1-bis-(4-chlorophenyl)-2,2-dichloroethene
DDT	dichlorodiphenyltrichloroethane
DEA	David Evans and Associations
DEET	N,N-Diethyl-meta-Toluamide (insect repellent)

Detailed Plan	Detailed Plan for Facilities Removal
DHS	California Department of Health Services
DMA	Designated Management Agency
DMMP	Dredged Material Management Program
DO	dissolved oxygen
DOA	Department of Agriculture
DOC	US Department of Commerce
DOF	Department of Finance
DOI	United States Department of the Interior
DPS	Distinct Population Segment
DPW	Department of Public Works
DRE	Dam Removal Entity
DSL	Oregon Department of State Lands
DTSC	California Department of Toxic Substance Control
DW	dry weight
DWR	California Department of Water Resources
ECST	Environmental Compliance Sub-Team of the Technical Management Team
EDD	Employment Development Department
EDR	Environmental Data Resources
EDRRA	Evaluation of Dam Removal and Restoration of Anadromy
EFDC	Environmental Fluid Dynamics Code
EFH	Essential Fish Habitat
EGC	Engineering, Geomorphology, and Construction Sub-Team
eGRID	Emissions & Generation Resource Integrated Database
EIS	Environmental Impact Statement
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
EO	Executive Order
ESA	Environmental Site Assessment
ESA	Federal Endangered Species Act
ESU	Evolutionary Significant Unit
FEIS	Federal Energy Regulatory Commission Environmental Impact Statement

FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FGC	Fish and Game Code
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FLIR	Forward Looking Infrared Radiometry
FDOT	Florida Department of Transportation
FNU	Formazin nephelometric units
FPA	Federal Power Act
FSBC	Floating Surface Bypass Collector
ft/day	foot per day
ft/s	feet per second
FTA	Federal Transit Administration
FTR	Final Technical Report
FWCA	Fish and Wildlife Coordination Act
GCM	Global Circulation Model
GEC	Gatherd Engineering Consultants
GHG	Greenhouse Gases
GIS	Geographic Information Systems
GWP	global warming potential
HABS/HAER	Historic Architectural Building Survey/Historic Architectural Engineering Report
HALS	Historic American Landscape Survey
HASP	Health and Safety Plan
HAZNET	California Facility and Manifest Database
HCM	Highway Capacity Manual
HCN or CN	Toxic free cyanide
HMBP	Hazardous Materials Business Plan
HMMP	Hazardous Materials Management Plan
HPMP	Historic Properties Management Plan
HSC	Health and Safety Code
HTRW	Hazardous, toxic, and radiological waste
HVTEPA	Hoopa Valley Tribe Environmental Protection Agency
ICNU	Industrial Customers of Northwest Utilities
ICP	Interim Conservation Plan
IHA	Indicators of Hydrologic Alteration
IM	Interim Measure

IMPLAN	Impact analysis for PLANning
IOD	Immediate Oxygen Demand
IPCC	Intergovernmental Panel on Climate Change
KBAC	Klamath Basin Advisory Council
KBCC	Klamath Basin Coordinating Council
KBRA	Klamath Basin Restoration Agreement
KDD	Klamath Drain District
Keno Transfer	Proposed transfer of the Keno Facilities from PacifiCorp to Reclamation
KFHAT	Klamath Fish Health Assessment Team
KHHD	Klamath Hydroelectric Historic District
KHP	Klamath Hydroelectric Project
KHSA	Klamath Hydroelectric Settlement Agreement
KMZ	Klamath Management Zone
KOPs	Key Observation Points
KRBFTF	Klamath River Basin Fisheries Task Force
KRSIC	Klamath River Stock Identification Committee
KRWQM	Klamath River Water Quality Model
lbs	pounds
lb/ft <sup>3</sup>	pounds per cubic foot
Leq	Equivalent average noise level
Lmax	noise levels of equipment operating at full power measured from 50ft away
LMB	Largemouth Bass
LOMA	Letter of Map Amendment
LOMR	Letter of Map Revision
LOS	level of service
LPAHEL	Low Probability of Adverse Health Effects
LRMP	Land and Resource Management Plan
LTS	Less than Significant
LUST	leaking underground storage tank
LWD	large woody debris
Lv	vibration velocity level
m/sec	meters per second
MAA	Management Agency Agreement
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
MCPA	2-methyl-4-chlorophenoxyacetic acid

mgd	million gallons per day
MLPA	Marine Life Protection Act
mm	millimeters
MMTCO <sub>2e</sub>	million metric tons carbon dioxide equivalent
mph	miles per hour
MPRSA	Marine Protection, Research, and Sanctuaries Act, or Ocean Dumping Act
mtons/year	metric tons per year
MSAE	<i>Microcystis aeruginosa</i>
MTs	Maximum Levels
MTCO <sub>2e</sub>	metric tons carbon dioxide equivalent
MUTCD	Manual of Uniform Traffic Control Devices
MW	Megawatts
MWh	Megawatt hours
MWMT	Maximum Weekly Maximum Temperature
MY	Model Year
N/A	Not Applicable
N:P	nitrogen to phosphorus
N <sub>2</sub> O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAS	National Academy of Science
NBOD	Nitrogenous Oxygen Demand
NCFEC	No Change From Existing Conditions
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
N-fixation	Nitrogen fixation
NH <sub>3</sub>	ammonia
NH <sub>4</sub> <sup>+</sup>	ammonia
NHMRC	Australian Government National Health and Medical Research Council
NHPA	National Historic Preservation Act
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>3</sub> <sup>-</sup>	nitrate
NOAA Fisheries Service	National Oceanic and Atmospheric Administration Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NOP	Notice of Preparation
NO <sub>x</sub>	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NSO	Northern Spotted Owl
NSR	North State Resources
NTU	nephelometric turbidity unit
NVCP	Noise control and Vibration Plan
NWR	National Wildlife Refuge
NWSRS	National Wild and Scenic Rivers System
NWS	National Weather Service
O <sub>3</sub>	Ozone
OARs	Oregon Administrative Rules
OCAR	Oregon Climate Assessment Report
OCCRI	Oregon Climate Change Research Institute
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
ODOT	Oregon Department of Transportation
OEHHA	Office of Environmental Health and Hazard Assessment
OHV	Off Highway Vehicle
ON	organic nitrogen
ONHP	Oregon Natural Heritage Database
OPWAS	Off-Project Water Settlement
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statute
OWRD	Oregon Water Resources Department
OSU	Oregon State University
PAHs	poly-aromatic hydrocarbons
Pb	lead
PBDEs	polybrominated diphenyl ethers
PCA	Power Control Area

PCBs	polychlorinated biphenyls
PCEs	Primary Constituent Elements
PCPI	Per Capita Personal Income
PDO	Pacific Decadal Oscillation
PDPO	Pollutant Discharge Prohibition Ordinance
PELs	probable effect levels
PG&E	Pacific Gas and Electric Company
PFMC	Pacific Fishery Management Council
PM <sub>10</sub>	Particulate Matter <10 microns
PM <sub>2.5</sub>	Particulate Matter <2.5 microns
Porter-Cologne	California Porter-Cologne Water Quality Act
PP	particulate phosphorus
ppt	parts per thousand
PPV	peak particle velocity
PRBO	Point Reyes Bird Observatory
PRC	Public Resources Code
PRGs	Preliminary Remediation Goals
PRMS	Precipitation Runoff Modeling System
Proposed Action	Full Facilities Removal of Four Dams Alternatives
PSD	Prevention of significant deterioration
PSDDA	Puget Sound Dredge Disposal Analysis
PSPLC	Pokegama Sugar Pine Lumber Company
PUCs	Public Utility Commission
PWA	Phillip William and Associates
Reclamation	Bureau of Reclamation
RCA	Riparian Conservation Area
RED	Regional Economic Development
RES	Renewable Electricity Standard
RHJV	Riparian Habitat Joint Venture
RM	River Mile
RMA	Resource Management Associates
RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right of Way
RPS	Renewable Portfolio Standard
RSET	Regional Sediment Evaluation Team
RSLs	Regional Screening Levels
RV	Recreational Vehicle

RWS	River Water Surface
S	Significant
SAR	Sediment Accumulation Rates
SCAPCD	Siskiyou County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCF	Sectional Center Facility
SDOR	Secretarial Determination Overview Report
SDWA	Safe Drinking Water Act
SDU	Small Domestic Use Appropriation
Secretary	Secretary of the Interior
SEF	Sediment Evaluation Framework
SF <sub>6</sub>	Sulfur hexafluoride
SHPO	State Historical Preservation Officer
SIP	State Implementation Plan
SLs	Screening Levels
SLVs	Screening Level Values
SMS	Scenery Management System
SO <sub>2</sub>	Sulfur dioxide
SOD	Sediment Oxygen Demand
SONCC	Southern Oregon Northern California Coast
SOx	sulfur oxides
SQuiRTs	Screening Quick Reference Tables
SRH-1D	one dimensional sedimentation and river hydraulics model
SRP	soluble reactive phosphorus
SRRC	Salmon River Restoration Council
SSC	suspended sediment concentration
SSDI	suspended sediment concentration
SVOCs	semi-volatile organic compounds
SWAMP	California Surface Water Ambient Monitoring Program
SWE	Snow Water Equivalent
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resources Control Board
TCC	Technical Coordination Committee
TCP	Traditional Cultural Properties
TDI	Total Daily Intake
TIPU	Transportation, Information, and Public Utilities

Term	Stands For
TEQ	toxicity equivalent quotient
THP	Timber Harvest Plan
THPOs	Tribal Historical Preservation Officers
TID	Tulelake Irrigation District
TIN	Total Inorganic Nitrogen
TIPs	Tribal Implementation Plans
TKN	total Kjeldahl nitrogen, ; a measure of organic nitrogen plus ammonia, nitrate (NO <sub>3</sub> ) and ammonia (NH <sub>4</sub> <sup>+</sup> )
TMDL	Total Maximum Daily Load
TMT	technical management team
TN	total nitrogen
TNM2.5	Traffic Noise Model version 2.5
TP	Total Phosphorous
tpy	tons per year
TRVs	Toxicity Reference Values
TSS	Total Suspended Solids
UFWS	U.S. Fish and Wildlife Service
µg/L	micrograms per liter
UGB	Urban Growth Boundary
UKL	Upper Klamath Lake
UKWUA	Upper Klamath Lake Water Users Association
URBEMIS	Urban Emissions Model
USACE	United States Army Corp of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
UST	underground storage tank
v/c	volume to capacity ratio
VdB	vibration decibels
VOCs	volatile organic compounds
VRI	Visual Resources Inventory
VRM	Visual Resource Management Methodology

WECC	Western Electricity Coordinating Council
WHO	World Health Organization
WQ	Water Quality
WQCP	Water Quality Control Plan
WQMP	Water Quality Management Plan
WRIMS	Water Resource Integrated Modeling System
WSR	Wild and Scenic Rivers
WSRA	Wild and Scenic Rivers Act
WUA	Weighted Usable Area
WURP	Water Use Retirement Program
WY	Water year
yd <sup>3</sup>	cubic yards
YTEP	Yurok Tribe Environmental Program
1	No Action/No Project
2	Full Facilities Removal of Four Dams Alternative (Proposed Action)
3	Partial Facilities Removal of Four Dams Alternative
4	Fish Passage at Four Dams Alternative
5	Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

# Executive Summary

## ES.1 Introduction

This document, *Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report* (EIS/EIR), has been developed in accordance with the requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) to analyze the potential impacts to the environment from removing four PacifiCorp Dams (J.C. Boyle, Copco 1, Copco 2, and Iron Gate) on the Klamath River under the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA is one part of a basin-wide approach to address the continuing and unresolved issues related to the basin resources that have resulted from over-stressed water supplies and water quality concerns.

Due to these unresolved issues, during the previous ten years, the federal government has faced events and taken unprecedented and extraordinary actions in the Klamath Basin. The following are examples of some of these events and actions:

- In spring of 2001, the federal government announced there would be no deliveries of water from Upper Klamath Lake or Klamath River to Reclamation's Klamath Project due to Federal Endangered Species Act (ESA) concerns - the first time project water deliveries were not made at a Reclamation project (very limited deliveries occurred later in the summer).
- In 2002, there was a major fish die-off in the Klamath River of adult fall-run Chinook salmon (at least 30,000 fish).
- In 2005, warnings of contact with water in Iron Gate and Copco Reservoirs due to toxic algae blooms began being posted annually.
- In 2006, low abundance of Klamath Basin Chinook salmon led to severe restrictions on commercial and recreational harvest along 700 miles of the California and Oregon coast, as well as major reductions in Klamath River recreational and tribal fisheries.
- In 2009, Klamath area commercial salmon harvest was closed.
- In 2010, there was a significant reduction in water deliveries to Reclamation's Klamath Project due to dry hydrologic conditions.
- In 2010, the Klamath Tribes limited their harvest of suckers to ceremonial use for the 25th consecutive year and experienced their 92nd year without access to salmon.

These events and actions, plus others not mentioned, have demonstrated the need for long-term solutions that address these complex and basin-wide issues. There have been limited and piecemeal approaches that have provided interim relief or some mitigation, but the Klamath Basin faces substantial, long-term challenges that many believe call for different and more comprehensive approaches. As stated above, the KHSA is one part of a proposed approach to resolve these issues.

## **KHSA**

The KHSA is an agreement to study the potential removal of four dams on the Klamath River and, should a decision be made to remove these dams, the agreement provides a path forward on undertaking this removal. The potential removal of dams can be one of, or a part of, other long-term solutions to basin challenges. The KHSA was developed by representatives of 45 organizations including federal agencies, the States of California and Oregon, PacifiCorp, Indian Tribes, counties, irrigators, and conservation and fishing groups in order to end one of the most economically, environmentally, and culturally devastating water disputes in the western United States. The terms of the KHSA acknowledge, however, that there are many unknown consequences regarding the potential removal of these facilities and thus the agreement requires that the Secretary of the Interior undertake a series of scientific studies to determine whether dam removal would be in the public interest and would advance restoration of the salmon fishery. If the Secretary, in cooperation with the Secretary of Commerce and other Federal agencies as appropriate, determines that dam removal fulfills these criteria, the States of Oregon and California will consider whether to concur in that determination.<sup>1</sup> If the governors concur, dam removal will proceed in accordance with the KHSA. This joint EIS/EIR is intended to provide the required environmental review for both the Secretarial Determination and the gubernatorial concurrences. Consequently, this EIS/EIR has been prepared by the United States Department of the Interior (DOI), as lead NEPA agency, and the California Department of Fish and Game (CDFG), as lead CEQA agency (collectively referred to herein as Lead Agencies). Recognizing that elements of the Proposed Action would occur in California and Oregon, CDFG collaborated with DOI, with input from the State of Oregon, to make a reasonable, good faith effort in disclosing all significant environmental effects of the Proposed Action. Absent certain circumstances, CEQA does not apply to any project or portion thereof located outside of California which will be subject to environmental review pursuant to NEPA. (Public Resources Code § 21080(b)(14); CEQA Guidelines § 15277).

## **Klamath Basin Restoration Agreement (KBRA)**

The KBRA is also a basin-wide approach to addressing the current resources challenges. The KBRA will be signed by the United States upon congressional authorization.<sup>2</sup> The complete KBRA package entails various commitments and actions that have been or will be proposed and/or undertaken in the basin by federal, state, local, tribal, and private interests. Some of the KBRA actions could have effects (whether adverse or beneficial) on the same environmental resources that would be affected by dam removal. Some KBRA actions are expressly preconditioned by and therefore hinge upon dam removal, and an affirmative Secretarial Determination. Some KBRA actions are federal but are not expressly linked to dam removal, and some actions are completely between private parties.

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<sup>1</sup> There are certain conditions that must be met prior to the Secretary making this determination. One such condition is the enactment of federal law authorizing the KHSA which has not occurred as of this time. There are also other requirements. For a complete list of these requirements, please see [KlamathRestoration.gov](http://KlamathRestoration.gov), which has the KHSA posted in its entirety.

<sup>2</sup> Under the KHSA and KBRA (Agreements) the United States will be a party to the KBRA at the time of a Secretarial Determination under the KHSA, and obligated to implement the KBRA according to its terms.

## NEPA Specific Analysis

The federal lead agency, the DOI, is analyzing the KBRA as a connected action. NEPA defines connected actions as those actions that are closely related or cannot or will not proceed unless other actions are taken previously or simultaneously (40 CFR 1508.25(a)(1)(ii)).<sup>3</sup> Some actions or component elements of the KBRA are independent obligations and thus have independent utility from the KHSA, but the implementation of several significant elements of the KBRA package would be different, if the determination under the KHSA is not to pursue full dam removal. Recognizing that implementation of many elements of the KBRA are unknown and not reasonably foreseeable at this time, the connected action analysis is being undertaken at a programmatic level. Consequently, appropriate NEPA compliance will be completed for the KBRA in the future.

For purposes of this analysis, the KBRA is viewed as a whole program even though some of its component parts are currently being implemented (those without a federal nexus or not subject to environmental review) or could be implemented on an individual basis without dam removal. One of the reasons the KBRA is treated as a whole for purposes of this analysis under NEPA is that the individual activities under the KBRA will be implemented, through adaptive management and in close coordination with committees comprised of stakeholders, in a manner that seeks to attain synergy and optimize benefits through a coordinated, holistic approach to restoration and water management. Implementing those KBRA activities that are not connected to facilities removal on an individual basis without the benefit of adaptive management and stakeholder input will likely not provide the same level of optimization.

Consequently, for purposes of NEPA, in the EIS for alternatives where dams are not removed, the KBRA, as currently signed by the parties, would not be implemented. This is not a judgment about whether any particular measure in the KBRA will be implemented in the absence of dam removal. Rather, it is an assumption that in the absence of dam removal, the KBRA will not include all of the components present in their current form. This

### NHPA Section 106 Process

DOI elected to utilize the NEPA process to meet the federal requirements of Section 106 of the National Historic Preservation Act (NHPA) as allowed under 36 CFR Section 800.8(c). DOI defines the undertaking, for purposes of Section 106 of the NHPA, as the removal of the four PacifiCorp dams which may be a result of the Secretarial Determination. The proposed undertaking has the potential to affect historic properties triggering compliance with Section 106 of the NHPA. The analysis and consultations concerning any effects of the Proposed Action and alternatives on historic properties are integrated into the NEPA review and documentation pursuant to the criteria identified in 36 CFR Section 800.8(c)(1)-(4).

<sup>3</sup> We acknowledge, however, that the KBRA could also be analyzed as a cumulative or similar action under 40 CFR 1508.25(a)(2) and (3). We note that all three definitions (connected action, cumulative actions, and similar actions) are within the section that provides parameters for the "scope" of the action, which determines both the range of alternatives and the impacts to be considered in an EIS. Ultimately, however, we believe the important point is not the labeling but the analysis and whether the decision (in this case whether to remove four dams) is informed by a EIS that is proper in scope.

means that this document does not make decisions about implementing any specific program, plan, commitment, or activity under the KBRA if dams are not removed. Federal decisions on specific measures in the KBRA, including any necessary additional environmental review, will be made in a separate process. This document will be used to inform a decision related only to dam removal. In doing so, NEPA requires that we properly scope the EIS to include a discussion of connected actions. Further NEPA Section 40 CFR 1508.25 recognizes the interrelationship of scope to other statements and encourages to tier EISs, focusing on issues as they are ripe for decision.

### **CEQA Specific Analysis**

CDFG, as lead agency under CEQA, is analyzing relevant parts of the KBRA in a programmatic fashion, as described in Section 15168 of the CEQA Guidelines. This decision was made because many of KBRA's component elements have not been specified to a degree where the associated impacts would be reasonably foreseeable for purposes of this environmental analysis. The parties recognize that future project-specific analysis may be required for various components of the KBRA as they become more clearly defined and when a public entity, as defined by CEQA Guidelines section 15379, identifies a discretionary approval pursuant to CEQA Guidelines section 15378 which would obligate subsequent review. A program-level document is appropriate when a project consists of a series of smaller projects or phases that may be implemented separately. Under the programmatic EIR approach, future projects or phases may require additional, project-specific environmental analysis. It should also be noted that this EIR makes certain assumptions about the foreseeable effects of KBRA based on existing information, including, among other things, how the fishery and water resources programs may be designed and implemented. CDFG recognizes that subsequent environmental analysis may be required by any California public entity with an approval or permitting obligation if the circumstances specified by CEQA Guidelines section 15162(a) are triggered.

Importantly, CDFG could have analyzed the associated impacts of the KBRA relative to the KHSA in the indirect and cumulative impacts analysis portion of the KHSA EIR as it is not affirmatively approving or carrying out any one aspect of the KBRA that would be subject to environmental review. CDFG recognizes it is not “approving” any discretionary portion of the KBRA that could alter the physical environment and that by signing the KBRA it has already executed and committed to the agreement itself. Thus, similarly to the EIS, there are no alternatives that consider what a new or revised KBRA might look in the event dams are not removed. Rather, to avoid confusion, duplication, and wasted resources, CDFG has determined that the concurrent and connected nature of the KBRA to the KHSA warrants a clear understanding of its potentially significant impacts and that the approach of programmatic analysis is equally, if not more, sufficient for providing that information to decision-makers.

Thus, out of an abundance of caution, and to ensure full transparency, CDFG has agreed to consider significance determinations for the KBRA in a programmatic fashion. Recognizing that elements of the Proposed Action would occur in California and Oregon, CDFG collaborated with DOI to, with input from the State of Oregon, make a reasonable, good faith effort in disclosing all significant environmental effects of the Proposed Action. Absent certain circumstances, CEQA does not apply to any project or portion thereof located outside of California which will

be subject to environmental review pursuant to NEPA. (Public Resources Code § 21080(b)(14); CEQA Guidelines § 15277). CDFG considers the proposed actions by California to be implementation of the KHSAs and thus has crafted alternatives only for dam removal itself, assuming that absent full facilities removal the relevant elements of the KBRA will no longer be ascertainable.. CDFG recognizes that in the event subsequent analysis is deemed appropriate, it will be required to consider any feasible alternatives, mitigation measures, and any other elements required by CEQA as the basis for any approval of such KBRA project or phase in accordance with existing law.

### **Oregon Concurrence**

The State of Oregon, and more specifically the “Klamath Team” consisting of Oregon Water Resources, Oregon Department of Fish and Wildlife, and Oregon Department of Environmental Quality, will follow a distinct process for determining concurrence with an Affirmative Determination by the Secretary of Interior (as defined pursuant to Executive Order No. 10-10 by the Governor of Oregon).

The Oregon Klamath Team will evaluate two questions in order to determine concurrence:

1. Whether significant impacts identified in its environmental review can be avoided or mitigated as provided under state law.
2. Whether the facilities removal will be completed within the State Cost Cap.

The Klamath Team will provide the results of its evaluation in a recommendation to the Governor, for transmittal to the Secretary of Interior as a concurrence, if appropriate.

## **ES.2 Background**

Figure ES-1 illustrates many of the existing features of the Klamath Basin in southern Oregon and northern California. The Klamath Basin’s history, like numerous other river basins throughout the western United States, is one of fish harvest, dam construction, water diversion, and corresponding changes in the basin’s water quality, hydrology, and natural resources.



Figure ES-1. The Klamath Basin

### ES.2.1 Basin Timeline

Figure ES-2 displays a timeline of some of the events and activities within the basin which have contributed to current conditions related to water supply, fisheries, and stakeholder negotiations. Water diversions and planning for dam construction in the basin began prior to 1905, when the precursor to the Bureau of Reclamation (Reclamation) started construction of Reclamation's Klamath Project. Construction of the Klamath Hydroelectric Project, starting with Copco 1 Dam, began in 1911.

### ES.2.2 Activities Leading to the Development of the KHSA and the KBRA

While the construction and operation of reservoirs and dams on the Klamath River facilitated development, growth, and expansion of an agricultural economy in the region, it also contributed to declines in fisheries and water quality, as well as impacts on tribal resources and culture.

As described above, construction of the dams along the mainstem of the Klamath River resulted in fisheries declines. The construction of Copco 1 Dam resulted in decimation of the Klamath Tribes' anadromous fisheries by blocking fish passage to the Upper Basin. The 1980s and 1990s witnessed declining populations and closure of Lost River and shortnose sucker fisheries as well as the federal listing under the Endangered Species Act of both sucker species and coho salmon.

### Klamath Hydroelectric Project

The Klamath Hydroelectric Project was constructed between 1911 and 1962 and includes eight developments: the East and West Side power facilities, and Keno, J.C. Boyle, Copco 1, Copco 2, Fall Creek, and Iron Gate Dams. Located at the upstream boundary of the Klamath Hydroelectric Project, Link River Dam and Upper Klamath Lake are not part of the project.

All of the dams, excluding Link River Dam, are owned by PacifiCorp. Link River Dam was constructed to enhance hydroelectric production at the East and Westside power plants as well as control the storage and timing of water releases downstream to better control future power production at the lower river dams. The dam is operated by PacifiCorp under Reclamation's direction for regulating flows and storing water in Upper Klamath Lake.

Keno Dam regulates water levels of the Klamath River upstream of the dam. The facility does not include power-generating equipment. PacifiCorp operates the dam under an agreement with Reclamation to maintain stable water levels in Keno Reservoir for consistent water delivery to dependent water users.

The dams on the mainstem of the Klamath River include: J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams (the Four Facilities), which are currently owned by PacifiCorp. The portion of the Klamath River that includes these four most downstream dams is referred to as the Klamath Hydroelectric Reach. Fall Creek Dam is on a Klamath River tributary that flows into Iron Gate Reservoir.

The purpose of the Klamath Hydroelectric Project is power generation. The installed maximum capacity of the entire project is 169 megawatts and, on average since full installation in 1963, the project produced 82 megawatts, and annually generated 716,800 megawatt-hours of electricity.



Figure ES-2a. Klamath Basin Timeline



Figure ES-2b. Klamath Basin Timeline

In 2008 and 2010, the United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, respectively, issued biological opinions on Reclamation's Klamath Project operations to better protect listed species. Project operations are governed in part by both opinions.

Concurrently with the progression of these fish species and fisheries conditions in the basin, the water delivery curtailments described under Section ES.1, resulted in stressed natural resource availability throughout the basin. In 2006, power rates for irrigators began to climb, and Reclamation's Klamath Project irrigators faced more water shut-offs and curtailments. The likelihood that such widely traumatic cycles would continue, coupled with upcoming changes PacifiCorp would need to make in order to continue operating their hydroelectric project, led basin stakeholders and American Indian Tribes to collaborate for a mutually beneficial agreement as a sustainable option for solving the basin's problems.

While stakeholders began efforts to reach agreement on the multifaceted issues in the basin in the 1990s, the prospect of settlement increased in 2001 and 2002 following the water-related farming and fisheries crises experienced in those years. Official negotiations leading to the KHSA and KBRA began in 2005. The KHSA was an outcome of Federal Energy Regulatory Commission's (FERC) Alternative Dispute Resolution Procedures as outlined in the Energy Policy Act of 2005<sup>4</sup> (18 C.F.R. 385.601, et seq.) wherein the parties elected to set aside differences to reach resolution on a settlement that is in furtherance of the interests of all of the parties. As established in Section 1.2 of the KHSA, many of the parties to the settlement maintain that facilities removal will help restore basin resources and all Signatory parties agree that settlement will help reduce conflicts among Klamath Basin communities. The draft KBRA was released in January 2008. The agreements were negotiated and written to be executed together and are referred to herein as the Klamath Settlement.

#### ***ES.2.2.1 FERC Relicensing***

The KHSA and KBRA negotiation process coincided with PacifiCorp's 2004 relicensing application for the Klamath Hydroelectric Project. The company's original 1956 license expired in 2006. The 1956 PacifiCorp license pre-dated many environmental laws, and did not include prescriptions (Section 18 of the Federal Power Act (FPA) [16 USC 811]) for fish passage over or around the dams. Currently, only J.C. Boyle and Keno Dams have fish passage facilities, but these fishways do not meet current passage criteria.

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<sup>4</sup> Section 442 of the Energy policy Act of 2005, Pub. L. 109-58, SS 241, 119 Stat, 594, 67475 (Aug. 8, 2005) ("EPAAct") (codified in 16 U.S.C. SS 797 (e) and 811), and the underlying procedural regulations codified in 50 C.F.R. Part 221.

The dams have been operating under an annual license since the original license expired. PacifiCorp filed an application with FERC for a new operating license for the Klamath Hydroelectric Project in 2004. During relicensing, several agencies, led by the NOAA Fisheries Service, in addition to other agencies with 10(a) authorities, recommended to FERC under Section 10(a) authority of the FPA, removal of the Four Facilities as the preferred measure to protect declining Klamath River fisheries. Concurrently, under Section 18 authority of the FPA, the United States Department of Commerce (DOC) and DOI prescribed mandatory fishways and passage at each mainstem dam. Flows were conditioned from J.C. Boyle Dam downstream for riparian habitat, whitewater recreation, and fisheries by DOI under Section 4(e) authority. See the text box below that describes these sections of the FPA.

The fishway prescriptions by the DOC and DOI were supported by basin tribes, fishing interests, and conservation groups to address declining fish harvests in the lower Klamath River and to reopen blocked habitat. The fishway prescriptions and DOI's mandatory conditions were challenged by PacifiCorp and others under the Energy Policy Act of 2005, in a trial-type hearing that considered disputed issues of material fact relating to the prescriptions and conditions. The resulting Administrative Law Judge decision (*In the Matter of: Klamath Hydroelectric Project, Docket Number 2006-NMFS-0001, September 27, 2006*) found that the agencies met their burden of proof regarding most of the factual issues in dispute. FERC conducted environmental analysis of the proposed project, including the mandatory terms and conditions and prescriptions in 2007. The NOAA Fisheries Service recommended to FERC, under its Section 10(a) authority of the FPA, removal of the mainstem PacifiCorp dams as the preferred measure to protect declining Klamath fisheries. Concurrently under Section 18 authority of the FPA, the Department of Commerce and DOI prescribed mandatory fishways and passage at each mainstem dam.

### **The Federal Power Act**

The Federal Power Act (FPA) authorizes the Federal Energy Regulatory Commission (FERC) to license hydroelectric projects in the United States.

**Section 18** of the FPA states in pertinent part:

FERC “shall require the construction, maintenance, and operation by a licensee at its own expense of...such fishways as may be prescribed by the Secretary of the Interior or the Secretary of Commerce, as appropriate” Act Pub. L. 102-486, Title XVII, Section 1701(b), 106 Stat. 3008.

**What is a fishway?** Congress has defined fishways for the safe and timely upstream and downstream passage of fish to be limited to 'physical structures, facilities or devices necessary to maintain all life stages of such fish, and project operations and measures related to such structures, facilities, or devices which are necessary to ensure the effectiveness of such structures, facilities, or devices for such fish." 1992 Energy Policy

**Section 4(e)** of the FPA provides that FERC must consider environmental requirements for licensing the hydroelectric project located on a federal reservation. Specifically, FERC may issue a license within a reservation (including National Forests, National Parks, Land and Water Conservation Fund Act lands, National Wild and Scenic Rivers Act rivers, National Trails, Wilderness Areas, National Wildlife Refuges, and other public lands) only after finding that the license will not interfere or be inconsistent with the purposes for which such reservation was created or acquired and such license shall be subject to and contain such conditions that the federal agency with jurisdiction over the reservation deems necessary for the adequate protection and utilization of the reservation.

**Section 10(a)** of the FPA requires that: “In order to ensure that the project adopted will be best adapted to a comprehensive plan for development of the waterway, the Commission will consider:

- A. The extent to which the project is consistent with a comprehensive plan (where one exists) for improving, developing, or conserving a waterway or waterways affected by the project, and
- B. The recommendations of Federal and State agencies as well as Indian Tribes exercising administration over flood control, navigation, irrigation, recreation, cultural and other relevant resources of the State in which the project is located, and the recommendations (including fish and wildlife recommendations) of Indian tribes affected by the project.”

**Section 10(j)** of the FPA requires FERC to solicit recommendations from the U.S. Department of Commerce's National Marine Fisheries Service, the U.S. Department of Interior's Fish and Wildlife Service and state fish and wildlife agencies. Such recommendations are pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) FERC has to address and then either accept or refute recommendations from these resource agencies relative to the protection, mitigation, and enhancement of fish and wildlife resources impacted by the project.

Before FERC may issue any new license for the Klamath Hydroelectric Project, the states of Oregon and California must also issue water quality certification under Section 401 of the Clean Water Act (CWA). The California State Water Resources Control Board cannot issue certification until environmental documentation sufficient for consideration of the alternative of conditioning certification on dam removal is completed consistent with CEQA.

The agencies' mandatory prescriptions and conditions along with FERC's required conditions would result in significant operational changes to the hydroelectric project, substantially reducing power generation capacity (about 20 megawatts, or 24 percent of annual generation) and causing the Klamath Hydroelectric Project to operate at a net annual loss (FERC 2007).

PacifiCorp estimates that it would incur relicensing capital costs in excess of \$400 million (with the majority of costs resulting from implementation of aquatic resource protection, mitigation, and enhancement measures) and \$60 million in operations and maintenance costs over a 40-year license term (Oregon Public Utilities Commission 2010). PacifiCorp would be allowed to recover these costs through customer charges, if approved through future Public Utilities Commission actions.

The KHSA sets a cost cap of \$450 million for removal of the Four Facilities. Of this, an amount not to exceed \$200 million would come from additional charges to PacifiCorp ratepayers residing in California and Oregon, and up to \$250 million would come from the sale of bonds in California or other means deemed appropriate financing mechanisms to cover removal costs in excess of the rate-payer contributions. The United States government would not be responsible for the costs of facilities removal.

### Reclamation's Klamath Project

In addition to the Klamath Basin's distinctive setting, biological resources, and cultural history, the basin is the site of one of the first developments authorized under the 1902 Reclamation Act. Development and construction of what is today known as Reclamation's Klamath Project took place between 1905 and 1966, with major features of the project completed by the early 1940s. As the largest water management effort in the Upper Klamath Basin, its features include a system of reservoirs, dams, canals, and pumps (Figure 1-3). Reclamation's Klamath Project was originally authorized for the purpose of providing irrigation water to farms at a time when the frontier of the American west was still developing and increasing numbers of farmers were drawn to the fertile land in northern California and southern Oregon. Link River Dam, completed in 1921, is a major feature of Reclamation's Klamath Project. This dam is owned by Reclamation, but is operated by PacifiCorp under agreement with Reclamation.

**ES.2.2.2 The Four Facilities and PacifiCorp Involvement in the KHSA/KBRA**

The economic reality of implementing fishways and meeting CWA 401 Certification at the Four Facilities combined with the prospect of annual loss of revenue, and the protection of prudent and reasonable utility rates for its customers encouraged PacifiCorp to enter into collaborative discussions with basin stakeholders to identify ways to improve basin fisheries. These discussions resulted in PacifiCorp signing the KHSA. As described below in Section ES.4.2, PacifiCorp is not a direct signatory of the KBRA.

Table ES-1 summarizes data about the Four Facilities. Figures ES-3 through ES-6 show the four dams and associated hydropower facilities.

**Table ES-1. Hydroelectric Dams (Four Facilities) on the Mainstem Klamath River**

Dam	Year Operational	Maximum Power Generation Capacity (megawatts)	Annual Average Generation Rate (megawatts)	Dam Height (feet)
J.C. Boyle	1958	98	38	68
Copco 1	1918	20	12	126
Copco 2	1925	27	15	33
Iron Gate	1962	18	13	194
<b>Total</b>	--	<b>163</b>	<b>78<sup>1</sup></b>	--

Source: FERC 2007

Notes: <sup>1</sup> This annual average generation rate is only for the Four Facilities and does not include the Fall Creek or East and West Side Facilities. Under the agencies' mandatory prescriptions and conditions, along with FERC's required conditions, average annual generation for the entire project would drop by approximately 20 megawatts.



Figure ES-3. J.C. Boyle Dam and Powerhouse



Figure ES-4. Copco 1 Dam and Powerhouse

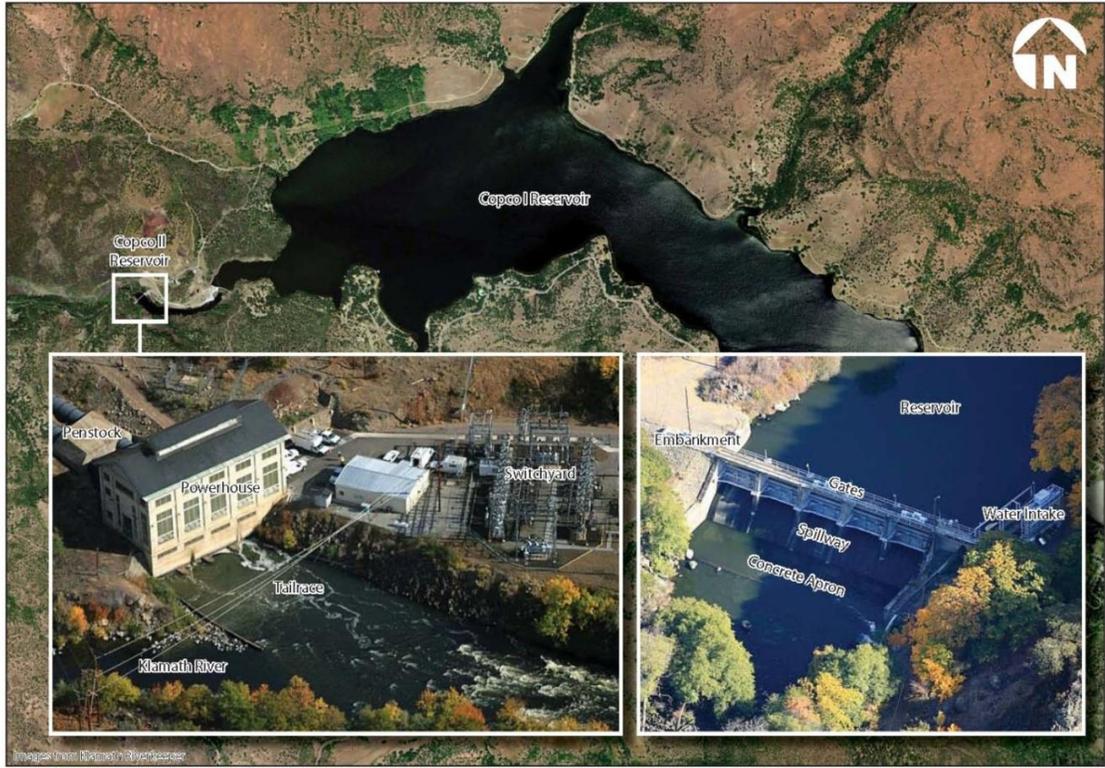


Figure ES-5. Copco 2 Powerhouse (left photo) and Dam



Figure ES-6. Iron Gate Dam, Reservoir, and Power Generating Facilities

## ES.3 Environmental Review

As described above, this EIS/EIR is being prepared in compliance with NEPA and CEQA. The DOI is Lead Agency under NEPA, and the CDFG is Lead Agency under CEQA. DOI and the CDFG are referred to together in this EIS/EIR as the Lead Agencies. The Purpose and Need for the Proposed Action (NEPA) and the Project Objectives (CEQA) are described below, and together form the basis for alternatives development and impact analysis considered in this EIS/EIR.

### NEPA Purpose and Need

The need for the Proposed Action is to advance restoration of the salmonid fisheries in the Klamath Basin consistent with the KHSA and the connected KBRA. The purpose is to achieve a free flowing river condition and full volitional fish passage as well as other goals expressed in the KHSA and KBRA. By the terms of the KHSA, the Secretary will determine whether the Proposed Action is appropriate and should proceed. In making this determination, the Secretary will consider whether removal of the Four Facilities will advance the restoration of the salmonid fisheries of the Klamath Basin, and is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes.

### CEQA Project Objectives

As required by CEQA, a lead agency must identify the objectives sought by the proposed project. For this project, CDFG as lead agency has identified the following objectives:

1. Advance restoration of the salmonid fisheries in the Klamath Basin.
2. Restore and sustain natural production of fish species throughout the Klamath Basin in part by restoring access to habitat currently upstream of impassable dams.
3. Provide for full participation in harvest opportunities for sport, commercial, and tribal fisheries.
4. Establish reliable water and power supplies, which sustain agricultural uses and communities and NWRs.
5. Improve long-term water quality conditions consistent with designated beneficial uses.
6. Contribute to the public welfare and the sustainability of Klamath Basin communities.
7. To be consistent with the goals and objectives of KHSA and KBRA.

## ES.4 Klamath Settlement Agreements

### ES.4.1 Klamath Hydroelectric Settlement Agreement

The KHSA establishes the process for additional studies, the development of a Detailed Plan for dam removal and environmental review to support the Secretary's Determination<sup>5</sup> as to whether removal of the Four Facilities on the Klamath River that are owned by PacifiCorp will accomplish the following two goals: 1) to advance restoration of the salmonid fisheries of the basin, and 2) be in the public interest, which includes, but is not limited to, consideration of the potential impacts on affected local communities and Indian Tribes.

The KHSA also includes provisions for the interim operation of the Four Facilities by PacifiCorp and the process to transfer, decommission, and remove the dams.

### Secretarial Determination and Connected Actions

If the Secretary publishes an Affirmative Determination, the process for facilities removal will proceed. The Secretary will also concurrently designate the dam removal entity. The dam removal entity, once identified, would refine the Detailed Plan to create a Definite Plan for Facilities Removal including the methods for removal and estimated costs.

In addition to the decommissioning and removal of the four hydroelectric dams, actions associated with an Affirmative Determination would include the transfer of Keno Dam ownership from PacifiCorp to DOI.

An Affirmative Secretarial Determination and federal authorizing legislation are two early key milestones towards full implementation of the KBRA.

A Negative Determination would be a potential termination event for the KHSA and facilities removal would likely not proceed. The FERC relicensing process would resume.

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<sup>5</sup> As defined in the KHSA, there are two different determinations on removal of the Four Facilities that the Secretary could reach: 1) Affirmative Determination: A determination by the Secretary under Section 3 of the KHSA that Facilities Removal should proceed; and, 2) Negative Determination: A determination by the Secretary under Section 3 of the KHSA that Facilities Removal should not proceed. The Secretary bases his determination on whether the conditions of Section 3.3.4 of the KHSA have been met and whether, in his judgment, Facilities Removal will accomplish the two goals stated above in Section ES.2.1. In the event of an Affirmative Determination, California and Oregon each shall provide Notice to the Secretary and other Parties as to whether the state concurs with the Affirmative Determination. In its concurrence, each state shall consider whether: 1) significant impacts identified in its environmental review can be avoided or mitigated as provided under state law; and 2) Facilities Removal will be completed within the State Cost Cap (KHSA Section 3.3.5A). If the Secretary determines not to proceed with Facilities Removal, the KHSA terminates unless the Parties agree to a cure for this potential termination event (KHSA Section 3.3.5B).

### **ES.4.2 Klamath Basin Restoration Agreement**

Concurrently with the signing of the KHSA, the same Parties, with the exception of the two federal parties and PacifiCorp, signed an accompanying agreement—the KBRA. The KBRA includes interrelated plans and programs intended to benefit fisheries throughout the basin, water and power users in the Upper Klamath Basin, counties, Indian Tribes, and basin communities. The KBRA brought many parties together to support one another's efforts to restore fisheries in the Klamath Basin and provide for sustainable agricultural communities.

Implementation of the KBRA is intended to accomplish the following:

1. Restore and sustain natural fish production and provide for full participation in ocean and river harvest opportunities of these fish.
2. Establish reliable water and power supplies for agricultural uses, communities, and National Wildlife Refuges (NWRs).
3. Contribute to public welfare and sustainability of all communities through reliable water supply; affordable electricity; programs to offset potential property tax losses and address economic development issues in counties; and efforts to support tribal fishing and long-term economic self-sufficiency.

The key negotiated outcomes of the KBRA include mutually-beneficial agreements for the Klamath, Karuk, and Yurok Tribes not to exercise water right claims that would conflict with water deliveries to Reclamation's Klamath Project water users and for project water users to accept reduced water deliveries. As a result, there would be more support for fisheries restoration programs, greater certainty about water deliveries at the beginning of each growing season, and agreement and assurances that certain of the parties will work collaboratively to resolve outstanding water-right contests pending in the Oregon Klamath Basin Adjudication process. In addition, the KBRA includes an Off-Project voluntary Water Use Retirement Program in the Upper Basin, three restoration projects intended to increase the amount of water storage in the Upper Klamath Basin, regulatory assurances, county and tribal economic development programs, and tribal resource management programs.

Copies of the KHSA and KBRA in their entirety are available electronically at:

<http://klamathrestoration.gov/>.

## **ES.5 Alternatives Development**

As part of the environmental review process, the Lead Agencies developed a full range of alternatives. A detailed description of this process can be found in this EIS/EIR, Appendix A titled Alternatives Formulation Report.

### **ES.5.1 Public Scoping and Alternatives Identification**

The Lead Agencies held seven public scoping meetings in locations around the Klamath Basin to receive input on alternatives and concerns regarding the project purpose, needs and objectives. Written and verbal comments were accepted at each meeting and comments were also received

by mail and electronically throughout the scoping period of June 14, 2010 through July 21, 2010. A Scoping Report that summarizes all comments received through July 21, 2010 was published in September 2010 and is available on the project website (<http://klamathrestoration.gov/>).

Following the scoping process, the Lead Agencies, along with the cooperating and responsible agencies, identified a wide range of alternatives that represent diverse viewpoints and needs, including alternatives suggested during the EIS/EIR public scoping process. This resulted in a set of 18 possible alternatives to be considered for detailed analysis (the initial list of action alternatives is described in Appendix A, Alternatives Formulation Report). The Lead Agencies applied a screening process to the 18 alternatives to determine which alternatives should move forward for further analysis. In order to determine which alternatives met all or most of the purpose and need/project objectives, and were potentially feasible, specific screening considerations were created based on NEPA (40 CFR Part 1502.14(a)) and CEQA guidance (CEQA Guidelines, §15126.6 (a)). Under CEQA, alternatives do not need to meet all of the project objectives; alternatives should be included if they can meet most of the objectives and avoid or substantially lessen significant environmental impacts of the project. Figure ES-7 illustrates the process that the Lead Agencies conducted to identify and screen alternatives and to select alternatives for more detailed analysis.



**Figure ES-7. Alternatives Development and Screening Process**

After the process of initial alternative screening, four action alternatives in addition to the No Action/No Project Alternative (Alternative 1) were selected to move forward for more detailed analysis in the EIS/EIR. Alternatives 2 and 3, the Proposed Action and Partial Facilities Removal, both fully meet the purpose and need/project objectives. While Alternative 4, Fish Passage at Four Dams and Alternative 5, Remove Copco 1 and Iron Gate Dams, Construct Fish Passage at J.C. Boyle and Copco 2 Dams, do not fully meet the purpose and need/project objectives, both alternatives were moved forward to the EIS/EIR for further review because at the time of developing a reasonable range of alternatives the Lead Agencies recognized the potential for Alternatives 4 and 5 to have fewer short-term adverse environmental impacts than the Proposed Action. Consideration of these alternatives would give the Secretary a reasonable range of alternatives to inform decision-making. Analysis of these alternatives will provide the Secretary with information needed to make a decision, and potentially to mix and match elements of the alternatives, if needed, to create an alternative that would reduce environmental impacts and increase environmental benefits.

## **ES.6 Alternatives Receiving Full Analysis in the EIS/EIR**

The EIS/EIR analyzes five alternatives in detail, including the No Action/No Project Alternative.

### **ES.6.1 Alternative 1 - No Action/No Project Alternative**

NEPA requires an EIS to “include the alternative of no action” (40 CFR Part 1502.14(d)). CEQA requires an EIR to include a No Project Alternative. CEQA Guidelines Section 15126.6(e)(2) states that “The ‘no project’ analysis shall discuss the existing conditions at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services.” For the Klamath Facilities Removal EIS/EIR, NEPA’s No Action Alternative and CEQA’s No Project Alternative describe the same conditions, and this alternative is referred to as the No Action/No Project Alternative.

The No Action/No Project Alternative represents the state of the environment without the Proposed Action or any of the alternatives. For the purposes of this analysis, the No Action/No Project Alternative will continue current operations with the Four Facilities remaining in place and PacifiCorp operating under the current annual license. The existing license has no requirements for additional fish passage or implementation of the agencies’ mandatory prescriptions and conditions that are currently before FERC in the relicensing process. PacifiCorp would continue to coordinate with Reclamation to operate the Klamath Hydroelectric Project in compliance with the existing NOAA Fisheries Service and USFWS biological opinions issued for Reclamation’s Klamath Project Operation Plan. PacifiCorp would also continue to operate the Iron Gate Hatchery under its current operations.

The KBRA is not included in the No Action/No Project Alternative. However, the No Action/No Project Alternative would include the ongoing resource management activities (these actions are described in further detail in Chapter 2 of this EIS/EIR). These resource management actions were started or were under consideration before the KBRA was developed and will move forward at some level even without the KBRA.

The No Action/No Project Alternative also includes “reasonably foreseeable actions” that are independent of FERC licensing and are expected to occur throughout the period of analysis (2012 to 2061). Reasonably foreseeable actions include the Total Maximum Daily Load (TMDL) provision of the Clean Water Act (Section 401) issued by the Oregon Department of Environmental Quality and California North Coast Regional Water Quality Control Board for impaired water bodies. There are currently nine TMDLs established in the Klamath Basin (see Section 3.2.2.4). Under the No Action/No Project Alternative, full attainment of these TMDLs would result in long-term water quality improvements in the basin; however, implementation mechanisms, funding, and timing are currently unknown.

### **ES.6.2 Alternative 2 - Full Facilities Removal of Four Dams (Proposed Action)**

The Full Facilities Removal of Four Dams Alternative (the Proposed Action) includes the removal of the Four Facilities during a 20-month period which includes an 8-month period of site preparation and partial drawdown at Copco 1 and a 12-month period for full drawdown and removal of facilities. This alternative would include the complete removal of the dams, power generation facilities, water intake structures, canals, pipelines, ancillary buildings, and dam foundations to create a free-flowing river. Preparation for dam removal would begin in May 2019 for Iron Gate Dam and June 2019 for Copco 1 Dam. Deconstruction efforts for the J.C. Boyle and Copco 2 Facilities would commence after January 1, 2020, and all four dams would be completely removed by December 31, 2020. This alternative would include implementation of the KBRA and the transfer of Keno Dam to DOI as connected actions. Figure ES-8 illustrates what full facilities removal would look like at Iron Gate Dam.



**Figure ES-8. Simulation of Iron Gate Dam  
Before and After Full Facilities Removal**

**ES.6.2.1 KBRA**

The KBRA is being analyzed in this EIS/EIR as a connected action to the Proposed Action. Implementation of the KBRA and the KHSA is dependent on an Affirmative Determination.

Table ES-2 provides a summary of KBRA programs. The programs with sufficient detail to investigate for potential environmental effects are analyzed in this EIS/EIR. These programs include the following (a more detailed description of the approach to analysis of the KBRA is in Section 3.1 of this EIS/EIR):

**Fisheries Program** - The Fisheries Program includes habitat restoration throughout the basin; a fisheries reintroduction and management plan; a fisheries monitoring plan; and actions intended to improve flow conditions and water quality for fish.

**Water and Power Programs** The Water and Power Programs include an agreement regarding limitations on water diversions to Reclamation’s Klamath Project, which includes a water diversion plan for the Tule Lake and Lower Klamath Lake NWRs. The programs also include a voluntary Water Use Retirement Program in the Upper Basin to increase inflow into Upper Klamath Lake and to provide a basis for further efforts among certain parties to work collaboratively for more reliable sources of water for fish harvests and agriculture. Additionally, there are agreements and assurances to resolve outstanding water right contests in the Oregon Klamath Basin Adjudication process.

**Table ES-2. KBRA Program Summary**

<b>Fisheries Program:</b>
Fish Habitat Restoration Activities <sup>1</sup>
Fisheries Restoration Phase I Plan
Fisheries Restoration Phase II Plan
Fisheries Reintroduction Plan – Phase I, Oregon
Fisheries Reintroduction Plan – Phase II, Oregon
Fisheries Reintroduction Plan – California
Fisheries Monitoring Plan
<b>Additional Water Storage Projects:</b>
Williamson River Delta Project
Agency Lake and Barnes Ranches Project
Wood River Wetland Restoration Project
Future Storage Opportunities <sup>2</sup>
<b>Water and Power Programs:</b>
Water Diversion Allocations for Reclamation’s Klamath Project and National Wildlife Refuges <sup>3</sup>
Groundwater Technical Investigations
On-Project Plan
Winter Shortage Plan
Water Use Retirement Program
Off-Project Water Settlement
Off-Project Reliance Program
Power for Water Management Program
Drought Plan
Emergency Response Plan
Climate Change Assessment
Environmental Water Management
Interim Flow and Lake Level Program
<b>Regulatory Assurances Programs:</b>
Fish Entrainment Reduction
General Conservation Plan or Habitat Conservation Plan
<b>County and Tribal Programs:</b>
Klamath County Economic Development Plan
California Water Bond (Siskiyou County Economic Development Funding)
Tribal Programs Fisheries and Conservation Management
Tribal Programs Economic Revitalization
Mazama Forest Project
Klamath Tribes Interim Fishing Site

Notes:

1. While on-going fish habitat restoration activities are not part of the Proposed Action because they are conducted under current authorities and funding levels, the scope of these activities would be increased in magnitude and accelerated through implementation of the KBRA. Habitat restoration under the Proposed Action would be guided by the Fisheries Restoration Plan to be developed under the KBRA.
2. Development of additional storage is also intended to restore habitats for endangered suckers, and would occur with implementation of KBRA and associated funding.
3. During the Interim Period, water diversion limitations to Reclamation’s Klamath Project water users would conform to the limits described in the Diversion Limitations section as closely as possible. However, before full implementation of the On-Project Plan, it might not be possible to fully comply with the diversion limitations in all years.

**County and Tribal Programs** - County and tribal programs include economic development for local governments and tribes; regulatory assurances that adverse impacts on local communities would be minimized; and tribal fisheries and natural resource conservation.

### **ES.6.3 Alternative 3 - Partial Facilities Removal of Four Dams**

The Partial Facilities Removal of Four Dams Alternative would include removal of enough of each dam to allow free-flowing river conditions and volitional fish passage for all Klamath River anadromous species at all times. Under this alternative, portions of each dam facility would remain in place, including ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes (Figure ES-9). Some of these remaining features would require perpetual maintenance and security measures to prevent unauthorized entry and safety hazards. All tunnel openings would be sealed and all potentially hazardous materials found in powerhouses and machinery would be removed prior to final decommissioning and securing of buildings.

The schedule for Partial Facilities Removal of Four Dams would be the same as for the Proposed Action (the Full Facilities Removal of Four Dams Alternative). The Partial Facilities Removal of Four Dams Alternative also includes the transfer of Keno Dam to DOI and implementation of the KBRA (as in the Proposed Action).



**Figure ES-9. Simulation of Partial Facilities Removal**

### **ES.6.4 Alternative 4 - Fish Passage at Four Dams**

The Fish Passage at Four Dams Alternative would include construction of fish passage facilities at each of the Four Facilities. This alternative would retain all hydropower generating facilities and operations; although operations would change in response to DOI mandatory flow conditions and the DOC and DOI fishway prescriptions. The Lead Agencies used the prescriptions developed during the FERC relicensing process to describe the facilities needed to achieve fish passage and required flow conditions. The prescriptions also included flow and operational

requirements that are included in this alternative. Figure ES-10 shows an example of a cast-in-place pool and weir fish ladder that is similar to that proposed for upstream fish passage at all four dams under this alternative. Typical downstream passage would include screening the fish away from the intake structures for the power generation facilities and the spillway modifications (if they are unsuitable for downstream passage).



**Figure ES-10. Example of Cast-In-Place Pool and Weir Fish Ladder**

The Hydropower Licensee would need to re-enter the FERC process to implement this alternative and would be responsible for its long-term

operation and maintenance. To meet essential flows in the bypass reaches, less water would pass through the power generating facilities than under current conditions, reducing power production. In addition, this alternative would result in restricted project ramping rates and would only allow peaking one day per week.

The Fish Passage at Four Dams Alternative would not satisfy the conditions in the KHSa. Consequently, it is assumed that the KBRA and the Keno Dam Transfer would not be implemented. For the purposes of this analysis, alternatives that would not result in full implementation of the KHSa do not include the KBRA as a connected action to the alternative. Additionally, the transfer Keno Dam to DOI would not move forward as a connected action.

This alternative would follow the schedule proposed in the FERC relicensing process. The prescriptions include a schedule for implementation and recommend that downstream facilities be installed prior to upstream passage facilities (DOI and NOAA Fisheries Service 2007). Table ES-3 shows the schedule for construction of the fish passage facilities at each dam, based on these constraints.

**Table ES-3. Timetable for Fish Passage Improvements at each Dam from Date of FERC License Renewal**

Dam	Upstream Fish Passage	Spillway Modifications <sup>1</sup>	Tailrace Barrier <sup>1</sup>	Screens & Bypass
J.C. Boyle	4 years	4 years	4 years	4 years
Copco 1	6 years	6 years	N/A	6 years
Copco 2	6 years	6 years	8 years	6 years
Iron Gate	5 years	5 years	N/A	5 years

Key:

N/A: Not Applicable

Notes:

1. The prescriptions require studies to determine the need for and design of spillway modifications and tailrace barriers. For the purposes of analysis in this EIS/EIR, Alternative 4 includes some specific fishway facility design and construction details that are beyond those required in the prescriptions.

### **ES.6.5 Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative includes the full removal of the Iron Gate and Copco 1 facilities and installation of upstream and downstream fish passage facilities at both the J.C. Boyle and Copco 2 Dams. Implementation of this alternative would provide fish passage while retaining some hydropower generation capacity, and would improve water quality (specifically, dissolved oxygen, water temperatures, and algal toxins) through removal of the two largest reservoirs. To meet essential flows in the bypass reaches, less water would pass through the power generating facilities at the J.C. Boyle and Copco 2 developments and power production would be reduced as compared to current conditions.

Similar to the Fish Passage at Four Dams Alternative, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would incorporate most of the DOI and DOC prescriptions from the FERC relicensing process related to fish passage at J.C. Boyle and Copco 2 Dams (see Attachment B of Appendix A for a list of prescriptions). Alternative 5 would not incorporate the prescriptions related to peaking power at J.C. Boyle and recreation releases. In Alternative 5, Copco 2 Dam would be the only dam remaining downstream from J.C. Boyle Dam. Copco 2 Reservoir is very small, and does not have adequate capacity to reregulate flows associated with peaking operations so that they are suitable for fish downstream. Therefore, Alternative 5 would not include peaking operations or recreation releases on any days at J.C. Boyle Dam.

The Hydropower Licensee would need to re-enter the FERC process to implement this alternative and would be responsible for the long-term operation and maintenance of the dams and fish passage facilities. The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would not satisfy the purposes of the KHSA to restore free flowing river conditions. Consequently, it is assumed in this analysis that the KBRA and Keno Dam Transfer would not be implemented. This alternative would follow a schedule similar to that of the Proposed Action, and could be completed by December 2020.

## **ES.7 Effects of the No Action/No Project, Proposed Action, and Action Alternatives**

This section describes the significant and unavoidable adverse impacts, as well as the beneficial effects, of the five alternatives.

### **ES.7.1 Significant and Unavoidable Adverse Impacts**

Significant and unavoidable adverse impacts refer to the environmental consequences of an action that cannot be avoided by redesigning the project, changing the nature of the project, or implementing mitigation measures. NEPA regulations require a discussion of any adverse impacts that cannot be avoided as a result of the proposed action (40 Code of Federal Regulations Part 1502.16). NEPA also requires a discussion of means to mitigate adverse impacts. CEQA Guidelines (Section 15126.2 (b)) require discussion of significant environmental effects that cannot be avoided, as well as significant environmental effects that can be mitigated but not reduced to an insignificant level. These impacts are summarized in Table ES-4. Table ES-5 summarizes the adverse environmental impacts of the resources analyzed in this EIS/EIR specific to NEPA including Socioeconomics, and Environmental Justice resources<sup>6</sup>.

A full listing of all impacts, including those that can be reduced to a less than significant level, is presented in Chapter 5 of this EIS/EIR.

The specific approach used to evaluate environmental effects of each alternative relative to each environmental resource is explained in Section 3.1 and in the resource sections throughout Chapter 3.

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<sup>6</sup> Effects relative to tribal trust resources are not displayed in this table given that no new adverse effects were identified relative to the alternatives analyzed in this EIS/EIR. Section 3.12, Tribal Trust of this EIS/EIR does however summarize the existing and ongoing tribal trust impacts present in the Klamath Basin.

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.2 Water Quality</b>				
<b>Water Temperature</b>				
<b>Upper Klamath Basin</b>				
Dam removal and/or elimination of hydropower peaking operations at J.C. Boyle Powerhouse could cause short-term <sup>7</sup> and long-term <sup>8</sup> alterations in daily water temperatures and fluctuations in the J.C. Boyle bypass and peaking reaches.	2, 3, 5	S	None	S
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term increases in spring time water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir.	2, 3, 5	S for springtime	None	S for springtime
<b>Lower Klamath Basin</b>				
Dam removal and conversion of the reservoir areas to a free flowing river could result in short-term and long-term increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River.	2, 3, 5	S – Iron Gate Dam to Salmon River for springtime	None	S – Iron Gate Dam to Salmon River for springtime
<b>Suspended Sediments</b>				
<b>Upper Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam.	2, 3, 5	S	None	S
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the lower Klamath River and the Klamath Estuary.	2, 3, 5	S	None	S

<sup>7</sup> Short-term is defined as <2 years following dam removal.

<sup>8</sup> Long-term is defined as 2-50 years following dam removal.

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Dissolved Oxygen</i></b>				
<b>Upper Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir.	2, 3, 5	S	None	S
<b>Lower Klamath Basin</b>				
Dam removal and sediment release could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	S (lower Klamath River from Iron Gate Dam to Clear Creek)	None	S (lower Klamath River from Iron Gate Dam to Clear Creek)
<b>3.3 Aquatic Resources</b>				
<b><i>Critical Habitat</i></b>				
Reservoir drawdown associated with dam removal could alter the quality of critical habitat.	2, 3, 5	S (short-term for coho)	None	S (short-term for coho)
<b><i>Essential Fish Habitat</i></b>				
Reservoir drawdown associated with dam removal could alter the quality of EFH.	2, 3, 5	S (short-term for Chinook and coho)	None	S (short-term for Chinook and coho)
<b><i>Species Impacts</i></b>				
<b><u>Coho Salmon</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect coho salmon.	2, 3, 5	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River)	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units)

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><u>Steelhead</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect steelhead in the short-term.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S
<b><u>Pacific Lamprey</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect Pacific lamprey in the short-term.	2, 3, 5	S	AR-2: Protection of Outmigrating Juveniles; AR-5: Pacific lamprey capture and relocation.	S
<b><u>Green Sturgeon</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect green sturgeon.	2, 3, 5	S	AR-3: Fall flow pulses	S
<b><u>Freshwater mussels</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect freshwater mussels in the short-term.	2, 3, 5	S	AR-7: Freshwater mussel relocation	S
<b><u>Benthic Macroinvertebrates</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect macroinvertebrates.	2, 3, 5	S	None	S
<b>3.4 Algae</b>				
<b><u>Hydroelectric Reach</u></b>				
Dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton (attached algae) in low-gradient channel margin areas within the Hydroelectric Reach. <sup>9</sup>	2, 3, 5	S	None	S

<sup>9</sup> Increased periphyton biomass would not affect levels of algal toxins in the Klamath River. The noxious blooms of phytoplankton (suspended algae) occurring in the calm, lake-like waters of Copco 1 and Iron Gate Reservoirs are responsible for the production of algal toxins, such as microcystin, in the Klamath River downstream of Iron Gate Dam (see Section 3.4). Noxious phytoplankton would not thrive in the free-flowing river following dam removal.

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.9 Air Quality</b>				
Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of VOC, NOx, CO, SO <sub>2</sub> , PM <sub>10</sub> , and PM <sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.	2, 3	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S
Reservoir restoration actions could result in short-term and temporary increases in criteria pollutant emissions from the use of helicopters, trucks, and barges that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S
<b>Trap and Haul Operations</b>				
Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.	4, 5	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.	2, 3	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S <sup>10</sup>
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap-and-haul activities.	2, 3	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S <sup>9</sup>
<b>3.10 Greenhouse Gases/Global Climate Change</b>				
Removing or reducing a renewable source of power by removing the dams or developing fish passage could result in increased GHG emissions from possible non-renewable alternate sources of power.	2, 3, 4, 5	S	CC-1: Market Mechanisms); CC-2: Energy Audit Program; and CC-3: Energy Conservation Plan	S

<sup>10</sup> While Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce impacts to LTS, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.13 Cultural and Historic Resources</b>				
The Proposed Action could result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD, which is considered eligible for inclusion on the National Register and California Register.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	S
<b>KBRA</b>				
Implementation of the KBRA programs including the Phase 1 and 2 Fisheries Restoration Plans, Fisheries Reintroduction and Management Plan, Wood River Wetland Restoration Project, On-Project Plan, Water Use Retirement Program, Fish Entrainment Reduction, Klamath Tribes Interim Fishing Site, and Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	S <sup>11</sup>
<b>3.19 Scenic Quality</b>				
Ongoing fish habitat restoration actions could result in short-term and long-term impacts on scenic resources.	1	S (short-term from construction)	None	S (short-term from construction)
The removal of historic structures could result in impacts on scenic resources.	2, 3, 5	S	None	S

<sup>11</sup> Studies will be conducted to identify cultural resources and reduce significant impacts to these resources. Implementation of specific plans and projects associated with the KBRA will require future environmental compliance as appropriate.

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.	2, 3, 5	S	None	S
Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.	2, 3, 5	S (short-term)	None	S (short-term)
Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the Klamath River could result in short and long-term impacts on scenic resources.	2, 3, 5	S (short-term)	None	S (short-term)
Replacement of the existing wooden Lakeview Bridge just downstream of Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.	2, 3	S (short-term)	None	S (short-term)
Relocation of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.	2, 3	S (short-term)	None	S (short-term)
Sediment release during dam and reservoir removal could cause temporary changes in water quality and the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	2, 3, 5	S	None	S
Demolition, construction, and restoration activities for the fishways could cause short-term adverse effects on the scenic vistas in the immediate vicinity of the Four Facilities.	4, 5	S	None	S
Fishways could cause substantial long-term impacts on scenic resources.	4, 5	S	None	S
<b><i>Trap and Haul Operations</i></b>				
Construction activities associated with fish collection facilities would introduce new features into the landscape.	4, 5	S	None	S

**Table ES-4. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Construction activities associated with fish collection facilities would introduce new features into the landscape.	2, 3	S	None	S
<b>3.20 Recreation</b>				
Changes in flows could decrease the number of days with acceptable flows for whitewater boating and fishing in the Hells Corner Reach.	2, 3, 4, 5	S (whitewater boating)	None	S (whitewater boating)
<b>3.23 Noise and Vibration</b>				
Construction and deconstruction activities at the dam sites could cause a temporary increase in noise levels at Copco 1 Dam that could affect residents in the area.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction and deconstruction activities at the dam sites could cause a temporary increase in nighttime noise levels at Iron Gate Dam.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Reservoir restoration activities could result in short-term increases in noise levels in the project vicinity.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Blasting activities at Copco 1 Dam could increase vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction activities at the dam sites could increase short-term vibration levels.	2, 3,5	S	NV-1: Noise and Vibration Control Plan	S

**Key:**

BLM = Bureau of Land Management

BOD = biological oxygen demand

CEQA = California Environmental Quality Act

CO = carbon monoxide

DOC = United States Department of Commerce

DOI = Department of the Interior

DRE = Dam Removal Entity

EFH = Essential Fish Habitat

FERC = Federal Energy Regulatory Commission

GHG = Greenhouse Gases

IOD = immediate oxygen demand

KBRA = Klamath Basin Restoration Agreement

KHHD= Klamath Hydroelectric Historic District

KHP = Klamath Hydroelectric Project

MSAE = Microcystis aeruginosa

NAGPRA = Native American Graves Protection and Repatriation Act

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ODEQ = Oregon Department of Environmental Quality

PM<sub>10</sub> = particulate matter < 10 microns

PM<sub>2.5</sub> = particulate matter < 2.5 microns

SO<sub>2</sub> = sulfur dioxide

SSC = suspended sediment concentrations

TN = Total Nitrogen

TP = Total Phosphorus

USFWS = United States Fish and Wildlife Service

VOC = volatile organic compounds

VRM = Visual Resource Management Methodology

WQ = Water quality

WSR = Wild and Scenic River

**Significance:**

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

**Alternatives:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

**Table ES-5. Summary of Adverse Environmental Effects Relative to NEPA<sup>1</sup>**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
<b>3.15 Socioeconomics</b>			
<b>Four Facilities</b>			
Changes in annual O&M expenditures required to continue the operation of the existing facilities could affect employment, labor income, and output in the regional economy.	2, 3, 5	Adverse	None
<b>Recreation</b>			
Changes to reservoir recreation expenditures could affect employment, labor income, and output in the regional economy.	2, 3, 5	Adverse	None
Changes to whitewater boating opportunities could affect recreational expenditures and employment, labor income, and output in the regional economy.	2, 3, 4, 5	Adverse (from reduced whitewater boating expenditures in the Upper Klamath River and Hell's Corner Reach)	None
<b>PacifiCorp Hydroelectric Service</b>			
Energy rates for PacifiCorp customers could change.	1, 4, 5	Unknown <sup>2</sup>	None
<b>Property Values and Local Government Revenues</b>			
Property values surrounding Iron Gate and Copco Reservoirs could change.	2, 3, 5 (around Copco 1 and Iron Gate Reservoirs)	Adverse (short-term); Unknown (long-term) <sup>2</sup>	None
Changes in real estate values around Copco 1 and Iron Gate Reservoirs could affect property tax revenues to Siskiyou County.	2, 3, 5	Adverse (short-term); Unknown (long-term) <sup>3</sup>	None
Changes in visitation for recreation activities could affect sales tax revenues.	2, 3	Unknown <sup>4</sup>	None

**Table ES-5. Summary of Adverse Environmental Effects Relative to NEPA<sup>1</sup>**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Increases in on-farm pumping costs could affect household income and reduce employment, labor income, and output in the regional economy.	2, 3	Adverse	None
Water acquisitions via short-term water leasing could decrease farm revenues and reduce employment, labor income, and output in the regional economy.	2, 3	Adverse (short-term)	None
<b>3.16 Environmental Justice</b>			
Increased traffic, air quality emissions, and noise associated with construction activities could disproportionately affect county residents and tribal people.	2, 3, 4, 5	Disproportionate Effects (short-term)	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks AQ-4: Dust control measures during blasting operations NV-1: Noise and Vibration Control Plan
Changes in county revenues could decrease county funding of social programs used by county residents.	2, 3, 5	Disproportionate Effects	None
Traffic on associated haul roads could disproportionately affect county residents and tribal people.	2, 3, 4, 5	Disproportionate Effects (short-term)	TR-1: Relocate Jenny Creek Bridge and Culverts

**Table ES-5. Summary of Adverse Environmental Effects Relative to NEPA<sup>1</sup>**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Implementation of the Water Use Retirement Program, Off-Project Reliance Program, and Interim Flow and Lake Level Program could disproportionately affect low income and minority farm workers.	2, 3	Disproportionate Effects (short-term)	None

**KEY:**

**Significance:**

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

**Alternatives:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

**Notes:**

1- Effects relative to tribal trust resources are not displayed in this table given that no new adverse effects were identified relative to the alternatives analyzed in this EIS/EIR. Section 3.12, Tribal Trust of this EIS/EIR does however summarize the existing and ongoing tribal trust impacts present in the Klamath Basin.

2 - Many factors affect setting customer electricity rates, including regulatory approval; therefore, it is difficult to assess how rates may change, if at all.

3 - It is unknown how the real estate value of properties with existing reservoir views may change in the long term from river restoration activities.

4 - Changes in recreation expenditures and associated sales taxes vary by recreation activity. The net effect of changes in recreation expenditures is unknown.

### **ES.7.2 Balancing Impacts and Benefits of the Alternatives**

Under NEPA (40 CFR Part 1502.16, Environmental Consequences), a discussion of the environmental impacts of the alternatives, including the proposed action, should be included. A discussion of the potential beneficial effects of the alternatives is also valuable for decision-makers when comparing and contrasting alternatives and determining the best course of action to be undertaken.

CEQA Guidelines require the balancing, as applicable, of the economic, legal, social, technological, or other benefits of a proposed project against its unavoidable environmental risks when determining whether to approve a project (Section 15093 (a)-(c)). If the specific benefits, including region-wide or statewide environmental benefits of a proposed project outweigh the unavoidable adverse environmental effects, the adverse environmental effects may be considered “acceptable.” When a lead agency approves a project which will result in the occurrence of significant effects which are identified, but not avoided or substantially lessened, the lead agency under CEQA shall state in writing the specific reasons to support its action based on the final EIS/EIR or other information in the record. This statement becomes the statement of overriding considerations as required under CEQA.

As illustrated throughout this Executive Summary, the dominant factors agreed upon in the KHSA and KBRA centered on improving and resolving issues of low or declining fish populations, inadequate water supplies, and degraded water quality. The primary goal of these agreements is to improve the condition of these basin resources and thereby benefit the communities who rely on them, or historically relied on them, for a way of life. This includes tribal, fishing, farming, and recreational communities throughout the Klamath Basin.

One example of the inter-relatedness of basin resources and communities can be seen by evaluating the impacts and benefits of the alternatives on environmental justice communities in the basin. Reversing the consequences of barriers to fish passage, degraded fish habitat, and degraded water quality throughout the basin could result in great benefit to tribal communities relying on fish, shellfish, riparian plants, clean water, and other resources for their subsistence, ceremonies, physical health, way of life, and spiritual well-being. While sediment release during dam removal could cause short-term (1 to 2 years) impacts on fisheries downstream of the Hydroelectric Reach, salmon and other aquatic resources would be expected to return to existing 2010 levels within 5 years, and would provide long term benefits to Indian Tribes for 50 years and beyond (these effects are analyzed in Section 3.16).

In addition to benefits to fisheries and water quality, over the period of analysis, dam removal combined with undertaking the programs in the KBRA would have beneficial effects on the following basin resources:

- **Terrestrial Resources** (analyzed in Section 3.5) through enhanced habitat connectivity and animal movement.
- **Socioeconomic Resources** (analyzed in Section 3.15) through changes in commercial, recreational, and tribal fishing harvests and refuge recreation, as well as local and

regional increases in economic output, employment, and labor income from construction and mitigation spending.

- **Scenic Quality** (analyzed in Section 3.19) through returning areas around the dams closer to the scenic quality characteristics of the natural landscape.
- **Recreation** (analyzed in Section 3.20) through improvements in water-contact-based recreation and benefits to the Wild and Scenic River Act designation of the Klamath River.

Because restoring fisheries, improving water quality, and helping communities are major goals of the Proposed Action and the alternatives, a summary of the major long-term benefits of each alternative and their impacts is summarized below relative to these goals (these are also summarized in Table ES-5). In addition, the baseline (existing) condition is summarized because it is the benchmark against which the five alternatives are compared.

### **Baseline**

The Klamath Basin currently suffers from degraded fisheries, degraded habitat quality (including flows, water temperatures, and river channel structure), habitat limitations (barriers to fish passage), and degraded water quality (including problems with dissolved oxygen, pH, nutrient enrichment, algal growth, and algal toxins). Major water quality problems exist in Upper Klamath Lake, Keno Reservoir, and the reservoirs in the Hydroelectric Reach.

One result of these impaired water quality and habitat conditions has been fish die-offs, listings under federal and California endangered species acts, and commercial fishing closures. Circumstances for threatened and endangered species in the Klamath Basin are not improving. In addition, basin water supplies are over-allocated and do not meet all user needs; these challenges have been particularly acute in dry years. Water shortages, combined with the need to balance supplies among the needs of ESA-listed species (suckers in Upper Klamath Lake and coho salmon in the Klamath River), national wildlife refuges, and farming communities have led to the reduction of irrigation water deliveries to farmers in dry years. In short, existing conditions represent a continued hardship for fishing, farming, tribal, and recreational communities. In particular, the Klamath Tribes have had to bear the hardship of being without salmon in the Upper Basin for nearly 100 years and without harvestable sucker populations for 25 years; these species are fundamental to their diet, their ceremonies, and their cultural well-being.

### **Alternative 1 (No Action/No Project Alternative)**

Alternative 1 (No Action/No Project Alternative) is continued operation of the Klamath hydroelectric project under an annual license issued by FERC and would result in the continuation of many of the existing conditions described under Baseline. Implementation of TMDLs in Oregon and California over the next 50 years would be expected to help alleviate some of the basin-wide water quality problems. However, the concurrent processes and effects of climate change over the next 50 years could further challenge the survival of ESA-listed fish, push more fish into ESA listing, or cause populations of certain species like Chinook or steelhead to further decline.

As the FERC relicensing process would resume following a negative determination on dam removal from the Secretary, Alternative 1 could not continue for decades as the status quo; however, over 50 years, this alternative would likely retain the majority of the existing hydroelectric power generation capacity and the reservoirs would remain in place and would continue to be used for recreational purposes (the significance of these effects is analyzed in Sections 3.18 and 3.20, respectively). The recreational value of these reservoirs, however, has been diminished in recent years (since 2005) due to the documented growth of toxic algae in Copco 1 and Iron Gate Reservoirs and health advisory postings to that effect.

Alternative 1 would not result in the short-term negative impacts related to construction activities or short-term impacts to fish from the downstream transport of sediment during reservoir drawdown.

#### **Alternative 4 (Fish Passage at Four Dams Alternative)**

Alternative 4 would result in the same benefits to water quality from TMDL implementation as Alternative 1; however the creation of volitional fish passage for salmon at each of the Four Facilities under this alternative would open Upper Basin habitat to anadromous fish. Consequently, the size and diversity of these populations would increase. Implementation of Alternative 4 and access to Upper Basin habitat would decrease crowding of adult salmon and reduce the prevalence of disease for juvenile salmon. In addition, fish would gain access to thermal refuge areas, particularly in the Upper Basin, offering some protection against the future changes associated with climate change.

Alternative 4 would retain the majority of hydroelectric power generation capacity and project reservoirs would remain in place and would continue to be used for recreational purposes (the significance of these effects is analyzed in Sections 3.18 and 3.20, respectively). Alternative 4 would not result in short-term impacts to fish from downstream transport of sediment during reservoir drawdown.

#### **Alternative 5 (Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate)**

Alternative 5 would result in the same benefits as Alternative 4 for anadromous fish; however, removal of Copco 1 and Iron Gate Dams would provide additional benefits. Fish would be able to migrate upstream and downstream more efficiently through a greater length of natural river channel and through fewer constructed fish passage facilities in order to use habitat in the Upper Basin. By removing the two largest reservoirs in the Hydroelectric Reach, many of the water quality impairments caused by impounding water, including high pH, elevated fall water temperatures, low dissolved oxygen, and the presence of algal toxins, would be eliminated within and below the Hydroelectric Reach. Alternative 5 would also eliminate peaking and stranding in the Hydroelectric Reach, which currently has adverse effects on biological communities.

While water quality problems would improve as a result of draining Copco and Iron Gate Reservoirs, Alternative 5 would also eliminate recreational uses of these reservoirs and could decrease the value of property with access to, or views of, the reservoirs, at least in the short term. Decreased recreational opportunities could have related effects on other resources analyzed in this EIS/EIR (i.e., Socioeconomics and Recreation, analyzed in detail in Sections 3.15 and 3.20, respectively).

Removal of Copco 1 and Iron Gate Dams would significantly decrease the amount of hydroelectric power generated by the Klamath Hydroelectric Project.

### **Alternatives 2 and 3**

Alternatives 2 and 3 would have the benefits of Alternative 5 for anadromous fish; however, Alternatives 2 and 3 would provide additional fisheries and water quality benefits. Removing all Four Facilities would provide for a free-flowing river and would optimize the efficiency of fish migration to and from the Upper Basin as well as through the entire Hydroelectric Reach. The entire river from Keno Dam to the Pacific Ocean would become a well-connected, free-flowing river and would provide new fish habitat in the Hydroelectric Reach. Dam removal would maximize the recruitment of gravel within and below the Hydroelectric Reach, which would benefit fish spawning. Additionally, Alternatives 2 and 3 would create a more natural flow pattern and a more mobile stream bed. Both of these conditions are anticipated to reduce the occurrence of juvenile salmon fish disease and would likely create better conditions for fish migration, rearing, and spawning.

Implementation of KBRA projects and programs under Alternatives 2 and 3 would achieve faster basin-wide habitat restoration for fish, faster basin-wide water quality improvements, and direct support for improving water quality in Upper Klamath Lake and Keno Reach, which would benefit migrating salmon and steelhead populations and resident sucker populations in Upper Klamath Lake. The KBRA Fisheries Reintroduction and Management Plans could have direct benefits for salmon by accelerating their reintroduction to the Upper Basin and by providing for fish population monitoring to optimize adaptive management of restoration activities.

This alternative would eliminate the recreational benefits of project reservoirs and could decrease the value of properties with access to, or views of the reservoirs, at least in the short term; however, full facilities removal would create new recreational benefits along the Hydroelectric Reach (the significance of these effects is analyzed in Section 3.20). Finally, Alternatives 2 and 3 would eliminate all of the hydroelectric power generation from the Four Facilities (the significance of these effects is analyzed in Section 3.18).

### **Comparing Alternatives 2 and 3**

There are many similarities in the benefits and potential impacts of Alternatives 2 and 3. The main difference between the alternatives is that Alternative 3 would leave some facilities in place, but both alternatives would create a free-flowing river and eliminate any passage barriers to fish from Keno Dam to the Pacific Ocean.

Given the fact that fewer structures would be removed under Alternative 3 compared to Alternative 2, there would be fewer short-term environmental impacts associated with construction activities and the use of heavy equipment. Thus, impacts related to the release of greenhouse gases, noise, and ground and land disturbance would be diminished and there would be less likelihood of displacing cultural resources or human remains (impacts to Cultural Resources are analyzed in Section 3.13). However, leaving various appurtenant power generation facilities in place has the potential to interfere with wildlife movement and aesthetic quality, and would require some level of long-term maintenance.

Table ES-6 below summarizes the expected major benefits to salmonids and water quality for all five alternatives in this EIS/EIR as compared to existing (baseline) conditions.

**Table ES-6. Summary of Major Long-Term Benefits for Salmonid Restoration and Water Quality**

<b>Major long-term benefits of alternatives for water quality and salmonids as compared to existing conditions (baseline)</b>	<b>Alternative 1</b>	<b>Alternatives 2 and 3</b>	<b>Alternative 4</b>	<b>Alternative 5</b>
<b><i>Water Quality Benefits</i></b>				
River no longer exceeds OR and CA water temperature, nutrient, dissolved oxygen, pH, and chlorophyll-a TMDL allocations (may not occur by 2062), improving water quality basin wide	X <sup>1</sup>	X	X	X
Accelerates when river no longer exceeds OR and CA water temperature, nutrient, dissolved oxygen, pH, and chlorophyll-a TMDL allocations through the KBRA Fisheries Restoration Plan, improving water quality basin wide		X		
Largely eliminates in 2020 elevated late summer/fall water temperatures in and below the Hydroelectric Reach by removing the largest reservoirs		X		X
Largely eliminates 2020 dissolved oxygen and pH problems produced in reservoirs in the Hydroelectric Reach and transported downstream		X		X
Largely eliminates in 2020 algal toxins produced in the Hydroelectric Reach and transported downstream <sup>3</sup>		X		X
<b><i>Salmonid Benefits</i></b>				
Provides slightly cooler water temperatures in spring and early summer benefiting migration of both adult and juvenile salmonids	X		X	
Provides fish with access to thermal refuge areas that are buffered from future effects from climate change		X	X	X
Provides for natural recruitment of spawning gravel and river processes within and below the Hydroelectric Reach through dam removal		X		Partial <sup>2</sup>
Expands access to salmonid habitat to the Upper Basin (above J.C. Boyle Reservoir)		X	X	X
Expands salmonid habitat to a "free-flowing" hydroelectric reach		X		Partial
Accelerates in 2012 restoration of fish habitat throughout the basin through the KBRA Fisheries Restoration Plan		X		

**Table ES-6. Summary of Major Long-Term Benefits for Salmonid Restoration and Water Quality**

Major long-term benefits of alternatives for water quality and salmonids as compared to existing conditions (baseline)	Alternative 1	Alternatives 2 and 3	Alternative 4	Alternative 5
Expands opportunity to create springtime flushing flows (KBRA Environmental Water Program) and to increase flow variability and bed movement (with dam removal), which are hypothesized to reduce juvenile salmon disease below the Hydroelectric Reach		X		Partial
Provides opportunity to reduce juvenile salmon disease by allowing volitional fish passage through the Hydroelectric Reach and decreasing crowding of adult salmon		X	X	X
Provides volitional fish passage through the Hydroelectric Reach		X	X	X
Provides optimal efficiency beginning in 2020 of upstream and downstream salmonid migration through the Hydroelectric Reach by creating a free-flowing river		X		
Accelerates the effective use of the Upper Basin by salmonids through the KBRA Fisheries Reintroduction and Management Plan		X		
Improves base flows for salmonids, particularly in drought years, through KBRA Water Resources Program		X		
Eliminates adverse effects of hydroelectric peaking and stranding of fish in the Hydroelectric Reach		X		X

Notes:

<sup>1</sup> "X" means the alternative provides this benefit.<sup>2</sup> "Partial" means the alternative provides only some of the benefit.<sup>3</sup> Increased periphyton biomass would not affect levels of algal toxins in the Klamath River. The noxious blooms of phytoplankton (suspended algae) occurring in the calm, lake-like waters of Copco 1 and Iron Gate Reservoirs are responsible for the production of algal toxins, such as microcystin, in the Klamath River downstream of Iron Gate Dam (see Section 3.4). Noxious phytoplankton would not thrive in the free-flowing river following dam removal.**ES.7.3 Environmentally Preferable/Superior Alternative**

NEPA requires the Lead Agency to identify the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR Part 1505.2(b)). The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources. Although this alternative must be identified in the ROD, it need not be selected for implementation.

Section 15126.6(e)(2) of the CEQA Guidelines requires agencies to identify the environmentally superior alternative in a draft EIR. If the No Project Alternative is the environmentally superior alternative, an additional environmentally superior alternative must be identified among the other alternatives.

CDFG has identified Alternative 3 (Partial Facilities Removal of Four Dams) as the environmentally superior alternative. All of the alternatives evaluated in the EIS/EIR, including for the No Action/No Project Alternative, have significant unavoidable environmental impacts as identified in Section 5.5. Alternative 2 (Full Facilities Removal of Four Dams, the Proposed Action), Alternative 3, and Alternative 5 (Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate) would have the most short-term significant and unavoidable impacts among the alternatives. These impacts would largely be limited to the time frame of direct dam deconstruction actions and sediment release. After dam deconstruction, impacts would include the loss of reservoir recreation and local economic impacts. Alternatives 2, 3, and 5 would significantly improve water temperature, dissolved oxygen, and algal toxins for aquatic resources and reduce the incidence of fish disease in juvenile salmon by removing the two largest reservoirs—Copco I and Iron Gate. Alternatives 4 and 5 would maintain some power production and recreational benefits thereby reducing local economic impacts.

Although the No Action/No Project Alternative will have no change from existing conditions resulting from construction, this alternative is not the environmentally superior alternative when compared to the Proposed Action, which is intended to improve environmental conditions. Alternative 3 is the environmentally superior alternative when compared with the Proposed Action because it would:

- Reduce the air quality impacts from emissions of volatile organic compounds (VOCs), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), particulate matter < 10 microns (PM<sub>10</sub>), and particulate matter < 2.5 microns (PM<sub>2.5</sub>) from reduced construction activities;
- Reduce the contribution to greenhouse gas emissions from reduced construction activities;
- Reduce noise and vibration from reduced construction activities;
- Reduce impacts to terrestrial plants and wildlife from fewer truck trips;
- Reduce disturbance to archaeological and historic sites from fewer truck trips;
- Retain structures for roosting bats; and
- Retain historically significant structures at Copco 1.

Alternative 3 would provide similar long-term benefits when compared with Alternative 2, but would reduce short-term impacts because it involves less construction. Alternative 3 would result in superior long-term beneficial environmental effects. In summary, Alternative 3 is considered the environmentally superior alternative among all the alternatives because it provides long-term beneficial environmental effects, while reducing some of the short-term significant effects of the Proposed Action (Alternative 2).

#### **ES.7.4 Controversies and Issues Raised by Agencies and the Public**

CEQA requires disclosure of the controversial project issues raised by agencies and the public. Table ES-6 presents a summary of some of the controversial project issues identified during the scoping period, which are addressed in this EIS/EIR. These are opinions and issues raised during scoping by agencies and members of the public and do not necessarily represent the position of the Lead Agencies. Additionally, Table ES-7 is not a summary of findings or determinations

from the analysis in this EIS/EIR. Chapter 5 of this EIS/EIR, *Other Required Disclosures*, presents the full list of controversial project issues and the timeline or process in which they will be addressed, or the document in which they are addressed. See the Scoping Report (located online at: <http://klamathrestoration.gov/>) for further information on issues identified by agencies and the public during the public scoping process.

**Table ES-7. Summary of Controversies and Issues Raised by Agencies and the Public<sup>1</sup>**

Issue	Summary of Issue	Timeline for Addressing or Document/Section Addressing Issue
<b>Loss of Renewable Power Supply</b>	Loss of the Klamath Hydroelectric Project will result in the loss of renewable power. The specific makeup of new power supplies is not certain and may come from non-renewable sources.	Greenhouse Gases/Global Climate Change (Section 3.10.4.3)  Public Health and Safety, Utilities and Public Services, Solid Waste, Power (Section 3.18.4.3)
<b>Regional Economic Impacts</b>	Loss of the Klamath Hydroelectric Project and lost power generation will negatively and disproportionately affect resource-based economies of local communities, many of which are struggling economically.	Socioeconomics (Section 3.15.4.3)
<b>Sediment Impacts from Dam Removal</b>	Sediment release during dam removal will have significant and deleterious effects on the aquatic environment from Iron Gate Dam to the Pacific Ocean during the period of dam removal.	Water Quality (Section 3.2.4.3)  Aquatic Resources (Section 3.3.4.3)
<b>Historic Anadromous Fish Distribution in the Upper Klamath Basin</b>	Dam removal would open large areas of the Upper Klamath Basin watershed to anadromous fish. The historical distribution of anadromous fish above the dams has been questioned.	Chapter 1, Introduction  Aquatic Resources (Section 3.3.4.3)
<b>KBRA Effects</b>	The KBRA may not produce enough social and economic benefits from implementation.	Socioeconomics (Section 3.15.4.3)
<b>Loss of Reservoir Environment</b>	Dam removal will result in a loss of the three largest reservoirs, affecting individuals that live on or near the reservoirs and who value the reservoirs' aesthetic and recreational value.	Land Use, Agricultural, and Forest Resources (Section 3.14.4.3)  Scenic Quality (Section 3.19.4.3)  Recreation (Section 3.20.4.3)
<b>Flood Risk</b>	Dam removal will increase the incidence and magnitude of flooding to downstream communities.	Flood Hydrology (Section 3.6.4.3)

**Table ES-7. Summary of Controversies and Issues Raised by Agencies and the Public<sup>1</sup>**

Issue	Summary of Issue	Timeline for Addressing or Document/Section Addressing Issue
<b>FERC Relicensing</b>	In the event of a negative Secretarial Determination, PacifiCorp would re-enter the FERC relicensing process. The outcome of this process is not known but could be the continued operation of the dams under a new license that includes the agencies' mandatory conditions and prescriptions.	Chapter 2, Proposed Action and Description of Alternatives
<b>Agriculture and Refuge Management contributes to poor water quality in Keno and Upper Klamath Lake</b>	Runoff from agriculture and refuges results in poor water quality in Keno Reservoir and in the mainstem Klamath River. This causes fish stress, disease and mortality. Continued farming and ranching in the Tule Lake National Wildlife Refuge and Lower Klamath Lake National Wildlife Refuge under the KBRA would inhibit fish species reintroduction and survival.	Water Quality (Section 3.2.4.3)  Aquatic Resources (Section 3.3.4.3)
<b>Water Quality Conditions in Keno Impoundment and Upper Klamath Lake would not allow sound fish passage</b>	Low levels of dissolved oxygen and high water temperatures during certain times of year would prohibit passage of fish through Keno Impoundment and Upper Klamath Lake.	Water Quality (Section 3.2.4.3)  Aquatic Resources (Section 3.3.4.3)

Notes:

<sup>1</sup> CEQA requires disclosure of the controversial project issues raised by agencies and the public. Table ES-7 presents a summary of some of the controversial project issues identified during the scoping period, which are addressed in this EIS/EIR. These are opinions and issues raised during scoping by agencies and members of the public and do not necessarily represent the position of the Lead Agencies. Additionally Table ES-7 is not a summary of findings or determinations from the analysis in this EIS/R.

## ES.8 References

Department of Interior and National Oceanic and Atmospheric Administration Fisheries Services. 2007. United States Department of the Interior and National Marine Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis Pursuant to Section 18 and Section 33 of the Federal Power Act for the Klamath Hydroelectric Project (FERC Project No. 2082). January 26, 2007.

Docket Number 2006-NMFS-0001. Decision of Administrative Law Judge in the Matter of Klamath Hydroelectric Project, September 27, 2006

Federal Energy Regulatory Commission (FERC). 2007. Final Environmental Impact Statement for Hydropower License, Klamath Hydroelectric Project, FERC Project No. 2082-027, FERC/EIS-0201F. Washington, DC, Federal Energy Regulatory Commission, Office of Energy Projects, Division of Hydropower Licensing.

Oregon Public Utilities Commission, 2010. In the Matter of PacifiCorp, dba Pacific Power. Application to Implement the Provisions of Senate Bill 76. Order No. 10-364. September 16, 2010.

40 Code of Federal Regulations Part 1502.16. Protection of the Environment. Part 1502: Environmental Impact Statement. 1502.16: Environmental Consequences.

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# Chapter 1

## Introduction

This Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) evaluates the potential impacts of the removal of the four PacifiCorp<sup>1</sup> dams on the Klamath River as contemplated in the Klamath Hydroelectric Settlement Agreement (KHSA [2010]). The Klamath Basin Restoration Agreement (KBRA [2010]), as well as the transfer of Keno Dam, will be treated and analyzed as a connected action<sup>2</sup>. The KBRA includes programs that will undergo detailed development and analysis in the future. Therefore, it is anticipated additional National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) analyses for the suite of actions contained in KBRA will be tiered as appropriate to this EIS/EIR. It is anticipated that additional CEQA analysis will be necessary prior to dam removal as contemplated in the KHSA. The EIS/EIR is being prepared in compliance with NEPA and CEQA and will inform a determination by the Secretary of the Interior (Secretary) on whether dam removal will advance salmonid restoration and is in the public interest, including but not limited to, consideration of potential impacts on affected local communities and tribes.

The KHSA establishes a process for the Secretarial Determination<sup>3</sup>. This process includes additional studies, environmental review, and the decision by the Secretary. This process also includes decisions by the States of Oregon and California as to whether they concur with the Secretarial Determination.

The J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams and appurtenant facilities (herein referenced as the Four Facilities) are being evaluated for removal, and Keno Dam is being evaluated for transfer (not the removal of) from PacifiCorp to the Department of the Interior (DOI) as a connected action. These dams are affecting salmonid fisheries by blocking up to 420 miles of potential river habitat, by affecting downstream water quality (specifically, dissolved oxygen, water temperature, and algal toxins), and altering flows in sections of the mainstem of the river (Hamilton et. al. 2011). If authorized through legislation, the Secretary will use the impacts analysis presented in this EIS/EIR to help determine whether facilities removal should occur. Under the KHSA, the Secretary will use best efforts to complete this determination by March 31, 2012.

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<sup>1</sup> PacifiCorp refers to the current utility and all previous owners/names.

<sup>2</sup> NEPA defines a connected action as an action that (i) automatically triggers other actions that may require environmental impact statements (ii) cannot or will not proceed unless other actions are taken previously or simultaneously (iii) is an interdependent part of a larger action and depends on the larger action for its justification. Connected actions are closely related and therefore should be discussed in the same impact statement (40 CFR Part 1508.25 (a)1).

<sup>3</sup> Secretarial Determination: Decision by the Secretary of the Interior based on a thorough scientific review of existing science, data and other information whether removal of the dams: (1) will advance restoration of the salmonid fisheries of the Klamath Basin; and (2) is in the public interest.

## **1.1 Physical and Biological Setting**

The Klamath Basin geography, topography, hydrology, and biology are unique from other watersheds in the Pacific Northwest. Water in the Klamath River, unlike other watersheds in the Pacific Northwest, originates in relatively flat, open valleys before crossing the Trinity and Coast Ranges in a steep river canyon and intercepting cold water inputs from the Shasta, Scott, Salmon, and Trinity Rivers. The flat topography, along with lower average precipitation in the Upper Klamath Basin than the Lower Basin, influences water flow and temperature in the river. Figure 1-1 illustrates many of the features of the Klamath Basin described in this section.

### **1.1.1 Geography and Topography**

The Klamath River originates just downstream of Upper Klamath Lake in southern Oregon and flows 253 miles southwest through northern California to the Pacific Ocean. Along this course, the Klamath River crosses the Cascade Mountains; the Klamath is one of the only rivers to do so. The Upper Klamath Basin has five main lakes: Crater Lake, Upper Klamath Lake, Lower Klamath Lake, Clear Lake, and Tule Lake. The Lower Basin, with its border beginning at Iron Gate Dam, is almost 200 miles long and contains the four major Klamath River tributaries: the Shasta, Scott, Salmon, and Trinity Rivers. The basin is generally rural, with a total population of approximately 120,000. Its largest communities are Klamath Falls, Oregon and Yreka, California.

The Upper Klamath Basin has broad, extending valleys shaped by volcanoes and active faulting. The fault-bounded valleys contain all of the large, natural lakes and large wetlands of the Klamath Basin.

As described above, the Klamath River is unlike most river systems, in that the river is warmer and flatter in its headwaters, while downstream portions, beginning near the dams, tend to be colder and steeper. The Klamath River flows through mountainous terrain from the Oregon-California stateline to the reaches downstream of Iron Gate Dam. Downstream of Iron Gate Dam, and for most of the river's length to the Pacific Ocean, the river maintains a relatively steep, high-energy channel. Here, the Klamath River forms a deep canyon surrounded by mountains of the Trinity and Coast Ranges. Lower Klamath Basin valleys include those of the Shasta and Scott Rivers (National Research Council 2004).

### **1.1.2 Climate and Hydrology**

The basin receives widely varying precipitation. The climate in the Upper Basin is dry, with an annual precipitation of approximately 13 inches at the river's origin near Klamath Falls, Oregon. In contrast, the Lower Basin is wet, with an annual precipitation of approximately 80 inches near the river's mouth at Requa, California. At its higher elevations (above 5,000 feet), the Upper Klamath Basin receives rain and snow during the late fall, winter and spring. Peak stream flows generally occur during snowmelt runoff in late spring/early summer. After the runoff period, flows drop in the late summer/early fall. Fall storms may increase flows compared with the lower summer flows in the Lower Basin.



Figure 1-1. The Klamath Basin

**Land- and Water-Use Changes in the Klamath Basin**

When settlers of European descent first arrived in the Klamath Basin in the 1800s, there was a vast complex of 350,000 acres of lakes and wetlands, interconnected by sloughs and river channels. Many of these wetlands were attractive for farming if drained and a reliable source of irrigation could be developed. Construction of Reclamation's Klamath Project began in the early 1900s to facilitate farming. The Klamath Project, the largest water delivery system in the basin, now includes 7 dams, 18 canals, 45 pumping facilities, and over 500 miles of ditches to supply irrigation water to over 235,000 acres. Upper Klamath Lake's outlet was modified with the construction of Link River Dam (completed in 1921) to allow more active storage of irrigation water for the Klamath Project.

Farms and ranches above Upper Klamath Lake, and on tributaries in the lower Klamath River (e.g. Scott, Shasta, and Trinity Rivers) use surface water supplies that are not part of the Klamath Project. In total, about 62 percent of the wetlands in the Klamath Basin were converted to farming and ranching activities. However, some of these wetlands were retained, like the Lower Klamath National Wildlife Refuge, by President Roosevelt in 1908, creating the first waterfowl refuge in the United States and providing critical habitat along the Pacific Flyway.

Economic development of natural resources changed conditions in the Klamath Basin over the past 100 years, including extensive basin-wide logging, gold mining in the lower river basin, and construction of a railroad causeway in the early 1900s that isolated and dried Lower Klamath Lake. Construction of four main-stem hydroelectric facilities on the middle part of the Klamath Basin between 1918 (Copco 1 Dam) and 1962 (Iron Gate Dam) blocked the passage of migrating salmon and steelhead to the Upper Basin and represents that last major hydrologic modification in the basin.

The combination of these changes have contributed to significant loss of fish habitat, degradation of water quality, and declining fish populations -- especially for salmon and two endangered sucker species (shortnose and Lost River suckers). Hydrologic alterations, including water diversions, wetland losses, declining water quality, and dam construction are among the most significant land- and water-use changes in the Klamath Basin.

Land use patterns in the Klamath Basin will continue to reflect the value of natural resources in providing economic gain for local communities and the Nation. Returning to conditions seen in the 1800's is unrealistic; however, there are numerous opportunities to substantially improve fisheries, wildlife habitat, and water quality conditions in the Klamath Basin and reverse the pattern of environmental problems in the Klamath Basin.

### 1.1.3 Biology

The Klamath Basin has some of the richest biological and ecological habitats in the United States. The Klamath Basin is within the Klamath Bioregion (California) and the East and West Slope Cascades (Oregon) eco-regions. Below are overviews of the biological resources within this unique and biologically important basin and effects of natural resource development on these resources in the Upper and Lower Basins. Chapter 3 and the appendices of this document describe these resources in detail.

#### 1.1.3.1 Vegetation

Vegetation communities in these eco-regions include drier pine and fir forests in the mountain ranges of Siskiyou County and wetter forests near the coast. Recognized for their biological diversity, the Klamath-Siskiyou mountain ranges contain more than 3,000 known plant species, including 30 temperate conifer tree species, more than any other ecosystem in the world (California Department of Fish and Game [CDFG] 2006). Land cover in the basin consists of a combination of upland tree habitat, aquatic habitat, and wetland habitat. Sagebrush and interior valley vegetation communities also exist within lower elevation areas.

The Klamath River Canyon itself is a mosaic of mixed conifer forest communities and riparian habitats (Federal Energy Regulatory Commission [FERC] 2007).

In addition to their ecological significance, many plants, especially wetland plants, in the Klamath Basin are culturally important to Indian Tribes in the Klamath River region for food, basketry, regalia, and medicine, and some have importance for ceremonial use as well (Larson and Brush 2010; FERC 2007).

#### 1.1.3.2 Wildlife

The Klamath Basin is home to a large number of wildlife species, with great diversity. Surveys have identified more than 200 vertebrate species, including amphibians, reptiles, birds, and mammals (PacifiCorp 2004a).

- Five amphibian species are known to occur in the Klamath River area: long-toed salamander, Pacific chorus frog, western toad, and Pacific giant salamander. In addition, western toad and yellow-legged frog were reported in some of the tributaries of the lower Klamath subbasin during trapping studies conducted in 1991 (U.S. Fish and Wildlife Service [USFWS] 1992).
- Reptile species diversity and relative abundance is considered high (PacifiCorp 2004a). The western fence lizard is a highly abundant reptile species and is found in a variety of habitats in the basin area. Other reptile species include gopher snake, northern sagebrush lizard, western rattlesnake, southern alligator lizard, yellow-bellied racer, common garter snake, western terrestrial garter snake, western pond turtle, common kingsnake, striped whipsnake, sharptail snake, ringneck snake, western skink, rubber boa, and California mountain kingsnake (PacifiCorp 2004a).

### Effects of Natural Resource Development

#### In the Upper Klamath Basin

- Logging, road-building, farming, and ranching above Upper Klamath Lake have removed riparian vegetation, warmed streams, and increased the loads of nutrients and sediment entering the rivers and Upper Klamath Lake, contributing to water-quality problems.
- Draining tens of thousands of acres of wetlands around Upper Klamath Lake for agriculture land increased nutrient loads to the lake and eliminated near-shore habitat for aquatic biota.
- Link River Dam operations to meet irrigation water demand cause wider water-level fluctuation in Upper Klamath Lake.
- Upper Klamath Lake has become more enriched with nutrients, leading to nuisance blooms of blue-green algae that produce toxins (primarily microcystin) and creating pH and dissolved oxygen problems that are stressful to aquatic biota.
- Shortnose and Lost River suckers went from a dominant species in Upper Klamath Lake, and a food source for tribal members, to an endangered species in 1988, a closed fishery, and a fish population that continues to decline.
- The 20-mile Keno Reach of the Klamath River receives large loads of decaying organic matter (blue-green algae) from Upper Klamath Lake, producing extremely low dissolved-oxygen levels that persist in the summer and fall.
- Draining and farming hundreds of thousands of acres of wetlands below Upper Klamath Lake (and the Lost River Valley) has decreased habitat for waterfowl on the Pacific Flyway and affects the amount and timing of water released downstream for fish.
- Klamath River is blocked at Iron Gate Dam for passage of fall and spring run Chinook salmon, coho salmon, and steelhead, limiting fish production in the basin and access to salmon by tribes in the Upper Basin.

#### Sources:

Bortleson and Fretwell, 1993; CDFG 2004; Chesney and Yokel, 2003; National Academies Press, 2003; NOAA 2009; Risley and Laenen, 1998; Snyder and Morace, 1997; Sullivan et al, 2008; USFWS 1993; USFWS 2009; Wood, 2009.

- The Upper Klamath Basin is along the Pacific Flyway, and it supports the largest concentration of migratory waterfowl in North America, with up to 2 million migratory birds during fall migration and about half that number in spring (Jarvis 2002). Large numbers of water-related birds also use the Upper Klamath Basin for breeding (Shuford et al. 2004). In addition, the Upper Klamath Basin supports the largest wintering population of bald eagles in the coterminous United States (Shuford et al 2004).
- In addition, many common mammals are found throughout the area including: black-tailed jackrabbit, mule deer, and California ground squirrel. Small mammals in the area include deer mouse, bushy-tailed woodrat, least chipmunk, and montane vole. Medium-sized mammals detected in the area include bobcat, striped skink, gray fox, yellow-bellied marmot, and coyote. Large mammals such as deer, elk, mountain lion, and black bear are also present. Five aquatic and/or riparian-associated fur-bearing mammals are present, including raccoon, beaver, muskrat, mink, and river otter (PacifiCorp 2004a).

### **1.1.3.3 National Wildlife Refuges**

The Klamath Basin National Wildlife Refuge (NWR) System comprises six refuges (Bear Valley, Clear Lake, Klamath Marsh, Lower Klamath, Tule Lake, and Upper Klamath). The refuges maintain critical wetland habitat in the river basin and provide a stopover point for three-quarters of the migratory waterfowl on the

### **Effects of Natural Resource Development**

#### **In the Lower Klamath Basin**

- The four dams create water temperature in the river that are too warm in the fall for fish migration, and they affect the natural flow variability in the lower river and cause crowding of salmon below Iron Gate Dam, both of which contribute to fish disease.
- Severe water quality problems in these four reservoirs, including blue-green algal toxins (that can affect humans and fish), low dissolved oxygen, high temperatures, and high pH, create stressful biological conditions.
- Use of water in major Klamath River tributaries (e.g. Scott and Shasta Rivers) for farming and ranching has decreased critical habitat for coho salmon, which was federally listed in 1997.
- High nutrient concentrations leaving the Upper Basin result in the excessive growth of attached algae (periphyton) in the lower main-stem river, which causes stressful swings in pH and DO for aquatic biota.
- Reduced flows during extreme droughts have been identified as a factor in large fish die-offs, as occurred in the fall of 2002 when tens of thousands of pre-spawned salmon and steelhead died in the lower river.
- Weak Klamath salmon stocks in the ocean periodically require closure of fisheries and commercial and recreational fishing along 700 miles of the Oregon and California coasts, as occurred in 2006.

#### **Sources:**

Bortleson and Fretwell, 1993; CDFG 2004; Chesney and Yokel, 2003; National Academies Press, 2003; NOAA Fisheries 2009; Risley and Laenen, 1998; Snyder and Morace, 1997; Sullivan et al, 2008; USFWS 2009; Wood, 1999.

Pacific Flyway (USFWS 2010). The refuges provide vital feeding, nesting, and resting habitat for one to two million birds during the spring and fall migrations, all of which are highly dependent on the water resources of the area.

#### **1.1.3.4 Fish**

The Klamath Basin is home to 19 native fish species. The Klamath Basin once produced large runs of steelhead, Chinook salmon, coho salmon, green sturgeon, eulachon, coastal cutthroat trout, and Pacific lamprey. Runs of these anadromous fish (fish that migrate from salt water to spawn in fresh water) contributed substantially to tribal, commercial, and recreational fisheries (USFWS 1986; DOI Klamath Basin Task Force 1991; Gresh et al. 2000).

Some of these fish species are listed under the Federal Endangered Species Act (ESA) and California Endangered Species Act. Federally listed species include coho salmon, bull trout, Lost River sucker, shortnose sucker, southern distinct population segment green sturgeon, and southern distinct population segment eulachon. California listed species include coho salmon, Lost River sucker, shortnose sucker and longfin smelt. In addition, both the Lost River sucker and the shortnose sucker are fully protected under the California Fish and Game Code Section 5515(a)(3)(b)(4) and (6), respectively.

Upper Klamath Lake and other waterways in the upper watershed provide habitat for the Lost River and shortnose suckers. Suckers are an important part of tribal culture and were an important part of tribal diet. The Lost River and shortnose sucker spawning runs still constitute ceremonial events for the Klamath Tribes. In 1988, these fish were listed as endangered under the ESA (USFWS 1988) and California Endangered Species Act, eliminating the ability to fish for suckers and thus eliminating them from tribal diet and traditional cultural practices.

Copco 1 Dam, completed in 1918, was the first mainstem dam to block fish passage to the majority of the Upper Klamath Basin. Iron Gate Dam, completed in 1962, is the downstream-most dam that blocks upstream fish passage. Flow releases from Iron Gate Dam, and the quality of the water being released, affect the quantity and quality of fish habitat for listed and non-listed species in the mainstem downstream of Iron Gate Dam (FERC 2007). The other hydroelectric dams, with the exception of J.C. Boyle Dam, which is equipped with a ladder that does not meet current standards (Administrative Law Judge 2006), also block upstream fish passage and isolate fish populations between these dams. The dams have eliminated access for anadromous fish, including salmon and steelhead, to approximately 420 miles of potential habitat upstream of Iron Gate Dam.

## **1.2 People and Historic Setting**

### **1.2.1 Tribes**

Six federally recognized tribes live, work, hunt, and fish within the basin, including the Klamath Tribes, Quartz Valley Tribe, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe, and Resighini Rancheria. The total tribal population in the basin is approximately 16,000. Historically, the tribes depended on the fish populations of the Klamath Basin for food as well as ceremonial traditions. Prior to European settlement, generations of Indian Tribes resided along the Klamath

and Trinity Rivers and in the Upper Klamath Basin, and depended on the fisheries for cultural, ceremonial, subsistence, and commercial purposes.

The decline in the fisheries has caused economic hardship for all the tribes. The Klamath Tribes, in the Upper Basin, have not had salmon harvest opportunities since 1918, when Copco 1 Dam was built. By contrast, the salmon harvest continues to provide revenue for the Yurok and Hoopa Valley Tribes (who reside in the Lower Basin).

#### **1.2.1.1 The Klamath Tribes**

The Klamath Tribes, headquartered in Chiloquin, Oregon, in the Upper Basin near Upper Klamath Lake, are composed of three historically separate tribes: the Klamath Tribe, the Modoc Tribe, and the Yahooskin band of Snake Indians. The Klamath Tribes' ancestral territory covers approximately 580,000 acres. The current membership is about 3,400 and the current total land base is approximately 600 acres.

#### **1.2.1.2 Quartz Valley Tribe**

The Quartz Valley Indian Reservation is a federally recognized tribe representing people of upper Klamath (Karuk) and Shasta Indian ancestry. The Quartz Valley Indian reservation is in Siskiyou County near the community of Fort Jones. The population is around 126, with a tribal enrollment of about 150. Total reservation size is 174 acres.

#### **1.2.1.3 Karuk Tribe**

The Karuk Tribe has been federally recognized since 1979 and occupies territory along the middle section of the Klamath River. The 2000 U.S. Census reported tribal membership to be 2,702 individuals. In 2004, the California Department of Housing and Community Development reported tribal membership to be 3,164 individuals. Currently, the Karuk have one of the largest tribes in California with approximately 4,800 members.

#### **1.2.1.4 Hoopa Valley Tribe**

The Hoopa Valley Indian Reservation is in the northeastern corner of Humboldt County in northern California, approximately 50 miles inland from the Pacific Ocean, and encompasses roughly 20 percent of Hupa aboriginal territory. The reservation has nearly 92,160 acres, and is the largest reservation in California. The northern portion of the reservation is in Yurok ancestral territory. The Trinity River bisects the reservation, and a small length of the northern border of the reservation includes about a quarter mile reach of the Klamath River. The 2000 U.S. Census counted 2,633 people on the reservation, and the tribe listed an enrollment of 2,130 in 2004.

#### **1.2.1.5 Yurok Tribe**

With more than 5,000 members, the Yurok Tribe is the largest tribe in California. The tribe's ancestral territory covers approximately 350,000 acres and includes approximately 50 miles of Pacific coastline. Today, the tribe's reservation in Del Norte and Humboldt Counties in California encompasses approximately 57,000 acres, bordered on the west by the Pacific Ocean, and consists of a strip of land extending a mile along each side of the Klamath River from just upstream of the confluence of the Klamath and Trinity Rivers about 50 miles inland.

### **1.2.1.6 Resighini Rancheria**

The Resighini Rancheria is in Del Norte County, California, and encompasses 239 acres. The Resighini Rancheria is several miles inland from the mouth of the Klamath River and rests on the southern banks of the river, completely surrounded by the Yurok Reservation. It is primarily settled by Yurok Indians affiliated with the Yurok Coast Indian Community. A population of 36 was reported on Rancheria lands in the 2000 U.S. Census.

### **1.2.2 Early Euroamerican Settlement and Hydroelectric History**

Before the influx of Euroamericans that began in the 1840s, the basin was settled by American Indians. Euroamerican exploration of the Klamath Basin began in the early 19th Century. The discovery of gold in California in 1848 prompted a dramatic influx of European immigrants to California and other areas, including the Klamath Basin. Euroamerican settlement in the Klamath River watershed continued throughout the 19<sup>th</sup> Century. Sustained logging enterprises appeared in the 1880s, and the first hydroelectric development in the Klamath Basin was established in 1891 in the Shasta River Canyon below Yreka Creek.

Envisioned in 1911, the Klamath Hydroelectric Project was built in phases, beginning with Copco 1 (1918), followed by Copco 2 (1925), J.C. Boyle (1958) and the Iron Gate facilities in 1962. The development of the Klamath Hydroelectric Project played a significant role in the area's economic development, both as part of a regionally significant, locally owned and operated private utility and through the role that increased electrical capacity played in the expansion of the timber, agriculture, and recreation industries during the 20th century.

### **1.2.3 Water Use and Management**

#### **1.2.3.1 Water Management Conflicts**

Figure 1-2 presents a timeline for activities within the Klamath Basin that have resulted in current conditions. Conflicts over water and other natural resources in the Klamath Basin between conservationists, tribes, farmers, fishermen, and state and federal agencies have existed for decades. In particular, several developments affecting the Klamath Basin have occurred in recent years:

- In 2001, water deliveries to irrigation contractors in Reclamation's Klamath Project (described below) were substantially reduced.
- In 2002, returning adult salmon suffered a major die-off.
- In 2006, the commercial salmon fishing season was closed along 700 miles of the West Coast to protect weak Klamath River and other major river salmon stocks.
- In 2010, due to drought conditions<sup>4</sup>, Reclamation's Klamath Project had a reduction in water deliveries resulting in short-term idling of farmland and increased groundwater pumping.

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<sup>4</sup> As declared by the Governor of Oregon (State of Oregon 2010)



Figure 1-2a. Klamath Basin Timeline Since 1905

Klamath Facilities Removal EIS/EIR  
Public Draft



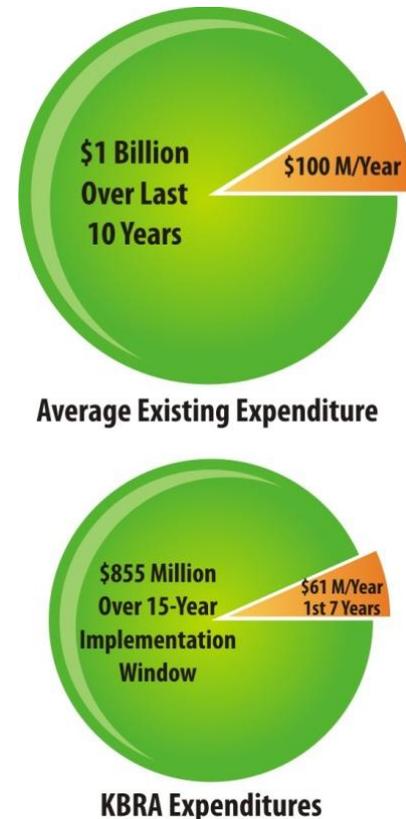
Figure 1-2b. Klamath Basin Timeline Since 1905

Historical conflicts over the Klamath Basin’s limited water resources stem in part from concerns over fish populations. The fish populations native to the Klamath River have decreased over time due to human activities in the basin. The Lost River and shortnose suckers have been affected by degradation and loss of habitat as a result of human activities in the Upper Basin over the last century (USFWS 2008). Water resource development on the Klamath River and its tributaries (including the Shasta, Scott, and Trinity Rivers) has contributed to declines in salmonid fish populations that have harmed both in-river and coastal fishing for subsistence, commercial, and recreational fishing (Congressional Research Service 2005). These conflicts have cost the United States an average of \$100 million per year over the past ten years (Sheets 2011). The KBRA was designed to reduce these expenditures, as shown in Figure 1-3.

#### 1.2.4 Reclamation’s Klamath Project

In addition to the Klamath Basin’s distinctive setting, biological resources, and cultural history, the basin is also the site of one of the first developments authorized under the 1902 Reclamation Act (P.L. 57-161, 32 Stat. 388). Development and construction of Reclamation’s Klamath Project took place between 1905 and 1966, with major features of the project completed by the early 1940s. As the largest water management effort in the Upper Klamath Basin, Reclamation’s Klamath Project features include a system of reservoirs, dams, canals, and pumps (Figure 1-4), and use of Gerber Reservoir and Clear Lake to reduce flooding of lands in the Tule Lake area. The authorization for Reclamation’s Klamath Project stated its purpose:

For project works to drain and reclaim lake bed lands of the Lower Klamath and Tule Lakes, to store water of the Klamath and Lost Rivers, including storage of water in Lower Klamath and Tule Lakes, to divert irrigation supplies, and to control flooding of the reclaimed lands.



**Figure 1-3. Klamath Basin Expenditures (Sheets 2011)**

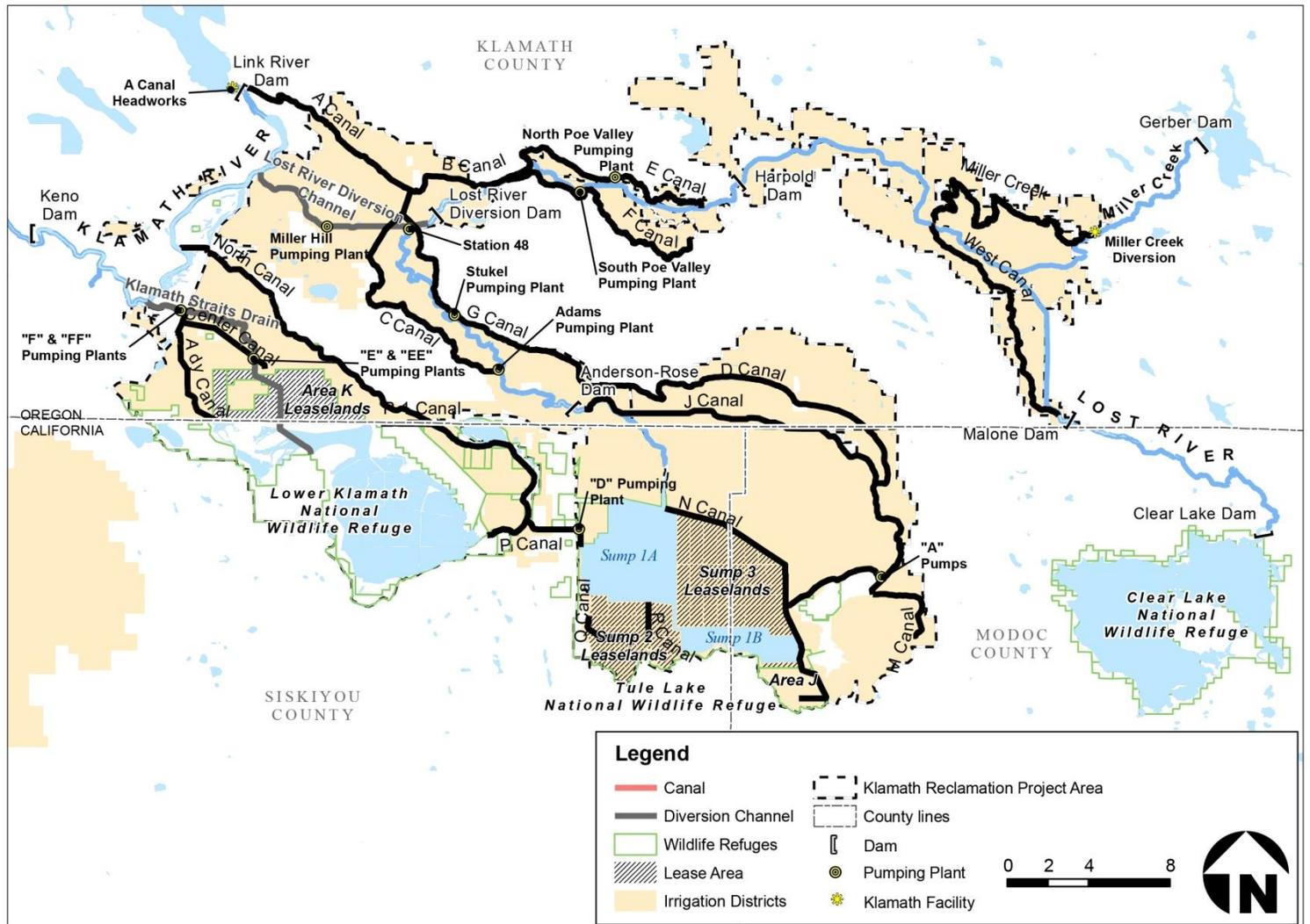


Figure 1-4. Reclamation's Klamath Project

Reclamation’s Klamath Project was originally authorized at a time when an increasing number of farmers were drawn to the fertile land in northern California and southern Oregon. Development of Reclamation’s Klamath Project converted much of the Tule Lake and Lower Klamath Lake wetland complexes into farmland.

The first dams constructed for Reclamation’s Klamath Project included Clear Lake Dam (1910), Lost River Diversion Dam (1912), and Lower Lost River Diversion Dam (1921). Also in 1921, the completion of Link River Dam, executed through a contract between PacifiCorp and the United States, allowed for additional water management in the Upper Basin. This included greater storage in Upper Klamath Lake, water releases reflecting natural conditions, and controlled releases from the lake to provide a source of irrigation water. The agreement between the power company and the government allowed for PacifiCorp to operate the dam for hydropower production, and in return, the company was to supply low-cost electricity to Reclamation and farmers in the region.

Today, Reclamation’s Klamath Project irrigates up to 235,000 acres of land on which farmers grow wheat, malt barley, potatoes, onions, alfalfa, and other crops (Congressional Research Service 2005). Reclamation’s Klamath Project features also provide recreational opportunities for boating, water skiing, hunting, fishing, camping, and picnicking. In addition, the Klamath Basin National Wildlife Refuge System usually receives water from the operation of Reclamation’s Klamath Project for the benefit of waterfowl and other species.

Reclamation’s Klamath Project, with the exception of Clear Lake, does not include multi-year water storage facilities. Upper Klamath Lake represents most of its storage, but the lake is shallow, with an average depth of approximately 9 feet when full (Wood et al. 2006). Upper Klamath Lake can only provide small opportunities for carryover storage between years; therefore, Reclamation’s Klamath Project operations are dependent on the amount of annual precipitation. During wet years, Reclamation’s Klamath Project irrigators typically receive full contract deliveries of water. In the past few decades, however, Klamath Project irrigators and refuge managers have not always had their requests for water met during drought years because of the need to conserve water for fish in the Klamath River downstream of Iron Gate Dam and in Upper Klamath Lake.

Keno Dam (constructed in 1966 by PacifiCorp) also plays an important role in regulating water elevations in Keno Impoundment/Lake Ewauna for the gravity operation of irrigation canals. Keno Dam is owned by PacifiCorp and is not part of Reclamation’s Klamath Project.

### **1.2.5 Adjudication**

If an appropriation of water was initiated prior to the enactment of the Oregon 1909 water code and has not been forfeited or abandoned since then, a water user may have a “vested” water right. Federal reserved water rights vest no later than the date of the reservation, and as early as “time immemorial,” regardless of whether they have been used. A claim to a vested water right is quantified and made a matter of record through an adjudication proceeding. The Oregon Water Resources Department (OWRD) is responsible for gathering information about the use of water and presenting its findings to the County Circuit Court. This circuit court is responsible

for resolution and issues a decree that states who has the right to use water, the amount and location of water use, and the priority date. A water right certificate is issued for each decreed right (State of Oregon 2009).

The Klamath Basin Adjudication is the adjudication process for pre-1909 and federal reserved water right claims for the use of surface water within the Klamath Basin. The Klamath Basin proceeding began in 1975. Claims of water use have been gathered and contests have been filed on most of those claims. Administrative law judges have been holding hearings and issuing proposed orders determining the claims and contests. The OWRD will review those proposed orders, and any proposed settlements of contests, and submit its Findings and Order of Determination to the Circuit Court in December 2012. Water right claims have been filed by private water users, The Klamath Tribes, Klamath allottees, and the United States (the Klamath Project and for Indian and other federal reservations of land). Once OWRD's findings are submitted to court there will be an opportunity for parties to file exceptions to those findings. The Klamath Circuit Court will resolve the exceptions and issue a decree. As of July 2010, 97 percent of contests and 92 percent of the claims in the Klamath have reached a proposed resolution, either by issuance of an administrative law judge's proposed order or by a proposed settlement of contests (State of Oregon 2010).

## **1.2.6 Klamath Hydroelectric Project and Relicensing**

### **1.2.6.1 Klamath Hydroelectric Project**

Constructed between 1911 and 1962, the Klamath Hydroelectric Project includes eight facilities: Iron Gate, Copco 1, Copco 2, J.C. Boyle, Fall Creek, and Keno Dams, and the East and West Side developments. The portion of the Klamath River that includes the four most downstream dams is referred to as the Klamath Hydroelectric Reach. Keno Dam was originally constructed to produce power, but hydropower facilities were never developed (PacifiCorp 2004b) and it currently has no generating facilities. Its primary purpose is to maintain water levels in Keno Impoundment/Lake Ewauna for gravity delivery of water into irrigation canals. Link River Dam was constructed for Reclamation's Klamath Project. Link River Dam is operated under Reclamation direction for regulating flows, storing water in Upper Klamath Lake, and hydropower production through the PacifiCorp's East and West Side powerhouses.

The purpose of the PacifiCorp Klamath Hydroelectric Project is power generation. PacifiCorp's total annual generation from the Klamath Hydroelectric Project is 716,800 megawatt-hours of electricity (FERC 2007). These dams were not designed to provide downstream flood protection or to provide water storage for drought relief (FERC 2007). The J.C. Boyle, Copco 1, and Copco 2 facilities are hydro peaking<sup>5</sup> operations and Iron Gate Dam is operated as a re-regulating facility, so that on a daily basis roughly as much water enters the Hydroelectric Reach as leaves the Hydroelectric Reach. Chapter 2 presents additional information about the physical characteristics of the Four Facilities.

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<sup>5</sup> Peaking: operation of a hydropower projects to meet peak electrical demands.

### **1.2.6.2 Federal Energy Regulatory Commission Relicensing**

The Klamath Hydroelectric Project is regulated by FERC. The original 1956 license for these dams expired in 2006. The dams have been operating under annual licenses since the original license expired. The annual license specifies the same conditions as the original license. The 1956 PacifiCorp license pre-dated environmental laws, and did not include prescriptions (Section 18 of the Federal Power Act [16 USC 811]) for fish passage over or around the dams; only J.C. Boyle Dam has fish passage facilities, but these fishways do not meet current criteria (Administrative Law Judge 2006).

On February 24, 2004, PacifiCorp filed an application with FERC for a new operating license for the Klamath Hydroelectric Project. FERC prepared a final EIS for relicensing the project, but no license has been issued. Currently, the relicensing proceeding is in abeyance<sup>6</sup>. Until a decision is made regarding its license application, PacifiCorp will continue to operate the dams under annual licenses from FERC.

As part of the process for the 2004 relicensing application, a variety of stakeholders (individuals, tribes, fishing interests, and conservation groups) expressed a strong desire that the four hydroelectric dams be decommissioned and removed to address declining fisheries in the lower Klamath River and reopen approximately 43 miles of blocked mainstem river habitat between Iron Gate and Keno Dams and hundreds of miles of stream habitat in Upper Basin tributaries. Fish considerations were a major subject during the relicensing process.

During relicensing, several agencies, led by the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, in addition to other agencies with 10(a) authorities, recommended to FERC under Section 10(a) authority of the Federal Power Act, removal of the Four Facilities as the preferred measure to protect declining Klamath River fisheries. Concurrently under Section 18 authority of the Federal Power Act, the Department of Commerce and DOI prescribed mandatory fishways and passage at each mainstem dam. Flows were conditioned from J. C. Boyle for riparian habitat, whitewater recreation, and attraction flows for fish passage by DOI under Section 4(e) authority. The fishway prescriptions by the Department of Commerce and the DOI were strongly supported by basin tribes, fishing interests, and conservation groups to address declining fisheries in the lower Klamath River and to reopen blocked habitat. The fishway prescriptions and the DOI's prescriptions were challenged by PacifiCorp and others under the Energy Policy Act of 2005, in a trial-type hearing that considered disputed issues of material fact relating to the prescriptions and conditions. The resulting Administrative Law Judge decision (*In the Matter of: Klamath Hydroelectric Project*, Docket Number 2006-NMFS-0001, September 27, 2006) found that the agencies met their burden of proof regarding most of the factual issues in dispute. FERC conducted environmental analysis of the proposed project, including the mandatory terms and conditions and prescriptions in 2007. However, the FERC relicensing proceedings are in abeyance at present; accordingly, the mandatory terms and conditions and fishway prescriptions, and the terms of Biological Opinions issued by the USFWS and NOAA Fisheries Service to FERC for the new license, have not been incorporated as terms of the Klamath Hydroelectric Project annual permits.

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<sup>6</sup> Abeyance: a state of temporary suspension

Before FERC may issue any new FERC license for the Klamath Hydroelectric Project, the states of Oregon and California must also issue water quality certification under Section 401 of the Clean Water Act. The California State Water Resources Control Board cannot issue certification until environmental documentation sufficient for consideration of the alternative of conditioning certification on dam removal, consistent with the requirements of the CEQA, is completed.

### **1.3 KHSA and KBRA**

The KHSA was an outcome of the FERC's Alternative Dispute Resolution Procedures as outlined in the Energy Policy Act of 2005<sup>7</sup> (18 C.F.R. 385.601, et seq.) wherein the parties elected to set aside differences to reach resolution on a settlement that is in furtherance of the interests of all of the parties. As established in Section 1.2 of the KHSA, many of the parties to the settlement maintain that removal will help restore basin resources and all Signatory parties agree that settlement is in the public interest. As also specified in the KHSA, and in compliance with applicable law, the Secretary is undertaking a scientific and environmental analysis of potential facilities removal, and connected actions under the KBRA. The Secretary acknowledges that full implementation of the KHSA will depend on factors not entirely within the control of the settling parties and that failure to implement the KHSA, like any proposed settlement, could lead to a resumption of the underlying new licensing proceeding for the Klamath Hydroelectric Project that is pending before the FERC. As a consequence, should the FERC proceeding resume for any reason, we want to remind the reader that the analysis in this EIS/EIR was undertaken pursuant to the KHSA for the purpose of implementation of this settlement and to inform the Secretary in his determination under the KHSA regarding dam removal. This analysis and its comparison of alternatives is being conducted pursuant to NEPA and CEQA and solely in support of the determination to be made by the Secretary pursuant to the KHSA, a negotiated settlement agreement. It is not prepared to inform any other determinations made or environmental documents prepared pursuant to NEPA or CEQA outside the KHSA framework, including FERC's determination in the Klamath Hydroelectric Project licensing proceeding, which is to determine whether, and if so, under what prescriptions, to issue a new license for the Klamath Hydroelectric Project, or the States' determinations including whether, and under what conditions, to issue a section 401 water quality certification for the Klamath Hydroelectric Project and associated environmental documents.

Negotiations leading to the KBRA began in 2005 after the water-related farming and fisheries crises occurred in 2001 and 2002. The negotiation process also coincided with PacifiCorp's 2004 relicensing application. The proposed KBRA was released in January 2008. The KHSA and KBRA are negotiated agreements and reflect the cooperative effort by more than 40 parties in the basin, representing different interest groups. The agreements were negotiated and written to be executed together and are referred to herein as the Klamath Settlement. Representatives of federal agencies, the states of California and Oregon, Indian Tribes, counties, farmers, and

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<sup>7</sup> Section 442 of the Energy policy Act of 2005, Pub. L. 109-58, SS 241, 119 Stat, 594, 67475 (Aug. 8, 2005) ("EPAAct") (codified in 16 U.S.C. SS 797 (e) and 811), and the underlying procedural regulations codified in 50 C.F.R. Part 221.

conservation and fishing groups agreed to the comprehensive solutions presented in the KHSA and KBRA<sup>8</sup>.

### 1.3.1 KHSA

The KHSA establishes the process for additional studies, including the development of a “Detailed Plan for Facilities Removal” (Detailed Plan) and environmental review to support the Secretary’s Determination as to whether removal of the four downstream-most dams on the Klamath River that are owned by PacifiCorp (1) will advance restoration of the salmonid fisheries of the basin, and (2) is in the public interest, which includes, but is not limited to, consideration of the potential impacts on affected local communities and tribes.

The KHSA also includes provisions for the interim operation of the Four Facilities by PacifiCorp and the process to transfer, decommission, and remove the dams.

#### 1.3.1.1 Detailed Plan and Other Studies

The Parties<sup>9</sup> to the KHSA agreed further studies were needed to determine if the actions specified under the KHSA were feasible.

These studies include analysis of the regional impacts of both the KHSA and the KBRA on water quality, economics, real estate, recreation, and biology.

#### From the KHSA...

“By March 31, 2012, the Secretary shall use best efforts to (i) determine whether the costs of Facilities Removal as estimated in the Detailed Plan, including the cost of insurance, performance bond, or similar measures, will not exceed the State Cost Cap, and (ii) otherwise complete his determination whether to proceed with Facilities Removal as described in Section 3.3.1, provided that any such determination shall not be made until the following conditions have been satisfied:

- A. Federal legislation, which in the judgment of the Secretary is materially consistent with Appendix E, has been enacted;
- B. The Secretary and PacifiCorp have agreed upon acceptable terms of transfer of the Keno facility pursuant to Section 7.5.2;
- C. The States of Oregon and California have authorized funding for Facilities Removal as set forth in Section 4 of this Settlement;
- D. The Parties have developed a plan to address the excess costs, consistent with Section 4.10 of the Settlement, if the estimate of costs prepared as part of the Detailed Plan (including the cost of insurance, performance bond, or similar measures) shows that there is a reasonable likelihood such costs are likely to exceed the State Cost Cap; and
- E. The Secretary has identified a DRE<sup>1</sup>-designate, and, if the DRE-designate is a non-federal entity: (i) the Secretary has found that the DRE-designate is qualified; (ii) the States have concurred in such finding; the (iii) the DRE-designate has committed, if so designated, to perform Facilities Removal within the State Cost Cap (KHSA Section 3.3.4).”

1 – DRE: Dam Removal Entity

<sup>8</sup> Although representatives of the federal agencies participated in negotiations for both the KHSA and the KBRA, federal agencies did not sign the KBRA.

<sup>9</sup> Parties: Signatories to the Klamath Hydroelectric Settlement Agreement.

In addition, the Secretary's Determination and concurrence from the states will also be based, in part, on a Detailed Plan that describes the following:

- Physical methods to remove the dams and achieve a free-flowing condition.
- As necessary and appropriate, plans for management, removal, and/or disposal of sediment, debris, and other materials.
- A plan for site remediation and restoration.
- A plan for measures to avoid or minimize adverse downstream impacts.
- A plan for compliance with all Applicable Laws, including anticipated permits and permit conditions.
- Estimated costs.
- A statement of measures to reduce risks of cost overruns, delays, or other impediments to Facilities Removal.
- The identification, qualifications, management, and oversight of a non-federal Dam Removal Entity (DRE), if any, that the Secretary may designate.

#### **1.3.1.2 State Cost Cap**

The KHSA sets a cost cap of \$450 million for removal of the Four Facilities. In addition, pending regulatory approval, the KHSA allows for PacifiCorp to recover the costs of the company's net investment in the facilities, the ongoing operating costs, and the costs of replacement power. The \$450 million would come from the State of California and PacifiCorp's ratepayers. Specifically, an amount not to exceed \$200 million would come from additional charges to PacifiCorp customers (residing in either state) and \$250 million from the sale of California bonds or other means at the discretion of California. The United States would not be responsible for the costs of facilities removal.

#### **1.3.1.3 Secretarial Determination**

The KHSA establishes a process for the Secretarial Determination. This process also includes decisions by the States of Oregon and California as to whether they concur with the Secretarial Determination. Implementation of the KHSA requires both federal legislation and for the Secretary to make a determination, in cooperation with the Secretary of Commerce and other federal agencies as appropriate, regarding facilities removal, particularly whether, in his judgment, the conditions of the KHSA have been satisfied, and whether facilities removal should proceed. This process includes existing and additional studies, environmental review, and the decision by the Secretary.

#### **Affirmative Determination**

If the Secretary finds that the removal of the facilities would advance restoration of the salmonid fisheries and is in the public interest, an Affirmation Determination, as defined under Section 3 of the KHSA, can be made. Once the Secretary has made an Affirmation Determination, California and Oregon would also provide notice to the Secretary and other parties within 60 days on whether each state concurs with the Affirmative Determination. The KHSA provides for each state to consider two factors when deciding to concur or not: 1) whether significant impacts identified in its environmental review can be avoided or mitigated as provided under its state law, and 2) whether facilities removal will be completed within the state cost cap (defined as the

collective maximum monetary contribution from the states of California and Oregon, described below and in Section 4.1.3 of the KHSA).

As part of an Affirmative Determination, the Secretary will also concurrently designate the entity that will serve as the DRE. The DRE, once identified, would develop a Definite Plan for Facilities Removal which would include all the information necessary to implement the Detailed Plan as well as the additional elements listed in KHSA Section 7.2.A. The Secretary must consult with the Parties to the KHSA prior to designating a non-federal DRE and receive concurrence from the states with that selection.

In addition to the decommissioning and removal of the Four Facilities, actions associated with an Affirmative Determination would include the transfer of Keno Dam ownership from PacifiCorp to DOI, which is analyzed as a connected action in this EIS/EIR.

### **Negative Determination**

If the Secretary determines not to proceed with facilities removal, the KHSA terminates unless the Parties can agree to a remedy for the issues leading to the Negative Determination<sup>10</sup>. Prior to adopting or public release of such a determination, the Secretary would notify the Parties of the tentative determination and its basis. The Parties would consider whether to amend the KHSA in a manner that would permit the Secretary to make an Affirmative Determination.

#### ***1.3.1.4 KHSA Implementation***

If an Affirmative Determination is made, PacifiCorp would transfer ownership of each facility when the DRE provides notice that all necessary permits and approvals have been obtained for removal of a facility, all contracts necessary for facility removal have been finalized, and facility removal is ready to commence. After the transfer, the DRE would remove the facilities. The target date to begin deconstruction is January 1, 2020.

### **Local Power**

Section 5 of the KHSA includes terms for collaborative efforts between PacifiCorp and the Parties to identify potential ways to reduce impacts of dam removal on local community power. However, the KHSA does not provide for specifics on this collaborative effort, and therefore is not included in the analysis presented in this EIS/EIR. For further information see Section 5 of the KHSA.

### **KHSA Interim Measures**

The KHSA includes interim measures for the operation of the Klamath Hydroelectric Project by PacifiCorp from the effective date of the agreement (February 18, 2010) or as otherwise specified for each interim measure. If the Secretary makes an Affirmative Determination, PacifiCorp would continue to perform the interim measures until decommissioning. If there is a Negative Determination or the KHSA terminates for other reasons prior to decommissioning, then the interim measures may generally cease, except for the purposes of the Clean Water Act or the Endangered Species Act. These measures include the implementation of measures

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<sup>10</sup> Negative Determination: A determination by the Secretary of the Interior under Section 3 of the Klamath Hydroelectric Settlement Agreement that facilities removal should not proceed.

included as part of PacifiCorp's Interim Conservation Plan<sup>11</sup>. Measures from the Interim Conservation Plan (see Appendix C of the KHSA) include funding for projects to enhance the survival and recovery of ESA-listed coho salmon, turbine venting to improve dissolved oxygen concentrations downstream of Iron Gate Dam, funding for the development and implementation of a Hatchery Genetics Management Plan for Iron Gate Hatchery, increased flow variability at Iron Gate Dam, and studies on fish disease.

Appendix D of the KHSA provides additional measures to be implemented during the interim period. These measures include funding restoration activities, increasing monitoring activities, removing the J.C. Boyle bypass barrier, funding water quality research, funding to the Bureau of Land Management for the land management measures in Appendix C of the KHSA, possibly removing three diversions on Shovel and Negro Creeks, and funding for Iron Gate Hatchery operations and maintenance (including funding for an 8-year period after removal of Iron Gate Dam).

### **Yreka Water Supply**

The City of Yreka has a municipal water supply intake on Fall Creek and a pipeline that crosses Iron Gate Reservoir; the pipeline would be affected if the Iron Gate Dam were removed. The KHSA addresses the possible impacts that facilities removal would have on the water supply pipeline for the City of Yreka and provides provisions for mitigation of impacts on this supply system. Signatories agree not to prevent use of Yreka's Water Rights permit and will study the potential risks to the water supply system from facilities removal. Necessary actions for the continued use of the Yreka water supply infrastructure would be funded and implemented as part of implementation of the KHSA (Section 7.2.3).

### **Keno Facilities Transfer**

The KHSA calls for transferring ownership and operation of Keno Dam from PacifiCorp to DOI. The Secretary and PacifiCorp are studying the proposed transfer of Keno facilities (the Keno Transfer). An Affirmative Determination by the Secretary depends on an agreement between the Secretary and PacifiCorp on terms for transfer of title of the Keno facility. Further, transfer of title shall be subject to completion of any necessary improvements to the facility to meet DOI directives and standards for dam safety identified by the DOI through its safety of dams inspection of the Keno facility. This EIS/EIR will analyze the impacts associated with the Keno Transfer as a connected action.

### **East and West Side Powerhouse Decommissioning**

PacifiCorp's East and West Side facilities were proposed for decommissioning in PacifiCorp's 2004 relicensing application, and their decommissioning through the FERC process is described in the KHSA (KHSA 6.4.1(B)). Removing the two facilities would result in the loss of 3.8 megawatts of generating capacity and the removal of the generating infrastructure. The dams and associated infrastructure were built in 1921, and would require upgrading and maintenance to remain in compliance with DOI and FERC standards. This would include the installation of

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<sup>11</sup> As described in the KHSA, the Interim Conservation Plan was developed by PacifiCorp through technical discussions with the NOAA Fisheries Service and the USFWS describing measures for the enhancement of coho salmon and suckers listed under the ESA (see KHSA Appendix A). The Interim Conservation Plan was submitted to FERC on November 25, 2008 and can be found online through the FERC website. (<http://ferc.gov>).

fish screens, which would require major construction changes and associated maintenance. The Link River Dam, which is the point of diversion for the two generating facilities, is already owned by Reclamation.

As noted above, the East and West Side facilities decommissioning is not dependant on an Affirmative Determination, and will be carried out through application to the FERC. This application will require future environmental compliance analysis and a FERC determination.

### **1.3.2 KBRA**

As a result of the Klamath Basin issues surrounding the limited availability of water to support agricultural, tribal, environmental, and fishery needs in many years, the United States<sup>12</sup>; the States of California and Oregon; the Klamath, Karuk, and Yurok Tribes; Klamath Project Water Users; and other Klamath Basin stakeholders (collectively the Parties) negotiated the KBRA to resolve the water conflicts among the many users, restore stressed fisheries, and identify reliable power supplies. The KBRA is intended to result in effective and durable solutions. The goals of the KBRA are to (1) restore and sustain natural fish production and provide for full participation in ocean and river harvest opportunities of fish species throughout the Klamath Basin; (2) establish more reliable water and power supplies which sustain agricultural uses, communities, and NWRs; and (3) contribute to the public welfare and the sustainability of all Klamath Basin communities. The Parties view these agreements as an important part of the resolution of long-standing, complex, and difficult-to-resolve concerns over resources in the Klamath Basin.

Negotiations leading to the KBRA began in 2005 after the water-related farming and fisheries crises occurred in 2001 and 2002. The negotiation process also coincided with PacifiCorp's 2004 relicensing application. The proposed KBRA was released in January 2008. The KBRA includes plans and programs that interrelate with each other and with facilities removal as contemplated by the KHSA, and is intended to benefit fish throughout the basin, water users in the Upper Klamath Basin, and the community overall. The KBRA brings many parties together, including federal and state agencies, Indian Tribes, Reclamation's Klamath Project irrigators, and on- and off-Project water users to support one another's efforts to restore fish populations in the Klamath Basin and provide for sustainable communities with a strong agricultural base. The KBRA has required each party to make some concessions in order to secure assurances on other important interests. These compromises include:

- Through the agreement, the Klamath, Karuk, and Yurok Tribes, the signatory tribes, have agreed to not fully exercise their senior water rights to achieve fisheries restoration and to withdraw claims for damages due to the loss of those fisheries. Under the KBRA, the tribes would benefit from a suite of fisheries restoration and reintroduction measures that would complement dam removal pursuant to the KHSA, improvements in water quantity and quality in the lakes and rivers of the basin, and other habitat improvements that would support a sustainable fishery throughout the basin.

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<sup>12</sup> Agencies involved in KBRA negotiations include: NOAA Fisheries Service, U.S. Forest Service, U.S. Department of the Interior (including, the Bureau of Indian Affairs, Bureau of Land Management, Bureau of Reclamation, and Fish and Wildlife Service).

- Most water users and irrigators, both on-Project and off-Project, agreed to limit their water diversions in exchange for increased predictability about seasonal water deliveries and affordable power supplies. Increased predictability allows individual landowners to more efficiently plan annual operations and avoid the economic impacts that result from uncertainty. The economic impacts felt at the individual level ripple up through the whole community, so this increased certainty benefits everyone. As reintroductions of currently threatened and endangered fish species are successfully implemented, the KBRA envisions that landowners will benefit from regulatory assurances that their operations would not be additionally burdened by new regulatory restrictions to the extent legally possible.

Under this system of compromises, the question of who “goes first” becomes critical. Some of the provisions in the agreement may take over 10 years to be implemented and so many of the proposed actions need to be started in good faith. The KBRA establishes a framework for interim actions and planning efforts that would involve the broader community and protect the Parties’ interests during the interim period. The interim period is the time between the signing of the KBRA and full implementation of the limits on water diversions to Reclamation’s Klamath Project. The plans and programs described in the KBRA lead through a series of milestones that culminate in the formal relinquishment of claims for damages, permanent assurances related to tribal water rights, and limitations on water diversions to Reclamation’s Klamath Project.

An Affirmative Determination and federal authorizing legislation are two early key milestones towards full implementation of the KBRA. Following an Affirmative Determination, the key milestones leading to the publication of a Secretarial Notice, which make federal water assurances permanent and is a prerequisite to other water rights assurances and diversion limitations, are described below:

- 1) “The application deadline under Section 15.3.8.A for full implementation of the On-Project Plan has passed
- 2) The required environmental analysis regarding the proposed project to reconnect the Wood River Wetlands to Upper Klamath Lake as described in Section 18.2.3 is completed, and any necessary funding to implement the preferred alternative of the required environmental analysis is authorized by Congress or that funding is otherwise committed by state, local, tribal, or private sources
- 3) The required environmental analysis regarding the proposed project to reconnect Agency Lake and Barnes Ranches to Upper Klamath Lake as described in Section 18.2.2.C is completed, and any necessary funding to implement the preferred alternative of the required environmental analysis is authorized by Congress or that funding is otherwise committed by state, local, tribal or private sources
- 4) Funding has been authorized for the Water Use Retirement Program described in Section 16.2.2; and
- 5) The physical removal of all or part of each of the Hydroelectric Facilities has occurred and achieved a free-flowing condition and volitional fish passage.” (KBRA Section 15.3.4.A)

Following publication of the Secretarial Notice, the Klamath, Karuk, and Yurok Tribes would make appropriate filings making tribal water rights assurances permanent and releasing breach of trust claims against the federal government. The key milestones that lead towards these tribal concessions include the following:

- 1) Federal authorizing legislation enacted
- 2) Publication of the Secretarial Notice and its associated milestones
- 3) Funding secured for implementation of the Phase I and Phase II Fisheries Restoration Plans, Phase I Fisheries Reintroduction Plans, Fisheries Monitoring Plan, the voluntary Water Use Retirement Program, and the Interim Flow and Lake Level Protection Program and Regulatory Assurance Programs
- 4) Funding secured for tribal resource management programs and for the Mazama Forest purchase
- 5) Removal of the hydroelectric facilities as provided under the KHSA
- 6) Approval of The Klamath Tribes request for an interim fishing site between Iron Gate Dam and I-5

**Programmatic Analysis**

For purposes of CEQA, the KBRA analysis is programmatic, as described in Section 15168 of the CEQA Guidelines. A program-level document is appropriate when a project consists of a series of smaller projects or phases that may be implemented separately. Under the programmatic EIR approach, future projects or phases may require additional, project-specific environmental analysis.

**Analysis Completed in this Document**

KHSA – Project Level  
 Keno Transfer – Project Level  
 KBRA – Programmatic Level  
 East Side and West Side Powerhouse Decommissioning – Programmatic Level  
 Trap and Haul around Keno Impoundment – Programmatic Level

Once the federal and tribal water rights assurances have been made permanent, the diversion limits on Reclamation’s Klamath Project, including a Refuge Allocation, would become permanent.

The federal lead agency is analyzing the KBRA as a connected action. NEPA defines connected actions as those actions that are closely related or cannot or will not proceed unless other actions are taken previously or simultaneously (40 CFR 1508.25(a)(1)(ii)).<sup>13</sup> Some actions or component elements of the KBRA are independent obligations and thus have independent utility from the KHSA, but the implementation of several significant elements of the KBRA package would be different, if the determination under the KHSA is not to pursue full dam removal (see Table 1-1). Recognizing that implementation of many elements of the KBRA are unknown and not reasonably foreseeable at this time, the connected action analysis is being undertaken at a programmatic level. Consequently, appropriate NEPA compliance will be completed for the KBRA in the future. The KBRA and KHSA are available in their entirety from the web site [klamathrestoration.gov](http://klamathrestoration.gov).

**Table 1-1. Linkage of KBRA Programs, Plans, Commitments to Dam Removal<sup>1</sup>**

Program, Plan, or Commitment	Linked to Dam Removal and Secretarial Determination	KBRA Programs Included in this analysis as a Connected Actions under NEPA
<b>Fisheries Programs:</b>		
Fish Habitat Restoration Activities	T	
Fisheries Restoration Phase I Plan	T	
Fisheries Restoration Phase II Plan	T	
Fisheries Reintroduction Plan – Phase I, Oregon	T	
Fisheries Reintroduction Plan – Phase II, Oregon	T	
Fisheries Reintroduction Plan – California	T	
Fisheries Monitoring Plan	T	
Additional Water Storage Projects:		X
Williamson River Delta Project		X
Agency Lake and Barnes Ranches Project		X
Wood River Wetland Restoration Project		X
Future storage opportunities		X
<b>Water Resources Program:</b>		
Water Diversion Limitations for Reclamation’s Klamath Project Including National Wildlife Refuges	O	
Water Deliveries for National Wildlife Refuges in Klamath Reclamation Project Area	O	
Groundwater Technical Investigations		X
On-Project Plan		X
Commitments among Project Irrigators, Party Tribes, and U.S. Related to Water Use/Rights	O	
Commitments Related to Finance Issues (§§ 15.4.2., 15.4.4.)		X
Operation of Klamath Reclamation Project Facilities (Link River and Keno Dams)	O	
Water Use Retirement Program (WURP)		X
Off-Project Water Settlement (OPWAS)		X
Off-Project Reliance Program		X
Power for Water Management Program and Plans		X

<sup>13</sup> We acknowledge, however, that the KBRA could also be analyzed as a cumulative or similar action under 40 CFR 1508.25(a)(2) and (3). We note that all three definitions (connected action, cumulative actions, and similar actions) are within the section that provides parameters for the “scope” of the action, which determines both the range of alternatives and the impacts to be considered in an EIS. Ultimately, however, we believe the important point is not the labeling but the analysis and whether the decision (in this case whether to remove four dams) is informed by an EIS that is proper in scope.

**Table 1-1. Linkage of KBRA Programs, Plans, Commitments to Dam Removal<sup>1</sup>**

Program, Plan, or Commitment	Linked to Dam Removal and Secretarial Determination	KBRA Programs Included in this analysis as a Connected Actions under NEPA
Drought Plan		X
Emergency Response Plan		X
Climate Change Assessment		X
Environmental Water Management		X
Interim Flow and Lake Level Program		X
<b>Regulatory Assurances Programs:</b>		
Fish Entrainment Reduction	T	
General Conservation Plan or Habitat Conservation Plan	T	
<b>County and Tribal Programs:</b>		
Klamath County Economic Development Plan		X
California Water Bond Legislation (Siskiyou County Economic Development Funding)	O	
Tribal Programs Fisheries and Conservation Management		X
Tribal Programs Economic Revitalization		X
Mazama Forest Project		X
Klamath Tribes Interim Fishing Site		X

## Notes

**T** means timing is related to dam removal or Secretarial Determination

**O** means other relationship to dam removal or Secretarial Determination through funding or other key milestones described in the KBRA

**X** means this Program, Plan, or Commitment is considered a connected action under NEPA for this analysis

<sup>1</sup> As explained above, for purposes of this EIS/EIR, we have determined that the KBRA should be evaluated in its entirety as a connected action. The purpose of this table is to show those individual activities under the KBRA that are not linked to the removal of the four facilities in order to provide an understanding of the potential effect to the KBRA in the absence of facilities removal. It shows those individual KBRA activities that are expressly linked to removal of the four facilities and those individual activities under the KBRA that are not linked to facilities removal. In the absence of facilities removal these activities may still proceed independently but the KBRA will not include all of the components present in its current form and some activities could be substantially altered or even avoided by parties who seek dam removal as a primary pre-condition for the commencement of their obligations. While we have decided to analyze the KBRA in its entirety as a connected action, we believe it also appropriate to show the relationship to dam removal of each of its component parts.

## **1.4 NEPA/CEQA**

### **1.4.1 NEPA/CEQA Requirements**

This document is a joint EIS/EIR, developed to satisfy the requirements of both NEPA and CEQA by disclosing to decision-makers and the public, significant environmental impacts of the Proposed Action, identifying feasible mitigation measures, and describing a reasonable range of alternatives prior to rendering any final decisions or issuing any permits, agreements, or authorizations on the Proposed Action. For the purposes of NEPA/CEQA analysis, the Proposed Action is to remove the four lower PacifiCorp dams on the Klamath River. As explained in Section 1.3.2, the KBRA and other actions (Keno Dam transfer) are being discussed programmatically as actions to the Proposed Action. It is anticipated that additional CEQA analyses will be necessary prior to dam removal as contemplated in the KHSA.

The impact analysis in this EIS/EIR addresses short-term and long-term effects of the Proposed Action and alternatives to the Proposed Action that would occur from the time that the record of decision is signed through the end of the deconstruction period. The EIS/EIR also includes the analysis of the Keno Facility Transfer and the KBRA. Analysis of the KBRA as it relates to the Secretarial Determination extends, where possible, for 50 years through 2060, the term of the agreement. This analysis of KBRA is being completed at a programmatic level. Certain effects of actions contained in KBRA and KHSA are expected to extend beyond 50 years.

This EIS/EIR has been prepared by the DOI, as lead NEPA agency, and the CDFG, as lead CEQA agency (collectively referred to herein as the Lead Agencies). Recognizing that elements of the Proposed Action would occur in California and Oregon, CDFG collaborated with DOI to, with input from the State of Oregon, make a reasonable, good faith effort in disclosing all significant environmental effects of the Proposed Action. Absent certain circumstances, CEQA does not apply to any project or portion thereof located outside of California which will be subject to environmental review pursuant to NEPA (Public Resources Code § 21080(b)(14); CEQA Guidelines § 15277).

NEPA requires the lead federal agency to request the participation of other government agencies or Indian Tribes with jurisdiction by law or special expertise, collectively referred to as Cooperating Agencies. Table 1-2 lists the governmental entities and Indian Tribes that have agreed to be Cooperating Agencies in the preparation of the EIS/EIR.

CEQA requires a lead agency to identify a list of agencies that are expected to use the EIR in their decision-making. For the Proposed Action, CDFG anticipates that the California Coastal Commission, The California State Water Resources Control Board, and the California North Coast Regional Water Quality Control Board will use this EIS/EIR in their decision-making.

**Table 1-2. Cooperating Agencies**

<b>Agency/Entity</b>
National Oceanic and Atmospheric Administration Fisheries Service
U.S. Forest Service
U.S. Environmental Protection Agency
Karuk Tribe
The Klamath Tribes
Quartz Valley Indian Reservation
Resighini Rancheria
Yurok Tribe
Hoopa Valley Tribe
Humboldt County
Trinity County
California State Water Resources Control Board
California North Coast Regional Water Quality Control Board
Oregon Department of Environmental Quality
Oregon Department of State Lands
Oregon Department of Fish and Wildlife
Oregon Water Resources Division
Klamath River Compact Commission
Klamath Water and Power Authority

## **1.4.2 Purpose and Need/Project Objectives**

### **1.4.2.1 Purpose and Need**

The stated Purpose and Need statement below has changed since the publication of the Notice of Intent in order to provide further clarification. These changes are not substantive and do not change any alternatives.

The Proposed Action is to remove the four lower PacifiCorp dams on the Klamath River. The need for the Proposed Action is to advance restoration of the salmonid fisheries in the Klamath Basin consistent with the KHSA and the connected KBRA. The purpose is to achieve a free flowing river condition and full volitional fish passage as well as other goals expressed in the KHSA and KBRA. By the terms of the KHSA, the Secretary will determine whether the Proposed Action is appropriate and should proceed. In making this determination, the Secretary will consider whether removal of the Four Facilities will advance the restoration of the salmonid fisheries of the Klamath Basin, and is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes.

### **1.4.2.2 Project Objectives**

This Draft Environmental Impact Report (Draft EIR) is prepared in accordance with the California Environmental Quality Act (CEQA, Public Resources Code section 21000 et seq.) to evaluate the potential environmental impacts associated with the implementation of the KHSA and KBRA to inform decision makers, including the Governor of the State of California, representatives of affected and responsible agencies, the public, and other interested parties of the potential environmental effects that may result from implementation of the Agreements as proposed. This Draft EIR describes potential impacts relating to a wide variety of environmental issues and methods by which these impacts can be mitigated or avoided.

As required by CEQA, a lead agency must identify the objectives sought by the proposed project. For this project, CDFG as lead agency has identified the following objectives:

1. Advance restoration of the salmonid fisheries in the Klamath Basin.
2. Restore and sustain natural production of fish species throughout the Klamath Basin in part by restoring access to habitat currently upstream of impassable dams.
3. Provide for full participation in harvest opportunities for sport, commercial, and tribal fisheries.
4. Establish reliable water and power supplies, which sustain agricultural uses and communities and NWRs.
5. Improve long-term water quality conditions consistent with designated beneficial uses.
6. Contribute to the public welfare and the sustainability of Klamath Basin communities.
7. To be consistent with the goals and objectives of KHSA and KBRA.

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# Chapter 2

## Proposed Action and Description of the Alternatives

This chapter includes an overview of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) requirements for a project description. It also includes a description of the alternatives formulation process to select a reasonable range of alternatives and a description of the Proposed Action and alternatives to the Proposed Action.

### 2.1 NEPA Requirements

Federal law outlines the required components of the “alternatives” section of an Environmental Impact Statement (EIS) (40 CFR Part 1502.14), which include the following:

- (a) Rigorous exploration and objective evaluation of all reasonable alternatives, and for alternatives which were eliminated from study, a brief discussion of the reasons for their having been eliminated.
- (b) Substantial treatment of each alternative considered in detail, including the proposed action, so that reviewers may evaluate their comparative merits.
- (c) Inclusion of reasonable alternatives that are not within the jurisdiction of the lead agency.
- (d) Inclusion of the alternative of no action.
- (e) Identification of the agency’s preferred alternative or alternatives, if one or more exists, in the draft statement and identification of such alternative in the final statement unless another law prohibits the expression of such a preference.
- (f) Inclusion of appropriate mitigation measures that are not already included in the proposed action or alternatives.

### 2.2 CEQA Requirements

The CEQA Guidelines<sup>1</sup> developed by the California Natural Resources Agency include prescriptive requirements for the components of the “project description” section of an Environmental Impact Report (EIR). The required components from Section 15124 of the CEQA Guidelines are listed below. Table 2-1 indicates the chapter and section in which each component is included in this EIS/EIR.

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<sup>1</sup> Title 14, California Code of Regulations, §§ 15000–15387.

(a) The precise location and boundaries of the proposed project shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on a regional map.

(b) The document will include a statement of objectives sought by the proposed project. A clearly written statement of objectives will help the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision-makers in preparing findings or a statement of overriding considerations, if necessary. The statement of objectives should include the underlying purpose of the project.

(c) A general description of the project’s technical, economic, and environmental characteristics, considering the principal engineering proposals, if any, and supporting public service facilities.

(d) A statement briefly describing the intended uses of the EIR.

(1) This statement shall include the following, to the extent that the information is known to the lead agency:

(A) A list of the agencies that are expected to use the EIR in their decision-making.

(B) A list of permits and other approvals required to implement the project.

(C) A list of related environmental review and consultation requirements required by federal, state, or local laws, regulations, or policies. To the fullest extent possible, the lead agency should integrate CEQA review with these related environmental review and consultation requirements.

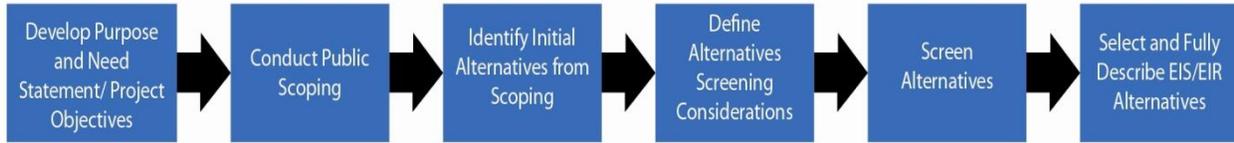
(2) If a public agency must make more than one decision on a project, all its decisions subject to CEQA should be listed, preferably in the order in which they occur.

**Table 2-1. Location of CEQA Guidelines  
Section 15124 Project Description Components**

Component	Location
(a) Map of project location and Boundaries	Section 1.1
(b) Project objectives	Section 1.4.2
(c) General description of the project’s characteristics	Section 2.4.3
(d) Statement of the intended uses of the EIR	Section 1.4.1
(d)(1)(B) A list of permits and other approvals required to implement the project	Chapters 6 and 7

## 2.3 Alternatives Development

Both NEPA and CEQA require EIS/EIRs to identify a reasonable range of alternatives and provide guidance on the identification and screening of such alternatives. For this EIS/EIR, the Lead Agencies followed a structured, documented process to identify and screen alternatives for inclusion in the EIS/EIR. Figure 2-1 illustrates the process that the Lead Agencies conducted to identify and screen alternatives.



**Figure 2-1. Alternatives Development and Screening Process**

During public scoping, the public provided input regarding potential alternatives to the Proposed Action. The Lead Agencies reviewed the purpose and need/project objectives statement, public scoping comments, and previous studies in their initial effort to develop conceptual alternatives. This resulted in an initial list of action alternatives described in Appendix A, Alternatives Formulation Report. The initial list included more than 18 alternatives; however, some were determined to have limited functionality as full alternatives because they focused on techniques for improving natural resources conditions that are already a part of the Klamath Basin Restoration Agreement (KBRA) and were screened out. The Lead Agencies then developed and applied a set of screening considerations to determine which alternatives should move forward for further analysis. Some alternatives were evaluated based on preliminary analysis conducted during the EIS/EIR development, as discussed in Appendix A.

Both NEPA and CEQA include provisions that alternatives meet (or meet most of) the purpose and need/project objectives, and be potentially feasible. Under CEQA, alternatives do not need to meet all of the project objectives; alternatives should be included if they can meet most of the objectives and avoid or substantially lessen significant environmental impacts of the project. The alternatives that moved forward for more detailed analysis in this EIS/EIR are those that best meet the NEPA purpose and need and CEQA objectives, minimize negative effects, are feasible, and represent a range of reasonable alternatives. Some alternatives do not fully meet the purpose and need/project objectives, but they have potential to minimize some types of environmental effects or help create a reasonable range of alternatives for consideration by decision-makers. Table 2-2 presents the screening results for the 18 initial alternatives. A full description of the alternatives and the rationale for screening the alternatives is presented in Appendix A, the Alternatives Formulation Report.

Alternatives may have moved forward for detailed analysis in the EIS/EIR if they do not fully meet the purpose and need/project objectives but may be able to reduce environmental effects or help create a reasonable range of alternatives.

**Table 2-2. Initial Alternatives**

<b>Alternative Number</b>	<b>Alternative Name</b>	<b>Description</b>	<b>Screening Result</b>
Alternative 1	No Action/ No Project	Implement none of the action alternatives; Klamath Hydroelectric Project would continue current operations.	Alternative 1 moved forward to the EIS/EIR for further review because it is required under NEPA and CEQA.
Alternative 2	Full Facilities Removal of Four Dams (Proposed Action)	Remove four dams and related facilities.	Alternative 2 moved forward to the EIS/EIR for further review because it fully meets the purpose and need/project objectives.
Alternative 3	Partial Facilities Removal of Four Dams	Remove main areas of four dams to allow a free-flowing river and volitional fish passage; related facilities and/or abutments may remain.	Alternative 3 moved forward to the EIS/EIR for further review because it fully meets the purpose and need/project objectives.
Alternative 4	Fish Passage at Four Dams	Construct fish passage facilities to provide upstream and downstream passage at four dams.	Alternative 4 has been retained for further analysis because the No Action alternative, per the requirements of NEPA, may not presume the types of conditions that FERC might require should it re-issue a license under the Federal Power Act. Consequently, without this alternative, there would be no analysis in this document on fish passage. The lead agencies believe it is appropriate to include in the alternatives for further consideration our best assessment of probable fish passage. By bringing the fish passage alternative forward, the public will be better informed, which will in turn help foster better decision-making by the Secretary, all of which being consistent with the goals of NEPA.
Alternative 5	Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate	Remove Copco 1 and Iron Gate Dams, construct fish passage at J.C. Boyle and Copco 2 Dams.	While Alternative 5 does not fully meet the purpose and need/project objectives, it moved forward to the EIS/EIR for further review because it could lessen potential construction-related environmental and power generation effects of the Proposed Action. Additionally, it would lessen water quality effects of the two larger reservoirs. Consideration of this alternative would give the Secretary a reasonable range of alternatives to inform decision-making.
Alternative 6	Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate	Remove Copco 1, Copco 2, and Iron Gate Dams, construct upgraded fish passage at J.C. Boyle.	The EIS/EIR will fully analyze effects of removing all dams, constructing fish passage facilities at all dams, and a combination of these measures as a part of Alternatives 2, 4, and 5. Potential effects of Alternative 6 will be fully analyzed through these other alternatives. Alternative 6 will not move forward for further analysis.
Alternative 7	Sequenced Removal of Four Dams	Sequence dam removal over three to five years.	Alternative 7 will not be carried forward for more detailed analysis in the EIS/EIR because it would not reduce environmental effects of the Proposed Action, and may increase effects to fish associated with sediment release from the reservoirs over multiple years.

**Table 2-2. Initial Alternatives**

<b>Alternative Number</b>	<b>Alternative Name</b>	<b>Description</b>	<b>Screening Result</b>
Alternative 8	Full Facilities removal of Four Dams without KBRA	Remove four dams and related facilities but do not implement KBRA elements.	Alternative 8 will not be carried forward for more detailed analysis in the EIS/EIR because it does not meet most of the purpose and need/project objectives and would not reduce environmental effects of the Proposed Action. The effects of removing the four dams and related facilities will be fully analyzed under Alternative 2.
Alternative 9	Trap and Haul Fish	Capture fish at Iron Gate Dam and transport them upstream of J.C. Boyle Dam.	Alternative 9 will not move forward for further analysis because it does not meet the purpose and need under NEPA or most of the project objectives under CEQA.
Alternative 10	Fish Bypass: Bogus Creek Bypass	Create fish bypass using Bogus Creek, Cold Creek, Little Deer Creek, and a constructed canal to connect to Copco 1 Reservoir.	Alternative 10 will not move forward for more detailed analysis in the EIS/EIR because it does not meet any elements of the purpose and need under NEPA or project objectives under CEQA.
Alternative 11	Fish Bypass: Alternative Tunnel Route	Create fish bypass using Bogus Creek and a 5-mile tunnel to connect to Copco Reservoir.	Alternative 11 will not move forward for more detailed analysis in the EIS/EIR because it does not meet any elements of the purpose and need under NEPA or project objectives under CEQA.
Alternative 12	Notching Four Dams	Notch four dams to create a free-flowing river.	Alternative 12 is very similar to Alternative 3, and would result in the same type of impacts. Therefore, this alternative will not move forward for more detailed analysis in the EIS/EIR as a separate alternative.
Alternative 13	Federal Takeover of Project	Use authority of the Federal Power Act for government to take over dams and initiate removal.	Alternative 13 will not move forward for more detailed analysis in the EIS/EIR because the environmental impacts would be generally the same (and have generally the same timeframe) as those under Alternative 2.
Alternative 14	Full Removal of Five Dams	Remove Keno Dam in addition to four downstream dams.	Alternative 14 will not be carried forward for more detailed analysis in the EIS/EIR because it does not fully meet the purpose and need/project objectives (because it is not consistent with the KHSA) and it would not avoid or lessen potential adverse environmental effects of the Proposed Action.
Alternative 15	Full Removal of Six Dams	Remove Keno and Link River Dams in addition to four downstream dams.	Alternative 15 will not be carried forward for more detailed analysis in the EIS/EIR because it does not fully meet the purpose and need/project objectives (because it is not consistent with the KHSA) and it would not avoid or lessen potential environmental effects of the Proposed Action. Implementation of Alternative 15 would also not be likely to meet Endangered Species Act requirements or tribal trust water rights within Upper Klamath Lake.
Alternative 16	Dredge Upper Klamath Lake	Remove sediments in Upper Klamath Lake to remove phosphorus and increase storage capacity.	Alternative 16 will not move forward for more detailed analysis in the EIS/EIR because it does not meet the purpose and need under NEPA or most of the project objectives under CEQA.

**Table 2-2. Initial Alternatives**

<b>Alternative Number</b>	<b>Alternative Name</b>	<b>Description</b>	<b>Screening Result</b>
Alternative 17	Predator Control	Control seal, sea lion, and cormorant populations that are salmonid predators.	Alternative 17 will not move forward for more detailed analysis in the EIS/EIR because it does not meet the purpose and need under NEPA or project objectives under CEQA. Moreover, it would be difficult to permit because of biological concerns.
Alternative 18	Partition Upper Klamath Lake	Create an “inner lake” that may improve water quality.	Alternative 18 will not move forward for more detailed analysis in the EIS/EIR because it does not meet the purpose and need under NEPA or project objectives under CEQA.

Key:  
 CEQA: California Environmental Quality Act  
 EIS/EIR: Environmental Impact Statement/Environmental Impact Report  
 FEIS: Federal Energy Regulatory Commission Environmental Impact Statement  
 FERC: Federal Energy Regulatory Commission  
 KBRA: Klamath Basin Restoration Agreement  
 KHSA: Klamath Hydroelectric Settlement  
 NEPA: National Environmental Policy Act

The Klamath Hydroelectric Settlement Agreement (KHSA) Section 3.2.1(iii), signed by Secretary of the Interior Ken Salazar on February 18, 2010, directs the Secretary to undertake environmental review in support of the Secretarial Determination. All alternatives carried forward for further analysis in the EIS/R were analyzed using existing studies and other appropriate data as suggested in KHSA Section 3.2.1 (i), where such analysis met criteria in (40 CFR 1502.22 and 43 CFR 46.125) to incorporate available information. As part of developing the basis for the Secretarial Determination, the KHSA requires in Section 3.3.2 that the Secretary prepare a Detailed Plan, including the identification, qualifications, management, and oversight of a non-federal DRE, if any, that the Secretary may designate. KHSA Section 3.3.4.D requires that an estimate of costs be prepared as part of the Detailed Plan. The Detailed Plan analysis provides most of the information for the project description for Alternatives 2 and 3, and this information was used to analyze these two action alternatives. As described in KHSA Section 3.2.1(i), the FERC record is used to form the project description for Alternatives 4 and 5. Alternatives 4 and 5 were analyzed to ensure that the review of reasonable fish passage alternatives was comprehensive. In addition, at the time of developing a reasonable range of alternatives, the lead agencies recognized that the inclusion of Alternatives 4 and 5 would provide an assessment of the short- and long-term effects from a broader range of reasonable alternatives, as defined under CEQA. Alternatives 4 and 5 are outside the authority of the Department of the Interior, the four facilities proposed for removal are privately owned structures, and there was no provision in the KHSA to include them in the Detailed Plan. The result is differing levels of available information for alternatives carried forward in the EIS/R consistent with the elements of each action alternative.

As a result of the initial alternative screening, four action alternatives and the No Action/No Project alternative were selected to move forward for analysis in the EIS/EIR. Table 2-3 presents the alternatives carried forward for analysis in the EIS/EIR. These alternatives represent a reasonable range of alternatives for analysis to provide context for decision-makers. Analysis

of these alternatives will provide the Secretary with information needed to make a decision, and potentially to mix and match elements of the alternatives, if needed, to create an alternative that would reduce environmental impacts and increase environmental benefits.

**Table 2-3. Alternatives Selected for Analysis in EIS/EIR**

<b>Alternative Number</b>	<b>Alternative Name</b>	<b>Description</b>
Alternative 1	No Action/ No Project	Implement none of the action alternatives; Klamath Hydroelectric Project would continue current operations.
Alternative 2	Full Facilities Removal of Four Dams (Proposed Action)	Remove four dams and related facilities.
Alternative 3	Partial Facilities Removal of Four Dams	Remove main areas of four dams to allow a free-flowing river and volitional fish passage; related facilities and/or abutments may remain.
Alternative 4	Fish Passage at Four Dams	Construct fish passage facilities to provide upstream and downstream passage at four dams.
Alternative 5	Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate	Remove Copco 1 and Iron Gate Dams, construct fish passage at J.C. Boyle and Copco 2 Dams.

## 2.4 Proposed Action and Alternatives

The following sections describe the alternatives under evaluation in this EIS/EIR. Appendix A includes more detailed descriptions of these alternatives.

### 2.4.1 Facilities Common to All Alternatives

All of the alternatives, except for the No Action/No Project Alternative, include actions at the Four Facilities of the Klamath Hydroelectric Project: the J.C. Boyle, Copco 1, Copco 2, and Iron Gate dam sites. Table 2-4 outlines characteristics of the Four Facilities.

**Table 2-4. Dam and Powerhouse Components**

	<b>J.C. Boyle</b>	<b>Copco 1</b>	<b>Copco 2</b>	<b>Iron Gate</b>
Dam type	Concrete and earthfill embankment	Concrete	Concrete	Earthfill embankment
Dam maximum height	68 feet	135 feet	33 feet	189 feet
Dam crest length	692 feet	410 feet	335 feet	740 feet
Reservoir surface area	420 acres	1,000 acres	N/A	944 acres
Reservoir storage volume	2,629 acre-feet	40,000 acre-feet	73 acre-feet	53,800 acre-feet
Type of facility to allow water to flow past dam	Overflow spillway with control gates and diversion culvert	Overflow spillway with control gates and diversion tunnel	Overflow spillway with control gates	Uncontrolled overflow spillway and diversion tunnel

Source: Federal Energy Regulatory Commission (FERC) 2007; Department of the Interior (DOI) 2011

Each of the facilities generates power using various methods for water delivery to the power generation facility as summarized in Table 2-5.

**Table 2-5. Power Generation Facilities**

	<b>J.C. Boyle</b>	<b>Copco 1</b>	<b>Copco 2</b>	<b>Iron Gate</b>
<b>Type of facility to divert water for power generation</b>	Concrete tower with screened water intake	Intakes at upstream end of dam	Diversion intake with gate	Concrete tower with water intake
<b>Water conveyance system to power generation facility</b>	638 feet of steel pipe (14-foot diameter), 2 mile concrete flume, 1,660 foot tunnel, and into two 10.5 foot penstock pipes 956 feet long	Two 10-foot and one 14-foot diameter penstock pipes	2,440 feet of concrete-lined tunnel, 1,313 feet of wood-stave pipeline, 1,110 feet of additional concrete-lined tunnel, and into two penstock pipes (16-foot diameter)	One 12-foot diameter penstock pipe
<b>Power generation mechanism</b>	2 turbines	2 turbines	2 turbines	1 turbine
<b>Powerhouse Type</b>	Concrete foundations with concrete pads for access, no building	Enclosed building	Enclosed building	Concrete foundations with concrete pads for access, no building
<b>Power Capacity</b>	98 MW	20 MW	27 MW	18 MW

Source: FERC 2007; DOI 2011

Key:

MW: megawatt

#### **2.4.1.1 J.C. Boyle Dam and Powerhouse**

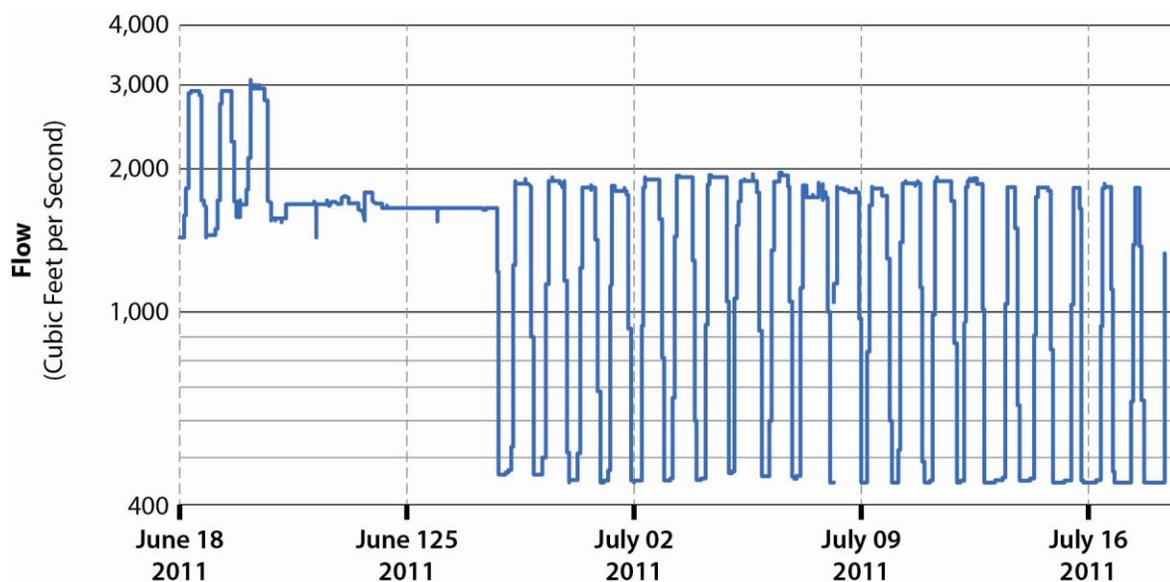
The J.C. Boyle facilities consist of a reservoir, embankment dam, concrete spillway, fish ladder, water intake structure, water conveyance system, and powerhouse. The narrow reservoir is created by an embankment dam with a concrete spillway as shown in Figure 2-2. The concrete spillway has flow control gates on the crest along with a fish ladder and water intake structure for diverting water to power generation facilities. The water conveyance system transmits diverted water several miles downstream to the powerhouse on the Klamath River.

At J.C. Boyle Dam, a portion of Klamath River flow is diverted into the power generation system and the non-diverted water is used to maintain flow in the fish ladder with the excess flow going over the spillway as necessary. The fish ladder discharge and spillway discharge combine and flow through the section of river referred to as the “Bypass Reach,” which contains less flow than other sections of the river. Water diverted at the dam for power generation is conveyed through a steel pipe, concrete canal, tunnel, and penstock pipe to the powerhouse. The powerhouse is approximately four river miles downstream from the dam. After water runs through the power generation facilities, it rejoins the Klamath River.



**Figure 2-2. J.C. Boyle Dam and Powerhouse**

J.C. Boyle powerhouse is generally operated as a peaking facility when river flows are too low to allow for continuous operations, such as the summer low flow period. Power demand peaks during weekday afternoons in the summer. Peaking power generation occurs in the late afternoons and early evenings to meet this demand, which allows the reservoir to refill during the night when power demand is minimal. Figure 2-3 shows early summer flows in 2011 as an example of how peaking operations affect flow downstream of the powerhouse. The reach between the powerhouse and the upstream end of Copco 1 Reservoir is referred to as the “Peaking Reach.” Historically, flows in this reach fluctuated rapidly to meet demand and peaking operations for power generation.



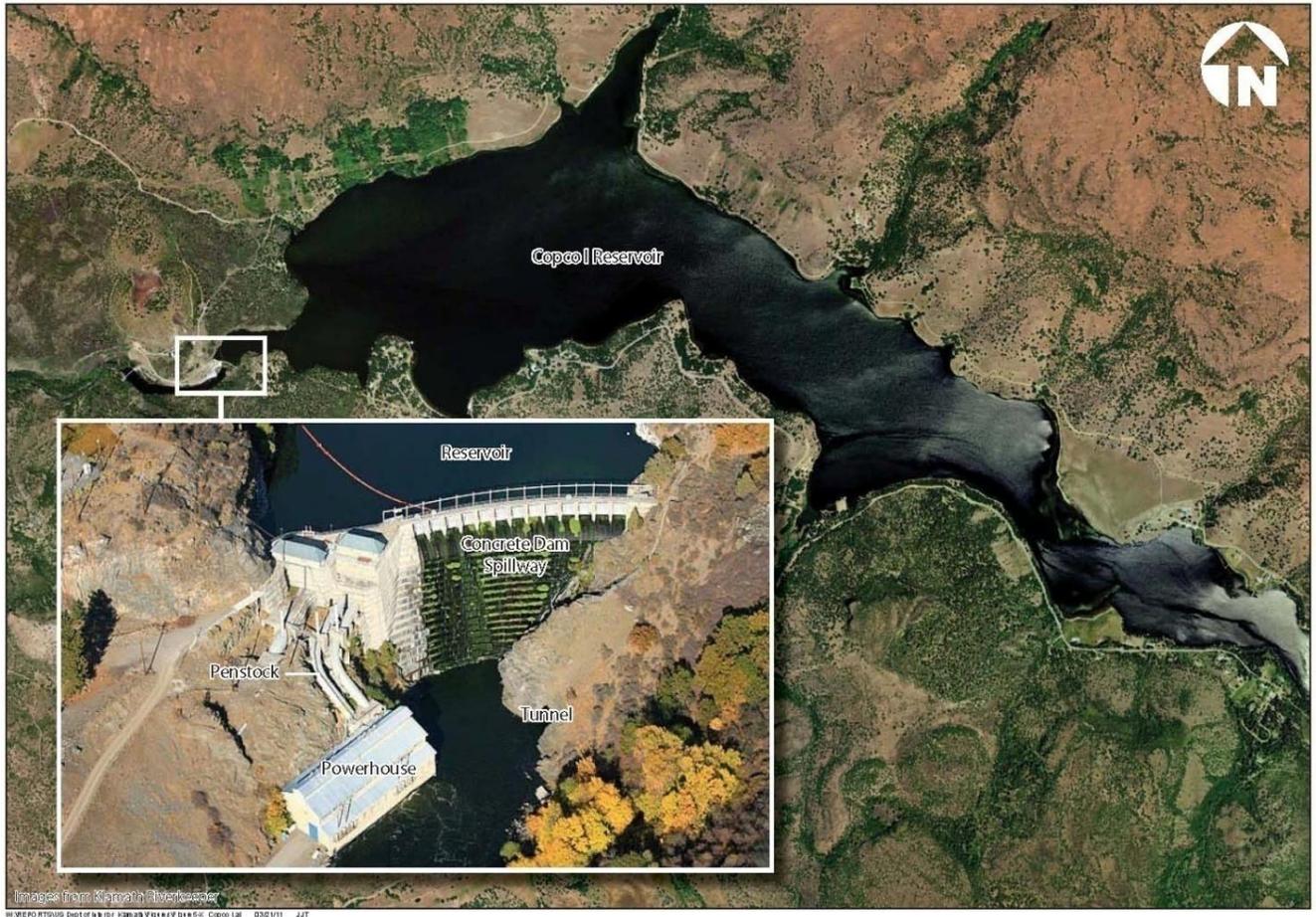
Source: USGS 2011

**Figure 2-3. Example Flows in Peaking Reach downstream from J.C. Boyle Powerplant (United States Geological Survey [USGS] station 11510700)**

#### **2.4.1.2 Copco 1 Dam and Powerhouse**

Copco 1 Dam (Figure 2-4) is in a bedrock canyon on the Klamath River at River Mile (RM) 198.6. Construction records show that the concrete dam includes 465 tons of 30-pound steel rails for reinforcement.

Water is routed past the dam, through the power generation facilities, and/or over the concrete spillway. Water diversion for power generation is via two intake structures on the right dam abutment (these descriptions refer to river right and river left when looking downstream). Water flows into the intakes and down to the powerhouse, located at the base of the dam, through steel penstock pipes. Excess water not diverted for power generation is allowed to flow over the concrete spillway and down the face of the dam. The entire width of the dam creates the spillway, which is controlled by gates that run across the top of the spillway. Water that flows over the spillway rejoins water diverted for power generation near the base of the dam at the powerhouse.



**Figure 2-4. Copco 1 Dam and Powerhouse**

#### **2.4.1.3 Copco 2 Dam and Powerhouse**

The Copco 2 facilities consist of a concrete dam, water diversion intake, water conveyance system for power generation, penstock pipes, powerhouse, and switchyard. The dam is at the bottom of a confined canyon on the Klamath River at RM 198.3. Copco 2 Dam is a concrete dam that spans the river with an earthen embankment section that fully spans the bottom of the canyon (see Figure 2-5).

At Copco 2 Dam, flow is diverted on river left through a water intake structure and conveyed through the power generation system. River flow in excess of diverted water is allowed to flow over the concrete spillway. An existing metal flume through the dam provides an additional 5 cubic feet per second (cfs) to the Bypass Reach below the dam.

Copco 2 Powerhouse is 1.5 miles downstream of Copco 2 Dam. Diverted river water flows from the dam through 2,440 feet of concrete-lined tunnel, 1,313 feet of pipeline, an additional 1,110 feet of concrete-lined tunnel, and two steel penstocks.

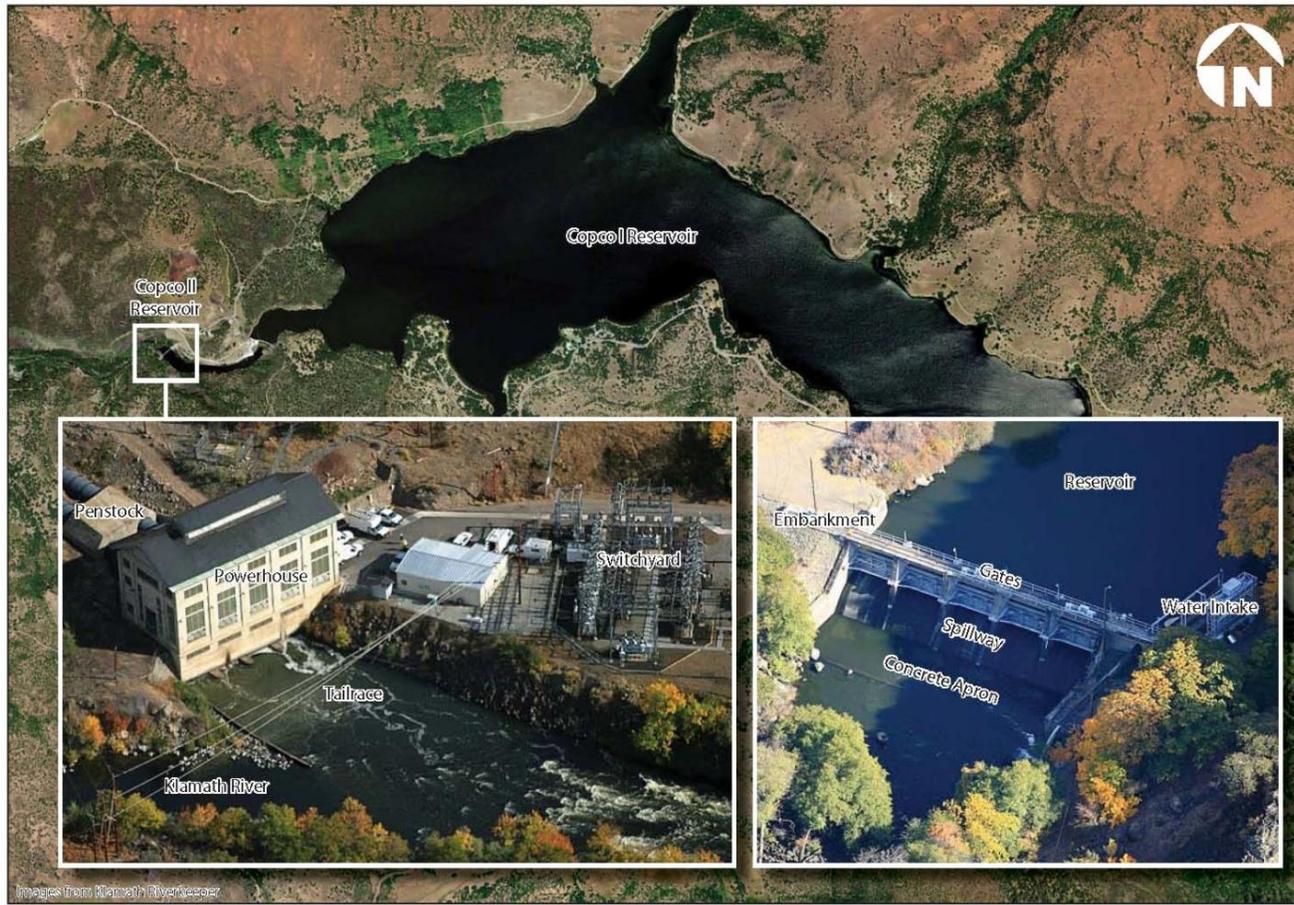


Figure 2-5. Copco 2 Powerhouse (left photo) and Dam

#### 2.4.1.4 Iron Gate Dam and Powerhouse

The Iron Gate facilities consist of a reservoir, earthfill embankment dam, concrete spillway, water intake structure, penstock pipes, and power generation facility (see Figure 2-6). The embankment dam is in a bedrock canyon at RM 190.1.

Water for power generation is drawn from the reservoir using a concrete water intake tower on the left side of the reservoir. Water is transported down the face of the dam through penstock pipes and into the powerhouse immediately downstream of the dam on the left bank of the river. The powerhouse consists of one turbine with concrete structural slabs and no overhead building structure.

Water not diverted for power generation is allowed to flow freely over the concrete spillway on the right side of the dam. There are no gates or flow controls for the spillway and flow is directed to the base of the dam where it converges with power generation return flows to resume flow down the Klamath River. The Iron Gate Dam has the original bypass tunnel used during construction of the dam that allows water in the reservoir to be drawn down over 125 feet.



**Figure 2-6. Iron Gate Dam, Reservoir, and Power Generating Facilities**

**2.4.2 Alternative 1: No Action/No Project Alternative**

NEPA requires an EIS to “include the alternative of no action” (40 CFR Part 1502.14(d)). CEQA requires an EIR to include a No Project Alternative. CEQA Guidelines Section 15126.6(e)(2) states that “The ‘no project’ analysis shall discuss the existing conditions at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services.” For the Klamath Facilities Removal EIS/EIR, NEPA’s No Action Alternative and CEQA’s No Project Alternative describe the same conditions, and this alternative is referred to as the No Action/No Project Alternative.

The No Action/No Project Alternative represents the state of the environment without the Proposed Action or any of the alternatives. In this instance, the No Action/No Project Alternative would be no change from current management conditions, other than as noted below, with the dams remaining in place. The No Action/No Project Alternative would only include the

portions of the KBRA that are ongoing resource management activities. These resource management actions could receive additional funding and could be expanded or accelerated through the KBRA; however, they were started or under consideration before the KBRA was developed and would move forward even without the KBRA. Therefore, the No Action/No Project Alternative includes the following resource management actions:

- **Williamson River Delta Project** - As part of this project, levees were breached on Williamson River in November 2008 to provide 28,800 acre-feet of additional storage in Upper Klamath Lake.
- **Agency Lake and Barnes Ranches Project** – The diked and drained portion of the ranches are currently used by Reclamation as pumped storage. The lands have been transferred from Reclamation to the United States Fish and Wildlife Service (USFWS) so that the dikes can be breached to reconnect wetlands to Upper Klamath Lake and add 63,770 acre feet of storage Upper Klamath Lake. USFWS is studying options to breach the dikes.
- **Fish Habitat Restoration** - restoration activities are ongoing throughout the basin under current authorities and funding levels. These restoration activities include, but are not limited to, restoration and permanent protection of riparian vegetation, water quality improvements, restoration of stream channel functions, measures to prevent and control excessive sediment inputs, remediation of fish passage problems, and prevention of entrainment into diversions. Specific types of activities include floodplain rehabilitation, large woody debris placement, fish passage correction, cattle exclusion, riparian vegetation planting, mechanical thinning to promote conifers, fire treatment, purchase of conservation easements/land, road decommissioning, gravel augmentation (main stem), and treatment of fine sediment sources. The fish habitat restoration program that would be implemented under the KBRA would include these same types of activities but is described under the Proposed Action.
- **Climate Change Assessment** – this assessment is intended to ensure that long-term climate change in the Klamath Basin is assessed early and continuously, allowing the Parties to collaboratively respond in a manner that protects basin interests from the adverse effects of climate change for as long as practicable, and to manage the resources of the basin on the basis of the best available science.

The KHSA outlines 20 Interim Measures (IMs) for the Klamath Hydroelectric Project that would be implemented until construction begins (if the Secretary makes an Affirmative Determination). Under the No Action/No Project Alternative, the KHSA would not move forward. However, several of these IMs have already been implemented, or would likely be implemented with a Negative Determination. Table 2-6 includes the IMs that are part of the No Action/No Project Alternative because:

- IMs are included in PacifiCorp's proposed Habitat Conservation Plan (National Oceanic and Atmospheric Administration [NOAA] Fisheries Service 2011) (IMs 2, 4, 5, 6, and 13);

- IMs are included in an Environmental Assessment from BLM and are scheduled to move forward before the Secretary makes a determination (IMs 7 and 8); or
- IMs represent a continuation of existing operations (IMs 14 and 17).

IM 7 (J.C. Boyle Gravel Placement) would start before the Secretary makes a determination, but it would end with a Negative Determination. Gravel placement would occur for approximately one year under the No Action/No Project Alternative before a determination is made; therefore, only one year of implementation of IM 7 is included in the No Action/No Project Alternative. IMs 3 (Iron Gate Turbine Venting) and 12 (J.C. Boyle Bypass Reach and Spencer Creek Gaging) have already been implemented and are therefore part of existing conditions. The remaining IMs would end with a Negative Determination and are not included in the No Action/No Project Alternative.

**Table 2-6. Interim Measures included in the No Action/No Project Alternative**

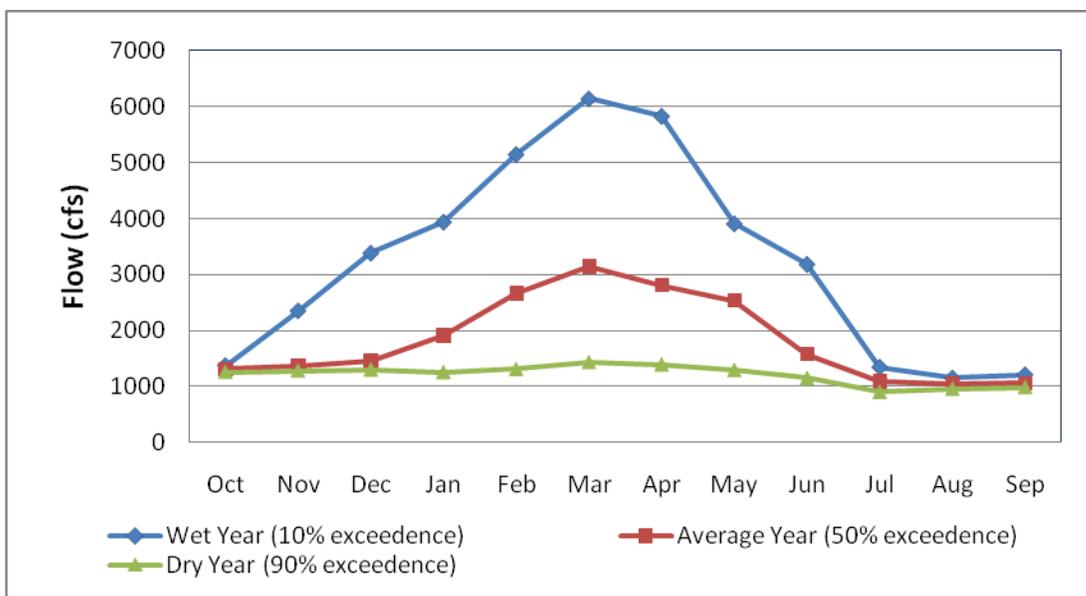
Interim Measure	Description
IM2 – California Klamath Restoration Fund/Coho Enhancement	PacifiCorp would fund actions to enhance survival and recovery of coho salmon, including habitat restoration and acquisition.
IM4- Hatchery and Genetics Management Plan	PacifiCorp would fund the development and implementation of a Hatchery and Genetics Management Plan for the Iron Gate Hatchery.
IM5- Iron Gate Flow Variability	PacifiCorp and Reclamation would annually evaluate the feasibility of enhancing fall and early winter flow variability to benefit salmonids downstream of Iron Gate Dams. In the event that fall and early winter flow variability can feasibly be accomplished, PacifiCorp would develop and implement flow variability plans. This IM would not adversely affect the volume of water available for Reclamation’s Klamath Project or wildlife refuges.
IM6- Fish Disease Relationship and Control Studies	PacifiCorp has established a fund to study fish disease relationships downstream of Iron Gate Dam. PacifiCorp would consult with the Klamath River Fish Health Workgroup regarding selection, prioritization, and implementation of such studies.
IM7- J.C. Boyle Gravel Placement and/or Habitat Enhancement (one year only)	PacifiCorp would provide funding for the planning, permitting, and implementation of gravel placement or habitat enhancement projects, including related monitoring, in the Klamath River above Copco Reservoir within 90 days of the effective date.
IM8 - J.C. Boyle Bypass Barrier Removal	PacifiCorp would remove the sidecast rock barrier approximately 3 miles upstream of the J.C. Boyle Powerhouse in the bypass reach. This IM would help with safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout.
IM13 - Flow Releases and Ramp Rates	PacifiCorp would maintain current operations including instream flow releases of 100 cfs from J.C. Boyle Dam to the J.C. Boyle Bypass Reach and a 9-inch per hour ramp rate below the J.C. Boyle powerhouse prior to transfer of the J.C. Boyle facility.
IM14 - 3,000 cfs Power Generation	Upon approval by OWRD, PacifiCorp would continue maximum diversions of 3,000 cfs at J.C. Boyle Dam for power generation prior to decommissioning of the facility.
IM17 - Fall Creek Flow Releases	PacifiCorp would continue to provide a continuous flow release to the Fall Creek bypass reach targeted at 5 cfs.

Key:  
 IM: Interim Measure  
 OWRD: Oregon Water Resources Department

PacifiCorp is including these IMs in a Habitat Conservation Plan (HCP) and analyzing them in accompanying NEPA environmental documents, biological opinions, and findings documents for NOAA Fisheries Service and USFWS. These documents are intended to inform Federal Endangered Species Act (ESA) Section 10 Incidental Take Permits (ITPs) by NOAA Fisheries Service and USFWS for implementation of interim conservation measures and related project operations for a ten-year period. Further background is provided in the notices of availability for the ESA Section 10 permit applications and related Environmental Assessment (NOAA Fisheries Service 2011). BLM has completed an Environmental Assessment and Finding of No Significant Impact related to IMs 7 and 8 (BLM 2011).

PacifiCorp would need to obtain a long-term operating license from the Federal Energy Regulatory Commission (FERC) to replace the existing annual license. PacifiCorp would resume relicensing proceedings with FERC to obtain the required long-term operating license.

For the purposes of this analysis, the No Action/No Project Alternative would continue current operations with the dams remaining in place and PacifiCorp operating under the current annual license. The existing license has no requirements for additional fish passage or implementation of the prescriptions that are currently before FERC in the relicensing process. PacifiCorp would continue to operate the Iron Gate Hatchery under its current operations. Flows would remain similar to current flows. Figure 2-7 shows modeled future flows in a dry year (represented by the flows exceeded 90 percent of the time, or 90 percent exceedence), an average year (flows exceeded 50 percent of the time), and a wet year (flows exceeded 10 percent of the time). These exceedence plots do not represent a flow pattern in any specific year. A “90% exceedence” flow is a flow that would be exceeded 90 percent of the time; therefore, it is generally representative of a dry year because most years have greater flows. Biological opinions may change in the future as understanding of species or their populations changes; however, these changes are unknown at this time and not included in the hydrologic assumptions.



**Figure 2-7. No Action/No Project Flows below Iron Gate Dam in Wet, Average, and Dry Years**

The USFWS issued a biological opinion to Reclamation on the operation and maintenance of Reclamation's Klamath Project (USFWS 2008). This biological opinion outlines measures to improve the habitat for the Lost River sucker and shortnose sucker affected by Reclamation's Klamath Project operations. Among other measures to protect the suckers, the biological opinion requires that specific surface elevations of Upper Klamath Lake be maintained to meet certain criteria.

The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries Service) also issued a biological opinion to Reclamation requiring releases from Reclamation's Klamath Project to produce specified rates of flow for the Klamath River downstream of Iron Gate Dam, based on the habitat needs of coho salmon (NOAA Fisheries Service 2010). Target flow rates in the Klamath River downstream of Iron Gate Dam vary by month, and are dependent in part on the amount of water entering Upper Klamath Lake.

PacifiCorp would continue to coordinate operations with Reclamation and operate the Klamath Hydroelectric Project in compliance with existing NOAA Fisheries Service and USFWS biological opinions issued for Reclamation's Klamath Project. Under the No Action/No Project Alternative, the Four Facilities would continue to be subject to requirements in PacifiCorp's current annual FERC permit:

- Operating the peaking facility at J.C. Boyle such that the river does not rise or fall more quickly than 9 inches per hour and that minimum flows immediately downstream of the dam are maintained at 100 cfs.
- Maintaining minimum flows downstream of Iron Gate Dam.
- Limiting the change in the rate of the release of water from Iron Gate Dam to no more than 250 cfs per hour or a three-inch change in river stage. (FERC 2007)

PacifiCorp also currently coordinates with Reclamation to meet ramp rates in the NOAA Fisheries Service biological opinion on Reclamation's Klamath Project:

- When flows at Iron Gate Dam are 3000 cfs or above, Iron Gate Dam ramp down rates will follow the rate of decline to inflows to Upper Klamath Lake combined with accretions between Keno Dam and Iron Gate Dam.
- When flows at Iron Gate Dam are between 1,750 cfs and 3,000 cfs, Iron Gate Dam ramp down rates will be 300 cfs or less per 24 hour period and no more than 125 cfs per 4 hour period.
- When flows at Iron Gate Dam are 1,750 cfs or less, Iron Gate ramp down rates will be 150 cfs or less per 24 hour period and no more than 50 cfs per two hour period. (NOAA Fisheries Service 2010)

The No Action/No Project Alternative would include other regulatory conditions that would affect conditions in the Klamath Basin. To improve water quality, the Oregon Department of Environmental Quality (ODEQ) and California North Coast Regional Water Quality Control Board (NCRWQCB) cooperated to develop Total Maximum Daily Loads (TMDLs) for impaired water bodies within the basin. TMDLs are pollution control plans that identify the pollutant load reductions that are necessary from point and nonpoint sources to meet water quality standards.

Table 2-7 shows the status of the TMDLs in the Klamath basin. The California and Oregon Klamath River TMDLs focus on reducing high water temperatures, increasing dissolved oxygen levels, and reducing nutrient concentrations in the mainstem Klamath River (NCRWQCB 2010a, ODEQ 2010). Major tributaries in the lower Klamath Basin, such as the Scott, Shasta, and Trinity Rivers, are not included in the technical analyses (i.e., modeling efforts) for the California Klamath TMDLs but the entire Klamath Basin is included in the associated Implementation Plan (NCRWQCB 2010b).

**Table 2-7. Status of TMDLs in the Klamath River Basin**

Water Body	Pollutant/Stressor	Agency	Original Listing Date	TMDL Completion Date <sup>1</sup>
<b>Oregon</b>				
Upper Klamath Lake Drainage	Temperature, dissolved oxygen, and pH	ODEQ	1998	2002
Upper Klamath and Lost Rivers	Temperature, dissolved oxygen, pH, ammonia toxicity, and chlorophyll-a	ODEQ	1998	2011
<b>California</b>				
Lower Lost River <sup>2</sup>	pH and nutrients	USEPA	1992	2008
Klamath River	Temperature, organic enrichment/low dissolved oxygen, nutrient, and microcystin	NCRWQCB	1996, 1998, 2006, and 2008	2010
Shasta River	Temperature and dissolved oxygen	NCRWQCB	1998 and 2008	2007
Scott River	Temperature and sediment	NCRWQCB	1992, 1996, and 1998	2006
Salmon River	Temperature	NCRWQCB	1996	2005
Trinity	Sediment	USEPA	1994 and 2006	2001
South Fork Trinity	Sediment	USEPA	1994 and 2002	1998

Notes:

<sup>1</sup> The TMDL completion date is the year the USEPA approved or is expected to approve the TMDL.

<sup>2</sup> The Upper Lost River upstream of the Oregon border, Clear Lake Reservoir, and tributaries are listed for water temperature and nutrients. In 2004, North Coast Regional Board staff completed an analysis of beneficial uses and water quality conditions in the Upper Lost River watershed and concluded that the listing is not warranted.

Key:

TMDL: Total Maximum Daily Load

ODEQ: Oregon Department of Environmental Quality

USEPA: U.S. Environmental Protection Agency

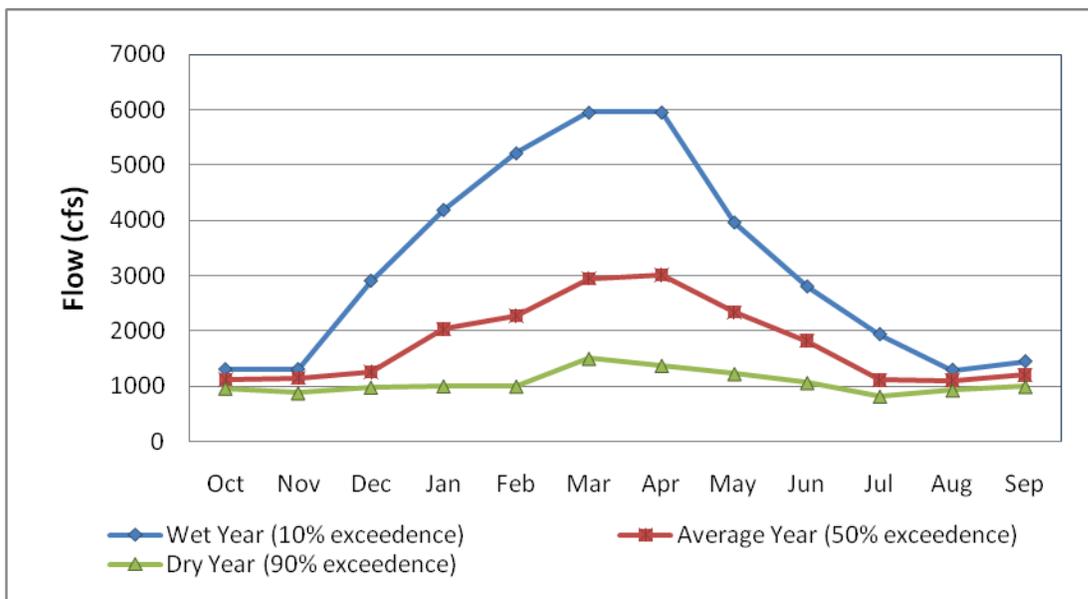
NCRWQCB: North Coast Regional Water Quality Control Board

The TMDLs within the basin are expected to result in improvements to water quality conditions, but the improvements cannot be quantified due to uncertainties regarding the timing and magnitude of mitigation projects, necessary to achieve water quality standards. Section 3.2, Water Quality, describes these TMDLs in detail.

### 2.4.3 Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)

The Full Facilities Removal of Four Dams Alternative (the Proposed Action) includes the removal of the Four Facilities as described in the KHSA. This alternative would include the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, ancillary buildings, and dam foundations. During deconstruction the four reservoirs would be closed to recreation. This alternative would include the transfer of Keno Dam to the Department of the Interior (DOI), decommissioning of PacifiCorp’s East Side/West Side facilities, and the implementation of the KBRA as connected actions as defined under NEPA.

The result of the Proposed Action would be that the Klamath River would have no dams downstream from Keno Dam. Operation of Reclamation’s Klamath Project and the related river flows, measured at the United States Geological Survey gauge downstream from Iron Gate Dam, would be according to the hydrologic model outputs in KBRA Appendix E-5. Figure 2-8 shows simulated future flows at the Iron Gate Gauge during a dry year (represented by the flows exceeded 90 percent of the time, or 90 percent exceedence), an average year (flows exceeded 50 percent of the time), and a wet year (flows exceeded 10 percent of the time)<sup>2</sup>.



**Figure 2-8. Proposed Action Flows at the Iron Gate Gauge in Wet, Average, and Dry Years**

Removing the Four Facilities would release some of the sediment currently stored behind the dams into the downstream river system. Table 2-8 shows the quantity of sediment in Iron Gate,

<sup>2</sup> Minimum flows may change in the future. Hydrologic modeling assumed that the Drought Plan would include a minimum flow of 800 cfs (DOI 2011). The final Drought Plan or future ESA actions could change the minimum flows; however, these assumptions reflect the best available information at the time of the modeling.

Copco 1, and J.C. Boyle reservoirs; the sediment in storage in Copco 2 reservoir is negligible. The sections below describe how much sediment would erode from each site.

Reservoir drawdown schedules were selected to minimize release of sediment during critical times for sensitive species. The lead agencies studied multiple drawdown scenarios to optimize performance for these sensitive fish. The challenge in selecting a drawdown period was to avoid impacts to migrating adult fish (salmonids, sturgeon, and lamprey), migrating juvenile smolts, and rearing of juveniles. During summer, there are juveniles rearing, green sturgeon adults, and spring-run Chinook salmon migrating. During fall, there are adult coho salmon, steelhead, and fall-run Chinook salmon migrating, and smolts outmigrating. During spring, there are smolts outmigrating, adult green sturgeon, and steelhead and spring-run Chinook adults migrating. Drawdown would primarily occur during winter because it would be the least harmful season; however, there are still species and life stages that may be affected, such as adult migrating steelhead and lamprey.

**Table 2-8. Sediment Stored In Reservoirs**

<b>Reservoir</b>	<b>Source area<sup>1</sup> (acres)</b>	<b>Period of Sediment Accumulation</b>	<b>Sediment Accumulation Volume (yd<sup>3</sup>)</b>
<b>Iron Gate</b>	135,680	40 yr (1962-2002)	4,700,000
<b>Copco 1</b>	174,720	84 yr (1918–2002)	7,400,000
<b>J.C. Boyle</b>	144,000	44 yr (1958–2002)	1,000,000
<b>Total</b>			<b>13,100,000</b>

Key:

yd<sup>3</sup>: cubic yards

yr: Year

Source: Department of the Interior 2011

Notes:

<sup>1</sup> Source Area refers to the sub basin that drains to the reservoir.

Prior to construction, IMs as described in the KHSA (KHSA Section 1.2.4) would be implemented and would control operations of the hydroelectric facilities. Some of these IMs would be implemented in the No Action/No Project Alternative, but the remaining would be included in the Proposed Action. Some of the IMs propose studies, planning efforts, or the continued funding of existing facilities that do not constitute new actions with the potential to affect the environment and are therefore not analyzed in this EIS/EIR. Table 2-9 presents these IMs included in the Proposed Action that would not result in environmental effects.

**Table 2-9. KHSA Interim Measures that would not produce Environmental Effects**

<b>Interim Measure</b>	<b>Description</b>
IM9 – J.C. Boyle Powerhouse Gage	PacifiCorp would fund the continued operation of the existing gage below J.C. Boyle Powerhouse.
IM10 – Water Quality Conference	PacifiCorp would fund a basin-wide technical conference on water quality.
IM15 – Water Quality Monitoring	PacifiCorp would fund long-term baseline water quality monitoring to support dam removal, nutrient removal, and permitting studies, and would also fund blue-green algae and toxin monitoring.
IM 18 – Hatchery Funding	PacifiCorp would fund Iron Gate Hatchery operations and maintenance.
IM21 - BLM Land Management Provisions	PacifiCorp would fund BLM's continued land management activities including road maintenance, invasive weed management, cultural resource management, and recreation.

Key:

IM: Interim Measure

BLM: Bureau of Land Management

The remaining IMs are also included in the Proposed Action and will be analyzed in Chapter 3 of this EIS/R (see Table 2-10). As discussed under the No Action/No Project Alternative, one year of IM7 would be implemented before the Secretary makes a determination. The remaining seven years, however, would only occur in the case of an Affirmative Determination and are therefore included in the Proposed Action.

#### **2.4.3.1 Deconstruction Actions**

##### **J.C. Boyle Dam and Powerhouse**

Full removal of the J.C. Boyle Dam and Powerhouse would include removal of the dam, spillway and gates, powerhouse, powerhouse equipment, and concrete fish ladder. This alternative would also include removal of ancillary facilities, such as the canal and pipeline that convey water to the powerhouse. The extensive headcut downstream of the forebay overflow discharge canal would be filled and stabilized with a portion of the material removed from the dam structure. Further, the dam removal entity (DRE) would fill the tailrace (where the powerhouse discharges water) to restore natural river conditions in this area. In order to access the dam for deconstruction, the DRE would perform a controlled reservoir drawdown using the spillway gates, conveyance pipeline and canal, and diversion conduit.

The deconstruction process would begin by gradually drawing down the reservoir. Reservoir drawdown would release water into the concrete canal (the power generation intake), the spillway, and the bypass conduit through the dam depending on the water surface elevation in the reservoir. Water would flow through the Bypass Reach throughout reservoir drawdown. As the reservoir was drawn down, the DRE would remove facilities from the top down. The DRE would start by removing the spillway gates, the spillway bridge, and the upstream concrete intake structure for the powerhouse canal. The DRE would use cranes and excavators for removal, and might also need blasting to remove concrete facilities.

**Table 2-10. KHSA Interim Measures Analyzed in the Proposed Action**

Interim Measure	Description
IM7- J.C. Boyle Gravel Placement and/or Habitat Enhancement (final 7 years)	PacifiCorp would provide funding for the planning, permitting, and implementation of gravel placement or habitat enhancement projects, including related monitoring, in the Klamath River above Copco Reservoir within 90 days of the effective date.
IM11- Interim Water Quality Improvements	<p>PacifiCorp would fund studies or pilot projects developed in consultation with the Implementation Committee regarding the following:</p> <ul style="list-style-type: none"> <li>• Development of a Water Quality Accounting Framework</li> <li>• Constructed Treatment Wetlands Pilot Evaluation</li> <li>• Assessment of In-Reservoir Water Quality Control Techniques</li> <li>• Improvement of J.C. Boyle Reservoir Dissolved Oxygen</li> </ul> <p>PacifiCorp would provide funding for implementation of projects approved by the ODEQ and the State and Regional Water Boards, and to cover project operation and maintenance expenses related to those projects.</p>
IM16 - Water Diversions	PacifiCorp would seek to eliminate three screened diversions from Shovel and Negro Creeks and would seek to modify its water rights as listed above to move the points of diversion from Shovel and Negro Creeks to the mainstem Klamath River.
IM19 - Hatchery Production Continuity	PacifiCorp would evaluate hatchery production options that do not rely on the current Iron Gate Hatchery water supply. The study will assess groundwater and surface water supply options, water reuse technologies or operational changes that could support hatchery production in the absence of Iron Gate Dam. Based on the study results, PacifiCorp would propose a post-Iron Gate Dam Mitigation Hatchery Plan to provide continued hatchery production for eight years after the removal of Iron Gate Dam. <sup>1</sup>
IM20 - Hatchery Funding After Removal of Iron Gate Dam	After removal of Iron Gate Dam and for a period of eight years, PacifiCorp would fund 100 percent of hatchery operations and maintenance costs necessary to fulfill annual mitigation objectives developed by the DFG in consultation with the NOAA Fisheries Service. <sup>1</sup>

Key:

DFG: California Department of Fish and Game

IM: Interim Measure

KBRA: Klamath Basin Restoration Agreement

NOAA Fisheries Service: National Oceanic and Atmospheric Administration

ODEQ: Oregon Department of Environmental Quality

Notes:

1. Funding for IMs 19 and 20 would be a component of the Fish Reintroduction Plans under the KBRA (see Section 2.4.3.9).

The DRE would install a temporary cofferdam to isolate the work area near the spillway to continue deconstruction activities. To the extent possible, the DRE would use debris from deconstruction for the cofferdam. The cofferdams would likely be constructed using a combination of concrete rubble, rock, and earthen materials that would come from the dams. The cofferdam would isolate the left side of the dam to allow the DRE to deconstruct the concrete portion of the spillway using a hoe-ram (an excavator with a hydraulic hammering attachment) or by drilling and blasting. The DRE would also remove other concrete facilities (including the fish ladder, intake structure, power canal, forebay structures, and powerhouse) using a hoe-ram or drilling and blasting.

After reservoir drawdown, the DRE would remove the embankment dam, working from the top down with standard excavation equipment. The DRE would place portions of the excavated rockfill on the upstream embankment to create an isolation cofferdam. After removing the embankment, the DRE would breach the cofferdam and allow materials to naturally erode.

Estimated waste quantities for full facilities removal at the J.C. Boyle Development include 40,000 cubic yards (yd<sup>3</sup>) of concrete, 140,000 yd<sup>3</sup> of earthfill, and 3,000 tons of mechanical and electrical items at the dam. The DRE would fill the original borrow pits on the right abutment of J.C. Boyle Dam with deconstruction waste. The DRE would haul materials on existing unpaved roads to the disposal sites along the cleared transmission line corridor, and place some material within ravines below the transmission lines (see Figure 2-9). The existing haul roads would require some initial clearing and minor improvements. The DRE would grade disposal sites for drainage and revegetate to prevent erosion.

The DRE would use surplus waste concrete and earth materials to fill the eroded scour hole on the hillside below the spillway structure to restore the area to near pre-dam conditions. For the remaining waste that would not be disposed on-site, the DRE would separate reinforcing steel from the concrete and haul the steel to a recycling facility in Klamath Falls, Oregon. The DRE would also haul mechanical and electrical equipment to Klamath Falls to be transferred to a suitable recycling facility outside the project boundaries.

Trapped sediments within the reservoir consist primarily of small particles of silts and clays that would be easily eroded and flushed out of the reservoir into the river. Modeling studies indicate that drawdown would erode and flush 41 to 65 percent of the stored sediment downstream during the drawdown period (DOI 2011). Once eroded from the reservoir, the fine sediment would continue to be suspended in the river water downstream to the ocean. Large quantities of sediment would remain in place after dam removal, primarily on areas above the active channel. The remaining sediments would consolidate (dry out and decrease in thickness) and would decrease the depth of the remaining sediment. Modeling studies show a change in sediment depth of up to 61 percent of original depth (DOI 2011). Similar shrinkage of sediment layers would be expected for Copco 1 and Iron Gate Reservoirs.

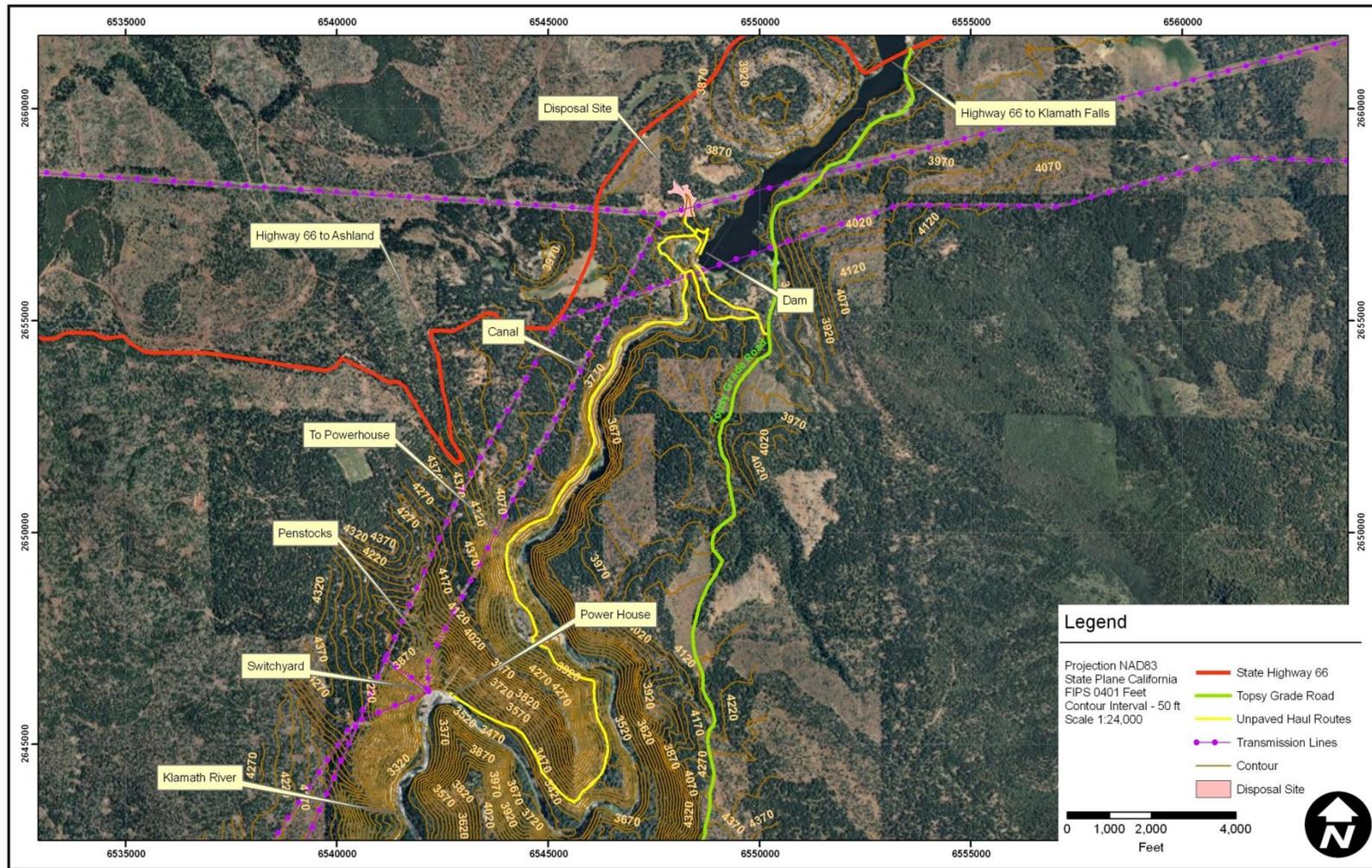


Figure 2-9. J.C. Boyle Haul Roads and Disposal Sites

### **Copco 1 Dam and Powerhouse**

Under the Proposed Action, the DRE would remove the entire Copco 1 Dam from canyon wall to canyon wall and five feet below the existing streambed (a total of 130 feet from the top of the dam). Removing all facilities would include removal of the concrete water intake structure, concrete gate houses, penstock pipes and supports, powerhouse, power generation support facilities, switchyard, and unused transmission lines.

The deconstruction process would begin by gradually drawing down the reservoir. Reservoir drawdown would release water through three primary locations: over the spillway, through the penstock pipes, and through the diversion tunnel. Use of the diversion tunnel would require removal of three gates, three valves, and a concrete plug to make it operable. Three new gates would be placed on the diversion tunnel; these could be remotely operated. The concrete dam could safely allow flows that overtop the dam crest during dam removal without dam safety or flood concerns. The DRE would construct multiple “notches” in the dam to allow the reservoir to drain; the notches would be 20-foot wide openings that would be a minimum of 16 feet deep.

As the reservoir was drawn down, the DRE would remove facilities from the top down. The DRE would start by removing the spillway gates and the spillway deck bridge, using cranes and excavators. The DRE would then remove the concrete dam in 8-foot-high sections using drilling and blasting. Dam removal would be challenging because the dam has large boulders embedded in the concrete and is reinforced with steel rails.

After removal of the concrete dam down to the water level, the DRE would construct a cofferdam to isolate one side of the dam and remove water from the working area. The DRE would remove the dry portion of the dam to 5 feet below the existing riverbed and then divert the river through the new opening. The DRE would then isolate the other side of the dam and remove it. The DRE would use mechanical means (such as hydraulic shears that break concrete by shearing it like scissors or an excavator with a hoe-ram attachment) to excavate the reinforced concrete in deck, wall, and floor slabs for remaining features (including powerhouse and diversion intake structure).

The estimated waste quantity for Full Facilities Removal at Copco 1 Dam is 62,000 yd<sup>3</sup> of concrete and 1,200 tons of mechanical and electrical items at the dam and powerhouse. The DRE would remove debris from the dam deconstruction, including concrete rubble and reinforcing steel, using a large tower crane on the right side of the river. The DRE would bury concrete rubble on the right abutment within an on-site disposal area (see Figure 2-10). After disposal was complete, the DRE would grade the areas for drainage and revegetate to prevent erosion.

The DRE would separate reinforcing steel from the concrete and haul it to a local recycling facility in Yreka, California. The DRE would haul mechanical and electrical equipment to Yreka, California for transfer to a salvage company or disposal outside the project boundaries.

The concrete dam and powerhouse are in a steep, narrow canyon. The existing access roads would require substantial upgrades to handle the hauling of excavated concrete and provide access for a large, crawler-mounted crane. Crane access may also be available from the left abutment using existing unpaved roads.

Modeling studies indicate that the initial drawdown would flush 46 to 81 percent of the 7,440,000 yd<sup>3</sup> of silts and clays behind the dam (DOI 2011). Once eroded from the reservoir, the fine sediment would continue to be suspended in the river water downstream to the ocean. After drawdown, the remaining sediments would consolidate (dry out and decrease in thickness). Copco 1 Reservoir sediments would likely consolidate substantially, which would decrease the depth of the remaining sediment.

### **Copco 2 Dam and Powerhouse**

The Proposed Action would include removal of the dam, spillway and gates, water intake structure, pipelines, penstock, power generation equipment, and unused transmission lines. The DRE would also reshape the embankment on river right to create a stable slope that blends into the natural hillslopes and river channel. Restoration would include filling in the tailrace channel between the powerhouse and the river to restore natural river conditions. The Copco 2 substation at the powerhouse and a switchyard on a bluff north of the river would remain in service following dam removal.

Because of the small reservoir size, a river diversion and work area isolation plan would be sufficient for dam removal. The DRE would start by removing the spillway gates and the spillway bridge using cranes and excavators. Next, the river flow would be lowered and routed through the spillway gates while a cofferdam would be constructed to isolate the left half of the dam. The river flow would be routed through the right two spillway gates as the left two spillway gates and spillway would be removed using mechanical techniques. The techniques would include use of hydraulic shears or hoe-ram attached to a track-hoe. The shears would be able to cut, or shear through the concrete like scissors while the hoe-ram is able to jackhammer the concrete into small pieces that can be removed. After the left spillway was removed, the river would be diverted through the vacated structure and the right portion of the dam would be removed using similar mechanical techniques. The remaining reinforced concrete walls and water intake structure on the side of the river would be removed after the dam is removed. The power generation water conveyance pipes and powerhouse would be removed using conventional track-hoes and off-road dump trucks.

Copco 2 Dam is a concrete dam in a confined canyon with poor access. The existing access roads would require substantial upgrades to handle the hauling of the excavated concrete and provide access for a large, crawler-mounted crane. The access bridge across the Klamath River downstream of the powerhouse could require improvements to handle the construction equipment loads.

Estimated waste quantities for full facilities removal at Copco 2 Dam and Powerhouse include more than 12,000 yd<sup>3</sup> of concrete, 1,500 yd<sup>3</sup> of earthfill, and 2,000 tons of mechanical and electrical items at the dam. The DRE would bury concrete rubble on the right abutment within an on-site disposal area (see Figure 2-10). The DRE would handle and dispose of reinforcing steel, concrete, and mechanical equipment in the same manner as removal of the Copco 1 facilities. Approximately 550 tons of creosote treated wood from the wood-stave conveyance pipe would have to be transported to an off-site disposal facility 120 miles from the site.

### **Iron Gate Dam and Powerhouse**

The Proposed Action would include removal of the earthen dam, diversion tunnel gate structure, concrete water intake structure, powerhouse generation facility, penstock and its concrete supports, unused transmission lines, and the switchyard. The DRE would bury the concrete spillway to restore the pre-dam appearance of the right abutment bedrock canyon. Further, the DRE would fill the tailrace (where the powerhouse discharges water) to restore natural river conditions in this area.

The Proposed Action would include removal of the fish handling facilities at the base of the dam, but the Iron Gate Fish Hatchery would remain in place. PacifiCorp would need to identify and secure an alternate water source for the fish hatchery to remain operational because the water supply pipe from the penstock intake structure to the fish hatchery would be removed with the dam. PacifiCorp would fund eight years of hatchery operations after decommissioning of Iron Gate Dam, after which the parties will be responsible for identifying funding for continued operation.

The DRE would draw down the reservoir by releasing water through the bypass tunnel and into the power generation facilities. The DRE would begin excavation of the embankment on the very narrow top section, which would be a slow process because of the confined work area. As the excavation worked down from the top, the width of the excavation footprint would be wider and additional equipment could be used. The DRE would remove the riprap during embankment excavation. The DRE would then remove reinforced concrete from remaining structures (including intake structures, fish handling facilities, and powerhouse) using mechanical methods if possible (or drilling and blasting if necessary). The construction of temporary cofferdams would be necessary to divert water when removing the base of the dam and create isolated work areas. These cofferdams would be built using materials from the dam removal process and removed upon completion of the work.

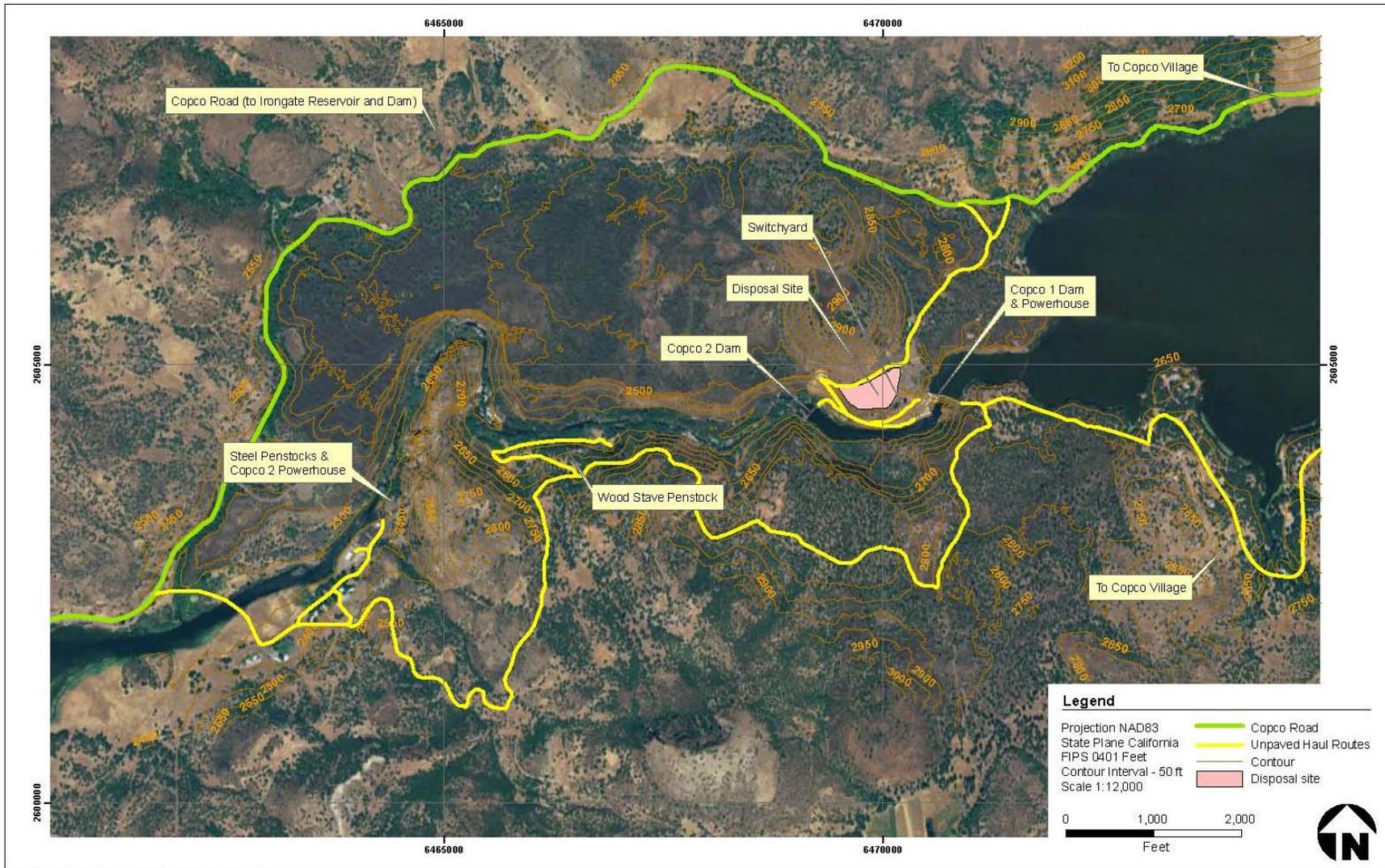


Figure 2-10. Copco 1 and Copco 2 Haul Roads and Disposal Sites

Estimated waste quantities for full removal of Iron Gate Dam and powerhouse include 12,000 yd<sup>3</sup> of concrete, 1.1 million yd<sup>3</sup> of earthfill, and 1,000 tons of mechanical and electrical items at the dam and powerhouse. Removal would also generate waste from four buildings with a combined area of 2,300 square feet.

An original borrow site approximately 0.75 miles upstream from the dam on the left abutment would serve as a disposal site for earth and concrete waste (see Figure 2-11). Another disposal site would be the existing concrete-lined side-channel spillway, chute, and terminal structure, which could accept up to 300,000 yd<sup>3</sup> of excavated material. As the excavation descended, the DRE would need to construct ramps out of the canyon. The DRE would stockpile some rockfill for later use as slope protection for the upstream cofferdam. The DRE would dispose of reinforcing steel, concrete, and mechanical and electrical equipment in the same manner as for the Copco 1 and Copco 2 sites.

Existing haul roads would require improvements to handle two-way traffic of large construction equipment between the dam and the disposal site. The access bridge across the Klamath River downstream of the dam could also require improvements to handle the construction equipment loads.

DOI modeling studies indicate that this drawdown would flush 25 to 38 percent of the trapped sediments in the reservoir (primarily silts and clays). Once eroded from the reservoir, the fine sediment would continue in suspension all the way to the ocean. The remaining sediments would consolidate after drawdown, and restoration efforts would stabilize the remaining sediment.

The City of Yreka's water supply pipeline passes under the upstream end of the Iron Gate Reservoir and would become exposed to high-velocity river flows after dam removal. Reconstructing the pipe further under ground would likely require digging in bedrock, which would be complicated and expensive. Therefore, the DRE would construct a new, elevated pipeline and steel pipeline bridge to support the pipe above the river. The prefabricated steel pipe bridge would be wide enough to accommodate the pipeline and walkway on the deck. The pipeline bridge would likely be three spans with a center span of 200 feet and two end spans of 100 feet. The spans would be supported on concrete piers. The new pipeline would be connected to the existing buried pipeline at each end of the bridge. In order to avoid a disruption to the City's water supply, the permissible outage period would be limited by the available storage tank capacity.

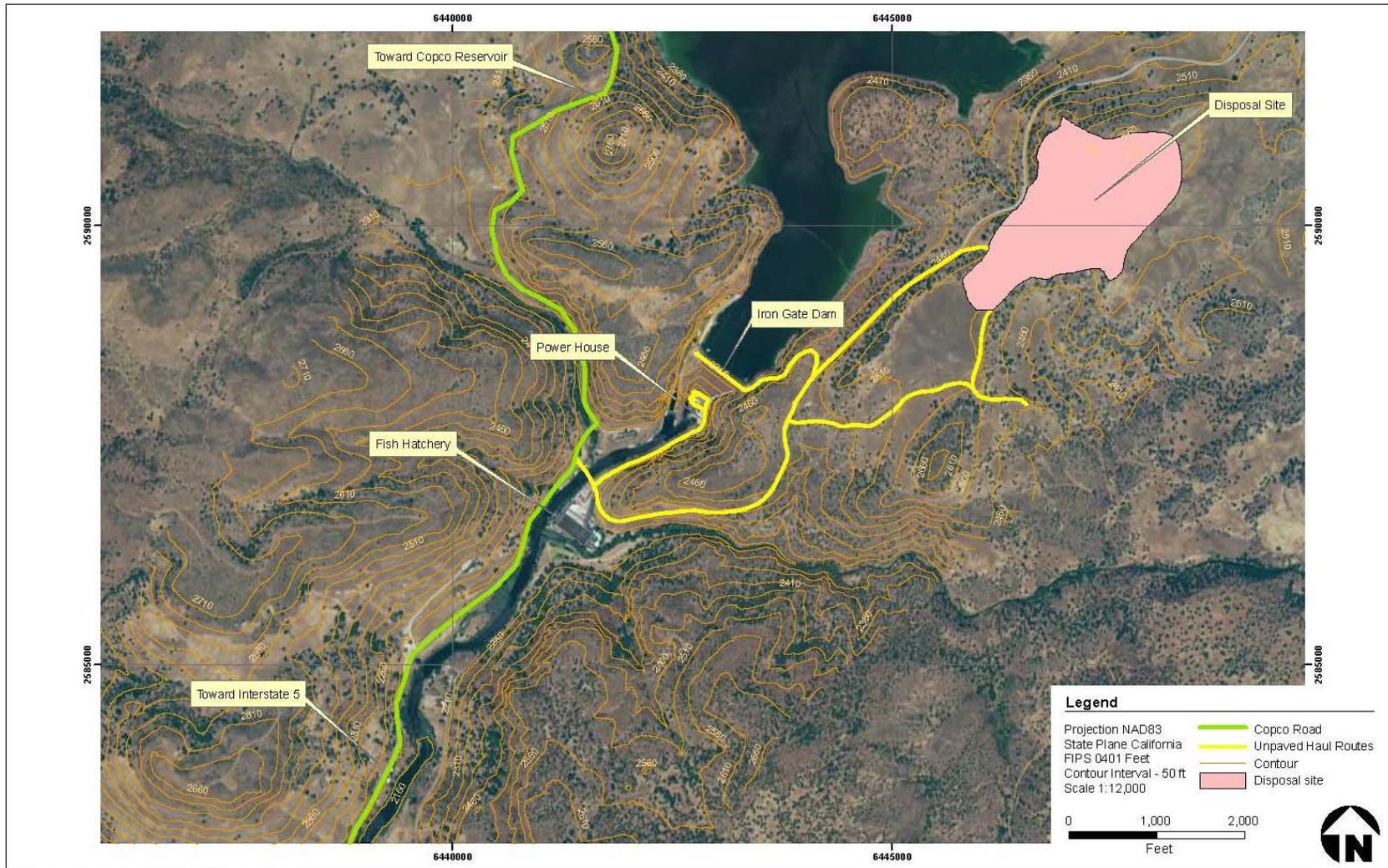


Figure 2-11. Iron Gate Haul Roads and Disposal Sites

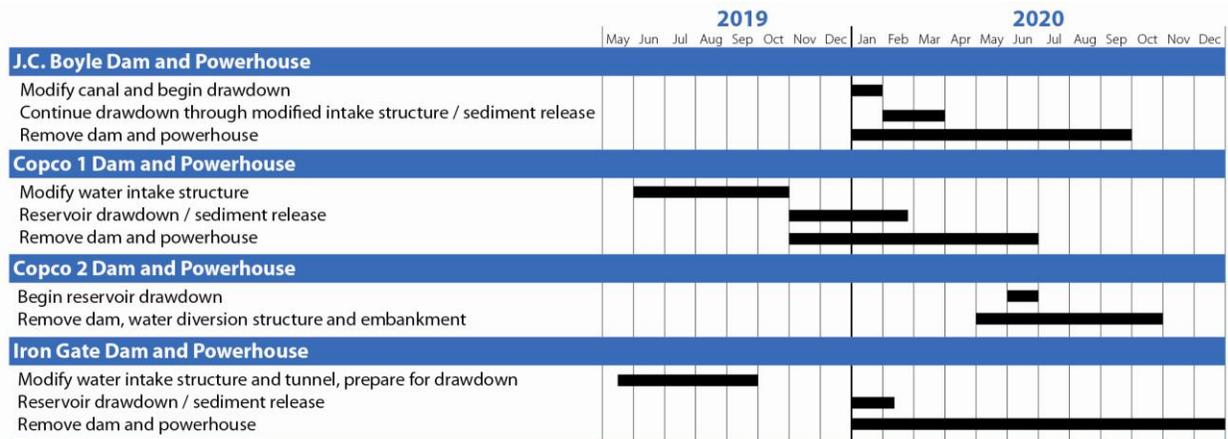
**2.4.3.2 Schedule**

The DRE would begin preparatory work in May 2019. The initial schedule for this alternative would stop power generation at the Iron Gate and J.C. Boyle facilities on December 31, 2019. Power generation would stop at Copco 2 Powerhouse in April 2020 and would cease at Copco 1 in October 2019. Table 2-11 shows the schedule to draw down J.C. Boyle, Copco 1, and Iron Gate Reservoirs. (Copco 2 has no drawdown limitations or sediment stored in the reservoir.) The Lead Agencies designed drawdown rates to protect slope stability, public safety, and structures near the reservoirs. The drawdown periods were scheduled to avoid sediment release into downstream areas during critical times for sensitive aquatic species. The end dates in Table 2-9 may vary depending on year type; these dates reflect an average water year, but the draw down might be longer in wet years or shorter in dry years.

**Table 2-11. Drawdown Plans for J.C. Boyle, Copco 1, and Iron Gate Reservoirs**

	J.C. Boyle	Copco 1			Copco 2	Iron Gate
		Phase 1	Phase 2	Phase 3		
Start Date	1/1/2020	11/1/2019	1/1/2020	2/5/2020	6/1/2020	1/1/2020
Starting Elevation (feet)	3,793	2,606	2,590	2,529	2,484	2,328
End Date	2/1/2020	11/17/2019	2/4/2020	2/24/2020	6/30/2020	2/11/2020
Ending Elevation (feet)	3,762	2,590	2,529	2,484	2,460	2,202
Average Drawdown (feet/day)	1	1	1.75	2.25	0.8	3

Figure 2-12 provides a schedule for the Proposed Action based on construction requirements for removal.



**Figure 2-12. Anticipated Schedule for Full Facilities Removal**

**2.4.3.3 Workforce**

The size of the construction workforce at each site would vary, and the peak times for construction would be staggered. Table 2-12 shows the construction workforce needed for the Proposed Action.

**Table 2-12. Workforce Projections for the Proposed Action**

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle	25 to 30 people	10 months	40 - 45	Jul 2020 - Sep 2020
Copco 1	30 to 35 people	12 months	50 - 55	Nov 2019 - Apr 2020
Copco 2	25 to 30 people	7 months	35 - 40	May 2020 - Aug 2020
Iron Gate	35 to 40 people	18 months	75 - 80	Jun 2020 - Sep 2020

#### **2.4.3.4 Environmental Measures**

The Lead Agencies have several standard procedures and management practices that they incorporate into projects to avoid adverse effects to the environment. Key elements of these measures are summarized below, and a more complete description is presented in Appendix B. All the procedures and practices identified in this EIS/EIR are incorporated into each action alternative analyzed in this EIS/EIR.

#### **Best Management Practices**

For all deconstruction and/or construction activities, the DRE would implement standard pollution prevention measures as part of project design specifications and standard construction practices. These measures would include the following:

- (1) Storm water erosion and sediment control measures for all deconstruction and/or construction activities;
- (2) Proper control of non-stormwater discharges;
- (3) Water application to exposed soil surfaces at least three times per day when needed for dust abatement; and
- (4) Hazardous spill prevention and response measures.

The Proposed Action would include the transfer of PacifiCorp land surrounding the Four Facilities (Parcel B lands) to a state agency. This agency would install fencing around these lands for the purposes of land management. It would prevent cattle access but would allow wildlife to pass.

#### **Terrestrial Resource Avoidance**

The DRE would take actions to avoid impacts that could include fencing wetlands, training employees about species present, excluding workers and construction activities on areas with sensitive species, and filling trenches and holes quickly to avoid trapping wildlife. Measures would be implemented during construction to avoid or reduce impacts to special-status birds and migratory birds in compliance with the Endangered Species Act, Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act. Specific avoidance measures would be developed in consultation with California Department of Fish and Game, Oregon Department of Fish and Wildlife (ODFW), and USFWS.

### **Repair Road Damage**

The DRE would repair any construction-related damage to surrounding roads.

### **Health and Safety Plan**

The DRE would prepare and implement a worker Health and Safety Plan prior to the start of construction activities.

### **Hazardous Materials Disposal**

If hazardous materials are encountered during construction or deconstruction activities, the DRE would use protocols for proper handling, transport, and disposal of the materials.

### **Traffic Signs**

The DRE would install signs to route construction traffic and warn other motorists about construction activities.

### **Work Area Isolation for Dam Removal**

The DRE would need to control water and isolate the work area from flowing water and aquatic organisms throughout the duration of construction. The DRE could control water in most areas using gravity diversions; however, pumps could be required to dewater isolated ponding. Pumps would be screened to prevent entrainment of fish. Prior to pumping, the DRE would conduct a fish rescue, as described below, within the screened area isolating the pump.

The DRE would work in wet conditions in areas that cannot be dried. For in-water work, physical barriers would isolate the work area. Barriers would consist of bulk bags, which are fabric bags filled with sand or gravel that can be stacked as “bricks” to temporarily isolate work areas. Alternately, the DRE could use steel sheets, concrete blocks, gravel berms, inflatable berms or plastic sheeting as physical barriers to isolate work areas. All barriers would be temporary, and would be removed after completing work.

A fish rescue would be conducted in all areas that cannot be drained in a manner that allows fish to volitionally depart the area. Fish rescue activities would follow each states’ regulations, rules, and policies and would be in accordance with the NOAA Fisheries Service and USFWS biological opinions on the Proposed Action.

#### ***2.4.3.5 Reservoir Restoration***

Under the Proposed Action, there would be substantial erosion of the reservoir sediment while the reservoirs were being drawn down. The eroded sediment would then be transported downstream. Following drawdown of the reservoirs, the DRE would complete restoration actions including revegetation, recreation area maintenance, and recreation area decommissioning, described in this section.

Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed reservoir sediment. Access for ground application equipment is expected to be limited immediately following drawdown due to terrain, slope, and sediment instability. Upper areas would be reseeded from a barge until the reservoir levels become too low to operate and access the barge. As the reservoirs are drawn down trucks will be used to apply hydroseed to all accessible areas. Aerial application

would be necessary for precision applications of material near the sensitive areas and the newly established river channel, as well as in the remaining areas inaccessible by barge or truck.

Additional fall seeding might be necessary to supplement areas where spring hydroseeding was unsuccessful. In cases where mulch moved/degraded or otherwise exposed bare soil, aerial hydroseeding would be used again for the fall re-seeding. In other cases, where establishment failed, yet the mulch remained intact, new seed material applications might need to be incorporated in order to re-establish seed/soil contact sufficient for germination.

### **J.C. Boyle**

Sediment in J.C. Boyle Reservoir is concentrated in the historical active channel and most of the sediment is near the dam. During drawdown, most of the sediment near the dam would be eroded from the reservoir area given the steep slopes on the reservoir floor. After drawdown, there would be minor amounts of sediment consolidation on the floodplain areas. Herbaceous species would be planted or would naturally recruit in the spring following drawdown. Woody species would gradually establish on the river terraces as they propagated from the outer edges of the reservoir.

### **Copco 1**

Among the reservoirs that would be removed, Copco 1 Reservoir contains the majority of the sediment and is the widest of the reservoirs. Most of the erosion would be focused in the main channel of the Reservoir where the thickness of the remaining sediment would be the greatest. Significant alluvial surface (the benches) would be exposed with drawdown of Copco 1. However, it is possible that reservoir sediment would remain in some of the side channels, particularly if dam removal occurred in a dry year.

After drawdown, the remaining sediments would begin to consolidate and decrease in thickness. Sediment erosion analysis indicates that allowing one high flow event (greater than 7,000 cfs) to pass through the reservoir area would minimize the need for sediment excavation after reservoir drawdown as part of the restoration effort. The erosion processes would be expected to occur during the winter season during the drawdown effort when the sediment would be the most erodible. Reestablishment of herbaceous species would occur soon after the revegetation in the spring. Woody species would be planted along the river banks and would establish over a period of years.

### **Iron Gate**

The reservoir sediment at Iron Gate Reservoir is relatively thin and the only thicknesses over 5 ft were found in the Jenny Creek delta. The river corridor is relatively narrow throughout the Iron Gate reach and the side slopes of the reservoir area are mostly steeper than 20 percent, with a substantial area steeper than 40 percent. Most of the sediment remaining after dam removal would be less than 3 feet thick.

There are far fewer alluvial surfaces in Iron Gate Reservoir than there are in Copco 1 Reservoir, and the resulting riparian corridor would be much narrower at Iron Gate Reservoir than at Copco 1 Reservoir. The tributaries are heavily vegetated with woody species upstream of Iron Gate Reservoir (Philip Williams & Associates 2009) and the tributaries are expected to reestablish a similar riparian and geomorphic condition in the exposed reservoir areas.

### 2.4.3.6 Recreation Facilities

The Proposed Action would change recreational opportunities from lake-based recreation to river-based recreation. Table 2-13 shows the change to existing facilities under the Proposed Action.

**Table 2-13. Recreation Facilities under the Proposed Action**

Site Name	Existing Facilities	Facilities Following Dam Removal
<i>Sites at J.C. Boyle Reservoir (Oregon)</i>		
Pioneer Park	Two day-use areas with picnic tables, fire rings, and portable toilets	All facilities would be removed
Topsy Campground	Campground, day-use area, boat launch	Site would be converted to river access facility. Boat ramp would either be extended to the river channel or removed. Other facilities would remain.
<i>Sites at Copco 1 Reservoir (California)</i>		
Mallard Cove	Day-use picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted.
Copco Cove	Picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted.
<i>Sites at Iron Gate Reservoir (California)</i>		
Fall Creek Trail	Day-use area and trail	This site would remain. There would be no improvements or changes.
Jenny Creek	Day-use area and campground	This site would remain. There would be no improvements or changes.
Wanaka Springs	Day-use area, campground, boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Camp Creek	Day-use area, campground, boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Juniper Point	Primitive campground and boat dock	All facilities would be removed. Parking area would be regraded, seeded, and planted
Mirror Cove	Campground and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Overlook Point	Day-use area	All facilities would be removed. Parking area would be regraded, seeded, and planted
Long Gulch	Picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Dutch Creek	Day-use area	All facilities would be removed. Parking area would be regraded, seeded, and planted
Iron Gate Fish Hatchery Public use Area	Day-use area and boat launch	This site would remain. There would be no improvements or changes.

Source: O'Meara et al 2010

#### **2.4.3.7 Keno Transfer**

As a connected action to removal of the Four Facilities, PacifiCorp would transfer ownership and operational responsibility of the Keno facility to the DOI. Reclamation is working with PacifiCorp on an Agreement in Principle for the transfer. They have a draft agreement, which will be further developed in preparation for a possible Affirmative Determination.

Prior to the transfer, PacifiCorp would complete any necessary improvements to the facility in order to meet DOI Directives and Standards for dam safety. Prior to the transfer, the facility would be operated under the terms of the existing contract signed in 1968 between PacifiCorp and Reclamation. Following the transfer, DOI would continue to operate the facility consistent with the terms of the same contract and with historic practices (KHSA Sections 7.5.3 & 7.5.4). Thus, operations under DOI would be consistent with the historic operations of the facility in place since the existing contract was signed on January 4, 1968; therefore, there would be no changes to operations or the surrounding areas as a result of the transfer. Future upgrades at the Keno facility by DOI would be subject to additional NEPA compliance.

#### **2.4.3.8 East Side/West Side Facility Decommissioning – Programmatic Measure**

In the event of an affirmative Secretarial Determination, under a plan outlined in the KHSA, PacifiCorp would apply to FERC for a partial surrender of its license of the East and West Side facilities in order to decommission the generating facilities (KHSA section 6.4.1(A)). PacifiCorp would be responsible for the decommissioning and for recovering its costs through “standard ratemaking procedures” (KHSA 6.4.1(B)). Once the decommissioning was completed, the lands associated with the East and West Side facilities would be transferred to DOI.

The two facilities were proposed for decommissioning in PacifiCorp’s 2004 relicensing application. Removing the two facilities would result in the loss of 3.8 megawatts (MW) of generating capacity and the removal of the generating infrastructure. The dams and associated infrastructure were built in 1921, and would require upgrading and maintenance to remain in compliance with DOI and FERC standards. The Link River Dam, which is the point of diversion for the two generating facilities, is already owned by Reclamation.

#### **2.4.3.9 KBRA – Programmatic Measures**

As described in Chapter 1, the KBRA is connected to the KHSA. The KBRA is also a basin-wide approach to addressing the current resources challenges. The KBRA will be signed by the United States upon congressional authorization.<sup>3</sup> The complete KBRA package entails various commitments and actions that have been or will be proposed and/or undertaken in the basin by federal, state, local, tribal, and private interests. Some of the KBRA actions could have effects (whether adverse or beneficial) on the same environmental resources that would be affected by dam removal. Some KBRA actions are expressly preconditioned by and therefore hinge upon dam removal, and an affirmative Secretarial Determination. Some KBRA actions are federal but are not expressly linked to dam removal, and some actions are completely between private parties.

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<sup>3</sup> Under the KHSA and KBRA (Agreements) the United States will be a party to the KBRA at the time of a Secretarial determination under the KHSA, and obligated to implement the KBRA according to its terms.

### **NEPA Specific Analysis**

The federal lead agency, the DOI, is analyzing the KBRA as a connected action. NEPA defines connected actions as those actions that are closely related or cannot or will not proceed unless other actions are taken previously or simultaneously (40 CFR 1508.25(a)(1)(ii)).<sup>4</sup> Some actions or component elements of the KBRA are independent obligations and thus have independent utility from the KHSA, but the implementation of several significant elements of the KBRA package would be different, if the determination under the KHSA is not to pursue full dam removal. Recognizing that implementation of many elements of the KBRA are unknown and not reasonably foreseeable at this time, the connected action analysis is being undertaken at a programmatic level. Consequently, appropriate NEPA compliance will be completed for the KBRA in the future.

For purposes of this analysis, the KBRA is viewed as a whole program even though some of its component parts are currently being implemented (those without a federal nexus or not subject to environmental review) or could be implemented on an individual basis without dam removal. One of the reasons the KBRA is treated as a whole for purposes of this analysis under NEPA is that the individual activities under the KBRA will be implemented, through adaptive management and in close coordination with committees comprised of stakeholders, in a manner that seeks to attain synergy and optimize benefits through a coordinated, holistic approach to restoration and water management. Implementing those KBRA activities that are not connected to facilities removal on an individual basis without the benefit of adaptive management and stakeholder input will likely not provide the same level of optimization.

Consequently, for purposes of NEPA, in the EIS for alternatives where dams are not removed, the KBRA, as currently signed by the parties, would not be implemented. This is not a judgment about whether any particular measure in the KBRA will be implemented in the absence of dam removal. Rather, it is an assumption that in the absence of dam removal, the KBRA will not include all of the components present in their current form. This means that this document does not make decisions about implementing any specific program, plan, commitment, or activity under the KBRA if dams are not removed. Federal decisions on specific measures in the KBRA, including any necessary additional environmental review, will be made in a separate process. This document will be used to make a decision related only to dam removal but in doing so, NEPA requires we properly scope the alternative and impacts analysis.

### **CEQA Specific Analysis**

For purposes of CEQA, relevant parts of the KBRA analysis are programmatic, as described in Section 15168 of the CEQA Guidelines. This decision was made because many of its component elements have not been specified to a degree where the associated impacts would be reasonably foreseeable for purposes of this environmental analysis. The parties recognize that future project-specific analysis may be required for various components of the KBRA as they become more clearly defined and if an affirmative public approval is identified. A program-level document is

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<sup>4</sup> We acknowledge, however, that the KBRA could also be analyzed as a cumulative or similar action under 40 CFR 1508.25(a)(2) and (3). We note that all three definitions (connected action, cumulative actions, and similar actions) are within the section that provides parameters for the “scope” of the action, which determines both the range of alternatives and the impacts to be considered in an EIS. Ultimately, however, we believe the important point is not the labeling but the analysis and whether the decision (in this case whether to remove four dams) is informed by a EIS that is proper in scope.

appropriate when a project consists of a series of smaller projects or phases that may be implemented separately. Under the programmatic EIR approach, future projects or phases may require additional, project-specific environmental analysis. It should also be noted that this EIR makes certain assumptions about the foreseeable effects of KBRA based on existing information, including, among other things, how the fishery and water resources programs may be designed and implemented. The lead agency understands that subsequent analysis during permitting of dam removal may be required by any public entity in California with an approval or permitting obligation if the circumstances specified by CEQA Guidelines section 15162(a) are triggered.

Importantly, California could have analyzed the associated impacts of the KBRA relative to the KHSA in the indirect and cumulative impacts analysis portion of the KHSA EIR as it is not affirmatively approving or carrying out any one aspect of the KBRA that would be subject to environmental review. California recognizes it is not “approving” any discretionary portion of the KBRA that could alter the physical environment and that by signing the KBRA it has already executed and committed to the agreement itself. Thus, similarly to the EIS, there are no alternatives that consider what a new or revised KBRA might look like in the event dams are not removed. Rather, to avoid confusion, duplication, and wasted resources, California has determined that the concurrent and connected nature of the KBRA to the KHSA warrants a clear understanding of its potentially significant impacts and that the approach of programmatic analysis is equally, if not more, sufficient for providing that information to decision-makers.

Thus, out of an abundance of caution, and to ensure full transparency, California has agreed to consider significance determinations for those portions of the KBRA elements located within California consistent with CEQA Guideline section 21080(b)(14) of the Public Resources Code, and CEQA Guidelines Section 15277 in a programmatic fashion. However, it too considers the proposed actions by California to be implementation of the KHSA and thus has crafted alternatives only for dam removal itself, assuming that absent full facilities removal the relevant elements of the KBRA will no longer be ascertainable. The lead agency recognizes that in the event subsequent analysis is deemed appropriate, it will be required to consider any feasible alternatives, mitigation measures, and any other elements required by CEQA as the basis for any approval of such KBRA project or phase in accordance with existing law.

### **Implementation**

Non-federal parties who have signed the KBRA include states, tribes, counties, irrigators, and other organizations (Table 2-14). Prior to the enactment of federal authorizing legislation, federal agencies are not parties to the KBRA. However, DOI, NOAA Fisheries Service, and the United States Department of Agriculture have each expressed their intent to take actions consistent with the KBRA to the extent that such actions are consistent with the agency’s existing legal authorities and appropriations available for such purposes. These federal agencies have each sent separate letters to the non-federal parties expressing this intent.

Upon the enactment of authorizing legislation, NOAA Fisheries Service, United States Forest Service (USFS), Bureau of Indian Affairs, Bureau of Land Management, Reclamation, and the USFWS would become parties to the KBRA. Additional appropriations would likely be necessary for these agencies to fully implement their responsibilities under the agreement.

**Table 2-14. Non-Federal Parties to the KBRA**

Karuk Tribe	Malin Irrigation District
Klamath Tribes	Midland District Improvement Company
Yurok Tribe	Pioneer District Improvement Company
California Department of Fish and Game	Plevna District Improvement Company
California Natural Resources Agency	Reames Golf and Country Club
Oregon Department of Environmental Quality	Shasta View Irrigation District
Oregon Department of Fish and Wildlife	Sunnyside Irrigation District
Oregon Water Resources Department	Tulelake Irrigation District
Humboldt County, California	Van Brimmer Ditch Company
Klamath County, Oregon	Randolph and Jane Walthall 1995 Trust
Ady District Improvement Company	Westside Improvement District #4
Collins Products, LLC	Winema Hunting Lodge, Inc.
Enterprise Irrigation District	Upper Klamath Water Users Association
Don Johnston & Son	American Rivers
Inter-County Properties Company	California Trout
Klamath Irrigation District	Institute for Fisheries Resources
Klamath Drainage District	Northern California/Nevada Council Federation of Fly Fishers
Klamath Basin Improvement District	Pacific Coast Federation of Fisherman’s Associations
Klamath Water Users Association	Salmon River Restoration Council
Klamath Water and Power Agency	Trout Unlimited
Bradley S. Luscombe	

The “interim period” is the time between the signing of the KBRA and full implementation of the limits on water diversions to Reclamation’s Klamath Project. The events that must occur to allow the full implementation of water diversion limits include the removal of the Four Facilities under the KHSA as well as other conditions listed in KBRA Sections 15.3.4 and 15.3.1.A.

While the water diversions to Reclamation’s Klamath Project users are not enforceable during the interim period, water diversions would conform to the limits described below in the Diversion Limitations section as closely as possible. Until the On-Project Plan is fully implemented, it might not be possible for water to be managed consistent with the diversion limitations in all years because there are an insufficient number and amount of water measuring devices and control structures.

Programs or activities that are scheduled to occur prior to the enactment of authorizing legislation would be conducted under existing authorities (see on-going activities in Table 2-15). However, implementation of most interim period activities would be dependent on appropriate authorizing legislation through Congress.

**Table 2-15. Summary of KBRA Programs**

Program <sup>1</sup>	On-Going Activities	Increased in Magnitude or Accelerated Schedule with KBRA	New Program initiated by KBRA
<b>Fisheries Programs:</b>			
Fish Habitat Restoration Activities <sup>2</sup>	X	X	
Fisheries Restoration Phase I Plan		X	X
Fisheries Restoration Phase II Plan			X
Fisheries Reintroduction Plan – Phase I, Oregon			X
Fisheries Reintroduction Plan – Phase II, Oregon			X
Fisheries Reintroduction Plan – California			X
Fisheries Monitoring Plan		X	
<b>Additional Water Storage Projects:</b>			
Williamson River Delta Project	X <sup>3</sup>	X	
Agency Lake and Barnes Ranches Project	X <sup>3</sup>	X	
Wood River Wetland Restoration Project			X
Future storage opportunities			X <sup>4</sup>
<b>Water and Power Programs:</b>			
Water Diversion Allocations for Reclamation's Klamath Project and National Wildlife Refuges (NWR)			X <sup>5</sup>
Groundwater Technical Investigations			X
On-Project Plan			X
Winter Shortage Plan			X
Water Use Retirement Program (WURP)			X
Off-Project Water Settlement (OPWAS)			X
Off-Project Reliance Program			X
Power for Water Management Program			X
Drought Plan			X
Emergency Response Plan			X
Climate Change Assessment	X <sup>3</sup>	X	
Environmental Water Management			X
Interim Flow and Lake Level Program			X
<b>Regulatory Assurances Programs:</b>			
Fish Entrainment Reduction			X
General Conservation Plan or Habitat Conservation Plan			X
<b>County and Tribal Programs:</b>			
Klamath County Economic Development Plan			X
California Water Bond Legislation (Siskiyou County Economic Development Funding)			X
Tribal Programs Fisheries and Conservation Management			X
Tribal Programs Economic Revitalization			X
Mazama Forest Project			X
Klamath Tribes Interim Fishing Site			X

Notes

1. "Plans" include both the development of the plan and the implementation of the plan.
2. While on-going fish habitat restoration activities are not part of the Proposed Action because they are conducted under current authorities and funding levels, the scope of these activities would be increased in magnitude and accelerated through implementation of the KBRA. Habitat restoration under the Proposed Action would be guided by the Fisheries Restoration Plan to be developed under the KBRA.
3. Action is considered part of the No Action/No Project Alternative
4. Development of additional storage would occur with implementation of KBRA and associated funding.
5. During the Interim Period, water diversion limitations to Reclamation's Klamath Project users would conform to the limits described in the Diversion Limitations section as closely as possible. However, before full implementation of the On-Project Plan, it might not be possible to fully comply with the diversion limitations in all years.

With enactment of authorizing legislation there would be the potential for additional funding to enhance some of the ongoing programs. In Table 2-15, these are shown as programs that would be increased in magnitude or would be accelerated in schedule with implementation of the KBRA in Table 2-15. Most of the programs described in the KBRA would only occur with the enactment of federal authorizing legislation and approval of funding at both the federal and state levels.

The plans and programs described in the KBRA lead through a series of milestones that culminate in the formal relinquishment of claims for damages, permanent assurances related to tribal water rights, and limitations on water diversions to Reclamation's Klamath Project. Long-term implementation would occur after the full implementation of the water diversion limitations.

The KBRA does not supersede existing federal laws such as NEPA and ESA. Programs to be developed and implemented under the KBRA would still be subject to review and analysis and would need to comply with federal statutory authorities.

The programs proposed by the KBRA and shown in Table 2-15 are considered to be connected to the Proposed Action (except as noted). This list includes plans and programs that would only be implemented through enactment of authorizing legislation and ongoing programs that would be enhanced by additional funding resulting from authorizing legislation. The portion of ongoing actions that would be amplified following enactment of authorizing legislation are considered a part of the Proposed Action and the portion that would be implemented regardless is considered under the No Action/No Project Alternative as noted above in Section 2.3.2.

### **Fisheries Program**

The Fisheries Program of the KBRA has three main goals:

- A. Restore and maintain ecological functionality and connectivity to historic habitat.
- B. Re-establish and maintain naturally sustainable and viable populations of fish to the full capacity of the restored habitats.
- C. Provide for full participation in harvest opportunities.

**To meet these goals, the parties to the KBRA agreed to prepare and implement fisheries restoration, reintroduction and monitoring plans and to provide additional sources of instream water to support fish.**

### **Fisheries Restoration Plans**

The Phase I Fisheries Restoration Plan is intended to establish restoration priorities and criteria for restoration project selection for the immediate future through 2020 (KBRA Section 10.1). The plan is to be prepared by basin Fish Managers who are defined in the KBRA as federal, state, or tribal agencies that have responsibility under applicable laws to manage one or more fish species or their habitat in the Klamath Basin. USFWS and NOAA Fisheries Service are to be the co-leads for administrative tasks related to the preparation of both the Phase I and Phase II Restoration Plans. Under the schedule anticipated in the KBRA, the Phase I Plan would be completed in March 2012.

The effectiveness of Phase I restoration activities would be monitored under the Fisheries Monitoring Plan. Monitoring results would be used in the development of the Phase II Restoration Plan to adjust the recommended mix of restoration activities, priorities, and/or project locations to more effectively restore aquatic habitats. The Phase II Fisheries Restoration Plan would establish long-term restoration priorities and an adaptive management process to maintain fish restoration through 2060. The Draft Phase II Restoration Plan is to be prepared within 7 years of the finalization of the Phase I plan, and a final plan is to be completed by March 31, 2022 (KBRA Section 10.2).

Implementation of the Phase I plan could include actions for restoration of existing fisheries in the upper basin, as well as actions necessary to prepare for reintroduction of anadromous fish upstream of Iron Gate Dam. Specific elements could include restoration and protection of riparian vegetation, water quality improvements, restoration of stream channel functions, measures to prevent excessive sediment inputs, remediation of fish passage blockages, and prevention of entrainment into diversions (KBRA Section 10.1.2). See Table 2-16 for a geographic breakdown of when and where restoration activities would occur.

Restoration activities similar to the general classes of actions described in the KBRA currently occur throughout the basin as funding is available. It is also expected that the Phase I Restoration Plan would build upon existing activities and identified restoration needs and that implementation would include the same types of restoration activities that are currently conducted within the basin. Activities would be prioritized under the Plan and additional funding that may become available under the KBRA would allow greater improvements to be realized than would occur without the KBRA.

Restoration activities are being conducted downstream of Iron Gate Dam on the mainstem and tributaries as well as in the upper basin subject to funding availability. The same types of activities would be expected to be conducted under the KBRA fish restoration program and would include the following types of work:

- Floodplain rehabilitation work includes activities to improve or restore connections between channels and floodplains to create and maintain off-channel habitat accessible to overwintering juvenile salmonids. Floodplain rehabilitation could include activities such as riparian planting and understory thinning, to facilitate the development of mature riparian stands that would provide shading and large and small wood to stream channels and floodplains; wetland restoration; and levee setback or dike removal to reconnect floodplain hydrology.
- Large woody debris placement could include both mobile wood and complex structures and could be used to create off-channel habitat or provide cover in pools.
- Correction of fish passage issues could include culvert upgrades or replacement to meet current fish passage standards and correction of other fish blockages to provide access to new or historic habitats.

**Table 2-16. KBRA Fisheries Restoration Projects**

<b>KBRA Project</b>	<b>Anticipated Schedule</b>
Preparation Phase I Restoration Plan	2012–2013
Preparation Phase II Restoration Plan	2018–2019
Williamson River Aquatic Habitat Restoration	2012–2021
Sprague River Aquatic Habitat Restoration	2012–2021
Wood River Aquatic Habitat Restoration	2012–2021
Williamson Sprague Wood Screening Diversion	2012–2014
Williamson and Sprague USFS Uplands	2012–2021
Upper Klamath Lake Aquatic Habitat Restoration	2012–2021
Screening of Upper Klamath Lake Pumps	2012–2014
Upper Klamath Lake Watershed USFS Uplands	2013–2016
Keno Reservoir Water Quantity Studies and Remediation Actions	2012–2021
Keno Reservoir Wetlands Restoration	2013–2017
Keno to Iron Gate Upland Private and Bureau of Land Management	2012–2021
Keno to Iron Gate Upland USFS (Goosenest)	2012–2021
Keno to Iron Gate Mainstem Restoration	2012–2021
Keno to Iron Gate Tributaries – Diversions and Riparian	2016–2018
Shasta River Aquatic Habitat Restoration	2012–2021
Shasta River USFS Uplands	2012–2021
Scott River Aquatic Habitat Restoration	2012–2021
Scott River USFS Uplands	2012–2021
Scott River Private Uplands	2013–2019
Mid-Klamath River and Tributaries (Iron Gate to Weitchpec) Aquatic Habitat Restoration	2012–2021
Mid-Klamath Tributaries USFS Upland	2012–2021
Mid-Klamath Tributaries Private Upland	2012–2021
Lower Klamath River and Tributaries (Weitchpec to Mouth) Aquatic Habitat Restoration	2012–2021
Lower Klamath Private Uplands	2012–2021
Salmon River Aquatic Habitat Restoration	2013–2018
Salmon River USFS Upland	2012–2021

Source: KBRA Appendix C-2

Key:

USFS: United States Forest Service

- Cattle exclusion typically includes the construction of fencing to prevent cattle from trampling stream banks, which allows riparian vegetation to grow. Cattle exclusion is often conducted in conjunction with riparian planting. Cattle exclusion fencing would only be implemented in accordance with applicable federal, state and county regulation and guidance.
- Mechanical thinning and prescribed burning are used to mimic some of the functions and characteristics historically provided by a natural fire regime. Thinning and prescribed burning reduce the potential for more catastrophic fires and the erosion that often follows.
- Purchases of conservation easements and land from willing sellers allow for more direct land management for habitat enhancement purposes.
- Decommissioning of roads could reduce road densities in areas with a high potential for failure and could stabilize slopes. Road failures can be a major source of chronic sediment inputs into stream systems.
- Gravel augmentation involves the direct placement of spawning-size gravel into the stream channel. Gravel augmentation could increase spawning habitat in systems by increasing the amount of area with suitable substrate. Currently, suitable spawning gravel substrate is limited due to capture of gravels behind dams or armoring of channel banks, or it could be covered with fines from sedimentation.
- Treatment of fine sediment sources could include a broad array of actions including management of stormwater runoff from roads and other developed areas, agricultural and forestry management practices, and other specific actions depending on the sources of fine sediments.
- Screening of diversion structures on the Williamson, Sprague and Wood Rivers and Upper Klamath Lake (UKL) pumps. (This activity is separate from the fish entrainment reduction activities proposed on Reclamation's Klamath Project facilities as described under the Regulatory Assurances Program.)
- Above UKL, activities may include restoration easements and grassbanks that facilitate habitat improvement and landowner economic stability.

### **Fisheries Reintroduction Plans**

Under the KBRA, the states of California and Oregon would each prepare separate Fisheries Reintroduction plans that identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam (KBRA Section 11). The Phase I reintroduction plans would be prepared if there is an Affirmative Determination and each state concurs with that Determination. Reintroduction activities specifically exclude the Trinity River watershed upstream of the confluence with the Klamath River; Lost River and its tributaries; and Tule Lake basin.

The Oregon Phase I Reintroduction Plan, to be prepared by the ODFW and the Klamath Tribes, would identify the facilities and actions necessary to start reintroduction and would be adaptable in order to incorporate information gained from the monitoring program. ODFW, the Klamath Tribes, and other Fish Managers would be responsible for implementation of the Phase I Reintroduction Plan.

Phase I reintroduction upstream of Upper Klamath Lake may include active intervention and movement of fish into suitable habitats (KBRA Section 11.3). This could include facilities for

collection, transport, and acclimation of fish. Fish would be collected and transported over the Four Facilities prior to dam removal, and trap and haul operations would occur at Keno Dam until water quality conditions no longer required them. A variety of release and rearing strategies would be utilized to optimize success; however, the KBRA does not contain specifics on what those strategies might include.

The California Phase I Reintroduction Plan, to be developed by the California Department of Fish and Game, would adopt a passive approach including development of reintroduction goals, monitoring protocols, habitat assessments, and strategies for adapting the plan as additional information is developed (KBRA Section 11.4). The Phase I Reintroduction Plan would also include development of guidelines for the use of a conservation hatchery at Iron Gate Dam or on Fall Creek to more quickly establish naturally producing populations in the wild if deemed necessary.

Once self-sustaining populations were established, Phase II Reintroduction Plans would be developed to integrate anadromous fisheries into each state’s harvest management plans. Fisheries management, including the setting of harvest levels, would be in accordance with the goal of maintaining a sustainable fishery throughout the basin. A schedule for Phase II Reintroduction Plans cannot be established at this time as it is dependent on the success of the establishment of anadromous fisheries in the upper Klamath Basin.

See Table 2-17 for the general classes of actions that could occur under the Fisheries Reintroduction program during the interim period.

**Table 2-17. KBRA Fisheries Reintroduction Projects**

<b>KBRA Project</b>	<b>Anticipated Schedule</b>
Reintroduction Plan	2012–2021
Collection Facility	2012–2021
Production Facility	2012–2021
Acclimation Facility	2012–2021
Transport	2015–2021
Monitoring and Evaluation	2012–2021
Hatchery Facilities (at Iron Gate Dam or Fall Creek)	2012–2021

Source: KBRA Appendix C-2

**Fisheries Monitoring Plan**

The Fisheries Monitoring Plan is intended to direct a cohesive effort to monitor the status and population trends of Chinook and coho salmon, steelhead trout, resident rainbow/redband trout, lamprey, suckers, bull trout, sturgeon, and eulachon (KBRA Section 12.2). Monitoring programs would also collect data on water quantity (*e.g.*, instream flows and Upper Klamath Lake level elevations), water quality (*e.g.*, temperature, nutrient loading, sediment, and algae), the effectiveness of restoration activities, and factors that may limit recovery of fish populations (KBRA Section 12.2).

The Monitoring Plan, to be prepared by the Fish Managers, is scheduled to be completed by March 2012. The results of the monitoring program are to be reviewed in 2020 and 2030 at a minimum. Adjustments in proposed restoration activities would be made on the basis of the results of the monitoring program.

Table 2-18 lists the general classes of actions that may occur under the Fisheries Monitoring program.

**Table 2-18. KBRA Fisheries Monitoring Projects**

<b>KBRA Project</b>	<b>Anticipated Schedule</b>
Adult Salmonids	2013 start
Juvenile Salmonids	2013 start
Genetics Otololith	2013 start
Hatchery Tagging	2013 start
Disease	2013 start
Green Sturgeon	2013 start
Lamprey	2013 start
Geomorphology	2013 start
Habitat Monitoring	2013 start
Water Quality	2013 start
Upper Klamath Lake Bloom Dynamics	2014 start
Upper Klamath Lake Water Quality/Phytoplankton/Zooplankton	2012–2021
Upper Klamath Lake Internal Load/Bloom Dynamics	2014 start
Upper Klamath Lake External Nutrient Loading	2012–2021
Upper Klamath Lake Analysis of Long-term Data Sets	2014 and 2019 only
Upper Klamath Lake Listed Suckers	2012–2021
Tributaries Water Quality/Nutrients/Sediment	2012–2021
Tributaries Geomorphology/Riparian Vegetation	2012–2021
Tributaries Physical Habitat	2012–2021
Tributaries Listed Suckers	2013 start
Keno Reservoir Water Quality/Algae/Nutrients	2012–2021
Keno Reservoir to Tributaries: Meteorology (Weather Stations)	2012–2021
Remote Sensing Acquisition and Analysis	2013, 2016, and 2019 only

*Source: KBRA Appendix C-2*

### **Additional Water for Fish**

Many of the components of the KBRA are intended to result in additional instream flows and to retain water in Upper Klamath Lake in order to support fisheries restoration. Most of these actions are intended to benefit both anadromous and sucker populations regardless of the effects of dam removal. A cornerstone of the KBRA is the agreement to limit diversions to Reclamation’s Klamath Project in exchange for certain assurances among the parties in the

Oregon water rights adjudication process and with respect to the exercise of certain tribal water rights

Most of the programs that provide additional water for fish are organized under the Water Programs section of the KBRA and are described in greater detail below. These programs include the following:

- Limit on diversions to Reclamation’s Klamath Project.
- Interim program of water lease and purchase to reduce diversions from the Klamath River and from tributaries upstream of Upper Klamath Lake.
- Voluntary Water Use Retirement Program (WURP) in upper basin to add up to 30,000 acre-feet of instream water per year to the Upper Klamath Basin including Wood River, Sprague River, Sycan River (except Sycan Marsh), and Williamson River.
- Increased water storage and conservation through specific projects including the following:
  - Breach levees on Williamson River Delta (Completed) - added 28,000 acre-feet of storage.
  - Reconnect Barnes and Agency Lake Ranches to Agency Lake (under study) - would add 63,700 acre-feet of storage.
  - The Wood River Wetlands would add 16,000 acre-feet of storage (under study).
- Monitor groundwater use to ensure that river flows and specified springs are not adversely affected.
- Assess effects of climate change for adaptive management of water resources. Provide at least an additional 10,000 acre-feet of storage in the Upper Basin to allow increased diversions in some years, to mitigate effects of drought, and/or to further fish restoration goals.

### **Additional Water Storage Projects**

Section 18 of the KBRA includes three restoration projects intended to increase the amount of water storage in the Upper Klamath Basin. Full implementation of the KBRA is linked to the completion of specific milestones in these projects.

#### Wood River Wetland Restoration Project

Bureau of Land Management presently manages the Wood River Wetlands for the purpose of restoring wetlands adjacent to Agency Lake. Under the KBRA, Bureau of Land Management would conduct a study, with input from other KBRA parties, to consider options for managing the Wood River Wetland area that would include operating it as a pumped storage within existing dikes or fully reconnecting the area to Agency Lake by breaching the dikes (KBRA Section 18.2.3). The intent is to provide additional water storage for a total of 16,000 acre-feet of potential water storage capacity between elevations 4,143.3 and 4,136.0 feet. Once the study is completed and a proposed action selected, the appropriate level of NEPA analysis and associated Endangered Species Act (ESA) consultation would need to be conducted. The anticipated schedule for the Wood River Wetland Restoration Project is 2013–2015 (KBRA Appendix C-2). Full implementation of the diversion limitations and associated assurances under the KBRA is linked to completion of the study, NEPA analysis, and ESA compliance and to funding for implementation of the selected alternative.

### Agency Lake Ranch and Barnes Ranch Project

In 2007, the Agency Lake/Barnes Ranches were transferred to USFWS to be managed as part of the Upper Klamath National Wildlife Refuge (NWR). Under the KBRA, USFWS would conduct a study with input from other KBRA parties, to consider options for managing the Agency Lake/Barnes Ranches area to enhance water management flexibility in providing benefits for water storage, fish, wildlife, and wetland habitats (KBRA Section 18.2.2). Potential options would include continuing to operate the area as a pumped storage facility or breaching lakeshore levees and reconnecting the land to Agency Lake. The restoration of diked and drained portions of the ranches could add 63,770 acre-feet of potential storage capacity to Upper Klamath Lake between elevations 4,143.3 and 4,136.0 feet. Once the study is completed and a proposed action is selected, the appropriate level of NEPA analysis and associated ESA compliance would need to be conducted. The anticipated schedule for the Agency Lake/Barnes Ranches Project is between 2013 and 2015 (KBRA Appendix C-2). Full implementation of the diversion limitations and associated assurances under the KBRA is linked to completion of the study, NEPA analysis, and ESA compliance and to funding for implementation of the selected alternative.

### Additional Water Storage

The KBRA includes provisions for further investigation and acquisition of at least an additional 10,000 acre-feet of storage (KBRA Section 18.3 and 15.1.1). This additional storage capacity would be in addition to the instream water and Upper Klamath Lake water storage benefits expected from the WURP and the water storage projects described above. Any project identified in the future that could provide this additional storage may need to comply with separate NEPA evaluations prior to implementation. The first 10,000 acre-feet of additional storage capacity is one of the identified milestones that would allow for increased diversion to Reclamation's Klamath Project users during the irrigation season in some years (KBRA Section 15.1.1).

### Water and Power Programs

The Water and Power Programs in the KBRA address water supply reliability and power affordability for on- and off-Project agricultural users, and for moving water through the area of Reclamation's Klamath Project (Figure 2-13). These plans are intended to help all water users in the basin to be better prepared for reasonably foreseeable events and unexpected conditions.

Plans and programs to be developed and implemented under the Water and Power Program of the KBRA are described in the following sections and include:

- On-Project Plan
- Winter Shortage Plan
- WURP
- Off-Project Water Settlement
- Off-Project Reliance Program Plan
- Power for Water Management Plan
- Drought Plan
- Emergency Response Plan
- Climate Change Evaluation
- Interim Flow and Lake Level Protection Plan
- Environmental Water Program

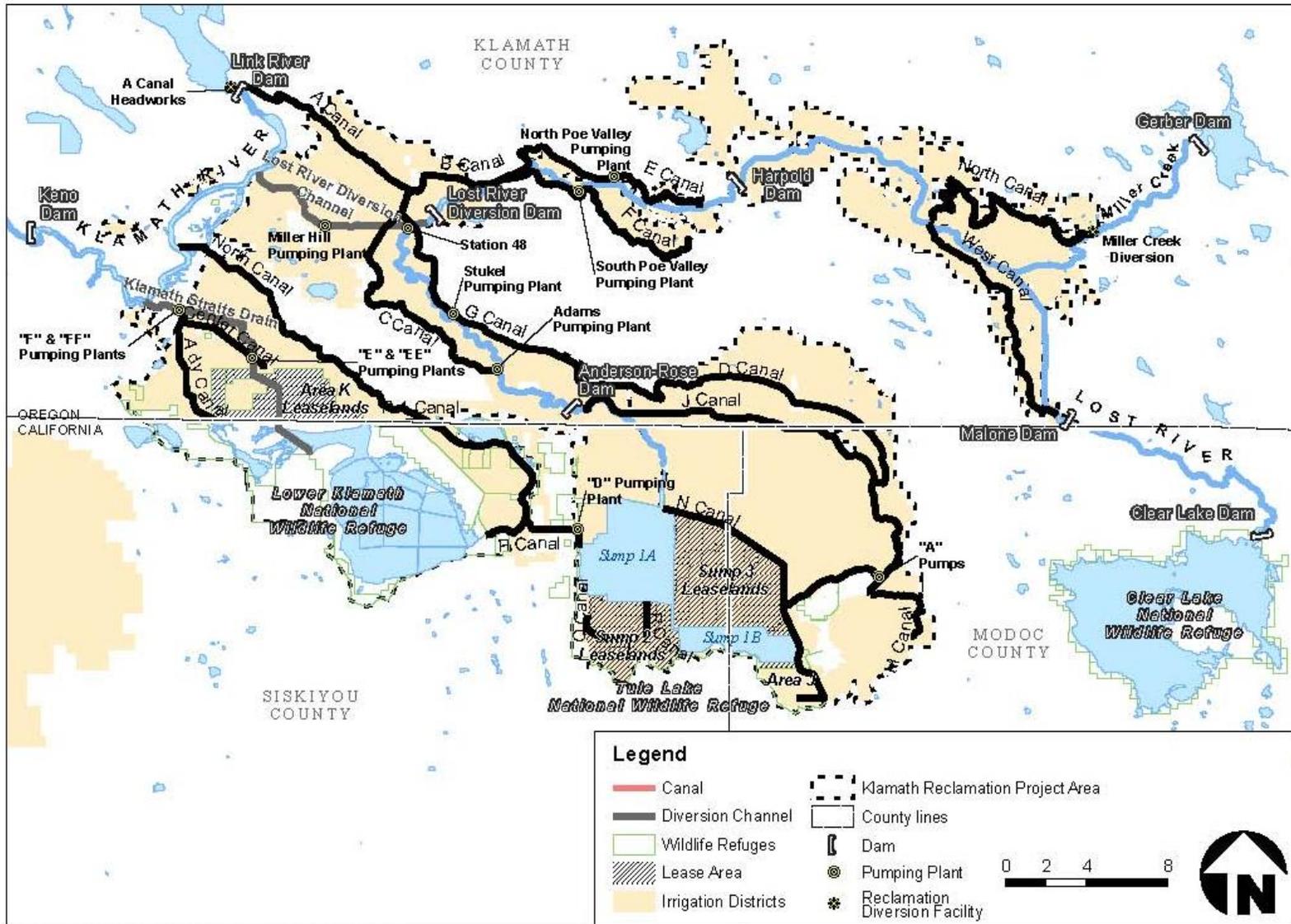


Figure 2-13. On-Project Area

## On-Project Water Management

### Diversion Limitations

The proposed limitations on diversions to Reclamation’s Klamath Project are described in Section 15 and Appendix E-1 of the KBRA. The diversion limitations would result in the availability of irrigation water to be approximately 100,000 acre-feet less than the current demand in the driest years to protect mainstem flows. Implementation of the diversion limitations would include assurances of increased reliability of diversions.

The amount of water that can be diverted to on-Project users, including the Lower Klamath NWR and Tule Lake NWR, varies by season and by water year forecast (whether a year is forecast to be wet or dry) (Table 2-19). The forecast to be used to set diversion limits each year is the Natural Resources Conservation Service 50 percent exceedence forecast for net inflow to Upper Klamath Lake. The 50 percent exceedence forecast is a prediction that there is a 50 percent chance that the actual stream flow will exceed the forecast value (and a 50 percent chance that flows will be less than the forecast value). Although Reclamation’s Klamath Project diverts water from a variety of sources, the Upper Klamath Lake forecast would be used to set the diversion limits each Spring and would generally characterize whether a particular year is expected to be wet or dry.

**Table 2-19. Reclamation’s Klamath Project Diversion Limitations per KBRA Appendix E-1**

Season	Forecast (acre-feet) <sup>1</sup>	Diversion Limits (acre-feet)
<b>Phase I<sup>2</sup></b>		
March–October		
	287,000 or less	378,000 (which includes a 48,000 Refuge Allocation (RA))
	287,000 to 569,000	378,000 to 420,640 (which includes 48,000 to 55,640 for the RA) <sup>3</sup>
	More than 569,000	445,000 (which includes a 60,000 RA)
November–February	N/A	80,000 (which includes a 35,000 RA)
<b>Phase II<sup>2</sup></b>		
March–October		
	287,000 or less	388,000 (which includes a 48,000 RA)
	287,000 to 569,000	388,000 to 430,640 (which includes 48,000 to 55,640 for the RA) <sup>4</sup>
	More than 569,000	445,000 (which includes a 60,000 RA)
November–February	N/A	80,000 (which includes a 35,000 RA)

Notes

1. “Forecast” means the March 1<sup>st</sup> Natural Resources Conservation Service 50% exceedence forecast (meaning there is a 50% chance that flow will exceed the forecast amount) for net inflow to Upper Klamath Lake during the period of April 1 to September 30.
2. Phase I of the diversion limits represent the baseline agreement. Phase II allows additional diversions up to 10,000 acre-feet under certain circumstances and would apply after i) the physical removal of the dams and a free-flowing condition and volitional fish passage has been restored; or ii) 10,000 acre-feet of new storage has been developed in the upper basin; or iii) determination after February 1, 2020 that the increase is appropriate.
3. The Phase I allowable diversion in thousands of acre-feet is calculated by the formula  $378 + \{42.64 \times [(Forecast - 287) / 282]\}$  and the refuge allocation is calculated by the formula  $48 + \{7.64 \times [(Forecast - 287) / 282]\}$ .
4. The Phase II allowable diversion in thousands of acre-feet is calculated by the formula  $388 + \{42.64 \times [(Forecast - 287) / 282]\}$  and the refuge allocation is calculated by the formula  $48 + \{7.64 \times [(Forecast - 287) / 282]\}$ .

Reclamation's Klamath Project would follow these limitations as much as practicable during the interim period before full implementation of the On-Project Plan. The On-Project Plan would identify what measures might be needed to fully implement the diversion limitations, such as conservation easements or efficiency measures. However, until the On-Project Plan is fully implemented, it might not be possible for water managers to comply completely with the diversion limitations in all years. Full implementation of the On-Project Plan is defined as completion of any measures necessary to allow full implementation of the diversion limitations.

The diversion limitations would not be binding on the parties to the KBRA until Appendix E-1 is filed in an appropriate forum. Appendix E-1 is currently formatted as a filing in the Oregon Water Resources Department (OWRD) water rights adjudication process; however, it is anticipated that that adjudication process will be completed before the Appendix is filed. In that case, the appendix would be reformatted for filing with the most appropriate forum and context, which likely would include a filing with OWRD as it concerns matters of water rights. Prior to filing, the appendix would be signed by the Department of the Interior, Reclamation and USFWS, and irrigation districts within the Klamath Project. Figure 2-14 shows the key KBRA milestones towards full implementation of diversion limits.

#### Additional On-Project Water Management Provisions

The KBRA contains additional provisions regarding management of water and facilities on Reclamation's Klamath Project. These provisions include direction on a) developing a plan for how water would be allocated and delivered to the Lower Klamath NWR; b) management of lease lands at the Lower Klamath NWR and Tule Lake NWR; c) the use of groundwater and a prohibition on adverse impacts to certain springs; d) payment schedule for D Pumping Plant costs; and e) management of Keno and Link River Dams.

#### Refuge Allocation and Management

The refuge allocation would be the amount of water that Lower Klamath NWR and Tule Lake NWR would receive from Reclamation's Klamath Project facilities as described in the KBRA and is shown in Table 2-19 (while the refuges receive some water from other sources, the amounts are minimal compared to water from Reclamation's Klamath Project facilities). The Refuge Allocation includes water for a) Lower Klamath NWR wetlands; b) Lower Klamath NWR cooperative farming lands; c) refilling of the Tule Lake NWR sumps after intentional draining; d) refuge-approved walking wetlands on lease lands, cooperative farm lands, or lands within Reclamation's Klamath Project but outside of the Klamath Basin National Wildlife Refuge System; and e) certain conveyance losses.

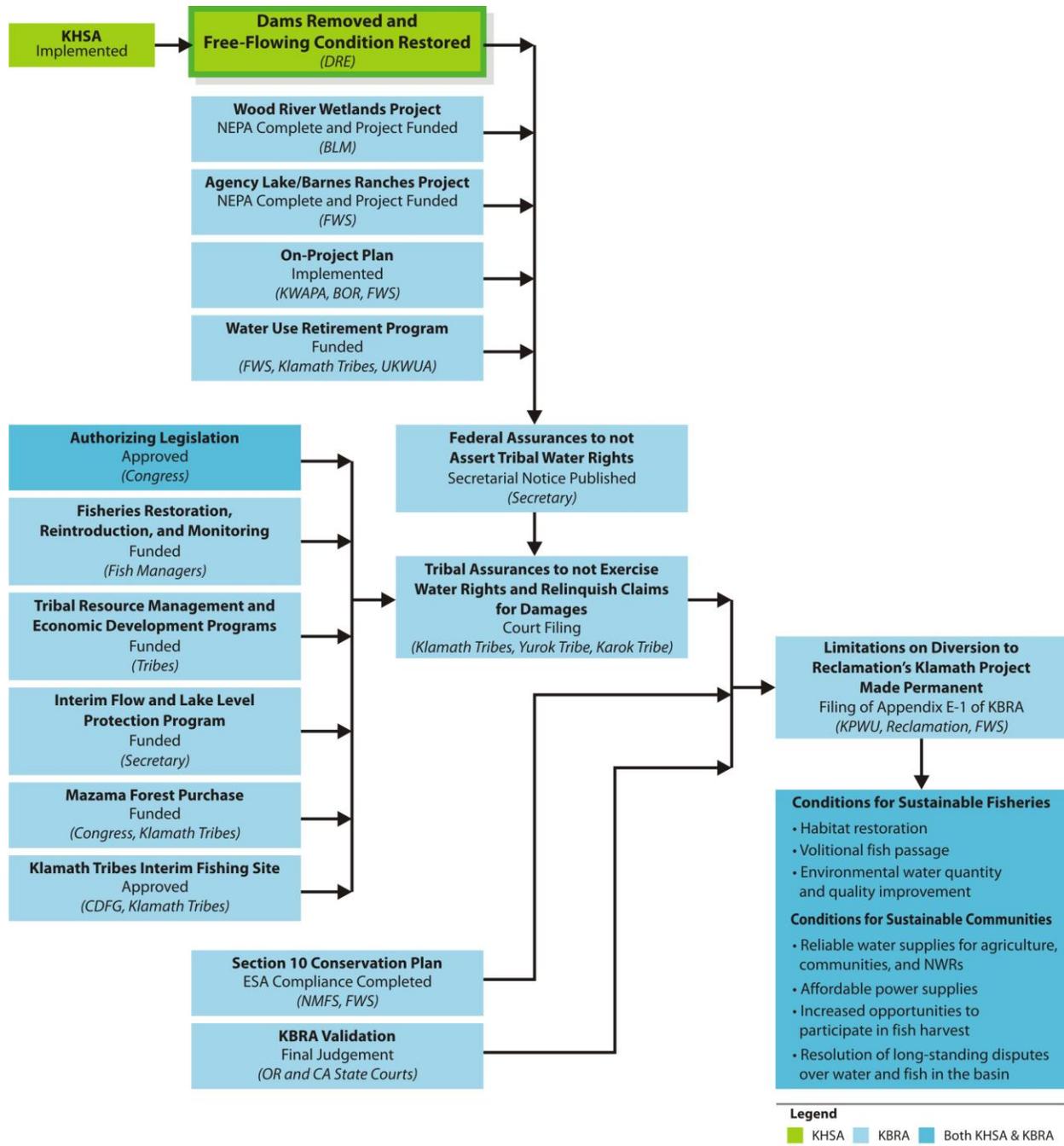


Figure 2-14. Key Milestones before Diversion Limits are Implemented

The parties to the KBRA are to develop agreements on the parameters of delivery of water to the refuges including schedules, volumes by time of year and points of diversion, and a system to determine whether water has “passed through” the refuge without being consumed. Agreement on the general parameters of delivery of the Refuge Allocation would be completed by 2011.

An anticipated schedule for specific projects under this element is identified in Appendix C-2 of the KBRA including:

- Operation and maintenance of North and P Canals in 2014
- Walking wetland construction 2013–2021
- Big Pond Dike construction in 2014

### Groundwater Management

The KBRA includes provisions for groundwater studies to evaluate potential effects of groundwater pumping and to provide baseline information needed to meet an objective of “no adverse impact” on specified springs in the basin. An adverse effect on springs is defined in the KBRA as a 6 percent reduction in flow and the year 2000 is used as a baseline. If future studies show that a 6 percent reduction or greater does not affect fisheries, then groundwater withdrawals may be increased. The results of the groundwater studies and ongoing monitoring of the effects of groundwater use would be included in the On-Project Plan (KBRA Section 15.2.4).

The anticipated schedule for the groundwater technical studies is between 2012 and 2014 (KBRA Appendix C-2). United States Geological Survey and OWRD would be the Lead Agencies to conduct groundwater technical investigations. The scope of these studies is described in Appendix E-2 of the KBRA. If investigations or monitoring identify an adverse impact, the parties to the KBRA will work together to modify the On-Project Plan and/or remedy the impact (KBRA Section 15.2.4.B.v). A fund for remedying adverse impacts due to groundwater use is identified in KBRA Appendix C-2.

### On-Project Plan

The On-Project Plan is intended to set the framework for implementation of the diversion limits to Reclamation’s Klamath Project (KBRA Section 15.2). The On-Project Plan would align supply and demand for water users within Reclamation’s Klamath Project and is to include the specific objective that groundwater pumping would not adversely affect springs within the basin.

The On-Project Plan would include details on appropriate responses in the event of summer or winter shortages. The KBRA specifies how and under what circumstances a deficit would be shared among on-Project users and the Lower Klamath NWR and Tule Lake NWR in the event of a summer shortage of water available for diversion. A plan for management of winter shortages is to be developed. The On-Project Plan would reference the Winter Shortage Plan, the Drought Plan, the Emergency Response Plan, and other plans to be developed as appropriate.

Full implementation of the On-Project Plan is to occur no later than March 1, 2022. To implement the On-Project Plan, managers may need to take a variety of actions including acquisition or negotiation of conservation easements; forbearance agreements; land acquisitions;

efficiency measures; conservation measures, development of groundwater sources; or creation of additional storage. The anticipated schedule to develop and implement the On-Project Plan is between 2012 and 2021 (KBRA Appendix C-2).

#### Winter Shortage Plan

In the event that there is insufficient water available for diversion to Reclamation's Klamath Project during the winter months (November through February) a plan would be developed to identify how shortages would be shared between the Reclamation's Klamath Project water users including the Lower Klamath NWR and Tule Lake NWR. This plan is intended to be completed by 2011 (KBRA Section 15.1.2.F).

#### Emergency Response Plan

An Emergency Response Plan would be developed to prepare water managers for potential failure of Reclamation's Klamath Project facilities or dikes on Upper Klamath Lake or Lake Ewauna that affects the storage and delivery of water needed to implement the commitments under the KBRA (KBRA Section 19.3). The emergency response plan is to include: a) a process to prepare for potential emergencies; b) funding sources to respond to emergencies; c) the priority of funding emergency responses; d) potential emergency response measures, including emergency NEPA review, as necessary; and e) a process to implement emergency responses. The Emergency Response Plan is intended to be completed in 2011 and implemented as needed.

#### **Water Use Retirement Program**

The voluntary WURP is intended to permanently increase the flow of water into Upper Klamath Lake by 30,000 acre-feet per year to support restoration of fish populations (KBRA Section 16.2.2). In exchange for this benefit to the Upper Klamath Lake fisheries, the Klamath Tribes would be willing to settle certain water rights claims with water users in the upper basin.

The WURP is intended to be part of the Off-Project Water Settlement (OPWAS, see below), but may also be implemented independently by the Upper Basin Team. It is expected that the WURP will take up to 10 years to be fully implemented and implementation would start with the completion of the OPWAS in 2012. The anticipated schedule for implementation of the WURP is between 2012 and 2016 (KBRA Appendix C-2).

The WURP may be implemented through a variety of measures including retirement of water rights, forbearance agreements, short-term water leasing, split season irrigation, upland management techniques, water efficiency measures, dry land cropping, and natural storage improvements such as wetlands or improved riparian areas.

The OWRD would determine when the required 30,000 acre-feet of water is permanently assigned to Upper Klamath Lake. The additional storage that would be provided by the Williamson River Delta, Wood River Wetlands, and Agency Lake/Barnes Ranches projects would not apply towards successful implementation of the WURP.

## **Off-Project Water Management**

### Off-Project Water Settlement (OPWAS)

The OPWAS is intended to provide a forum for resolving long-standing water disputes between the Upper Klamath Water Users Association, Klamath Tribes, and the Bureau of Indian Affairs (KBRA Section 16) in the Off-Project Area. The Off-Project Area includes the Wood River, Sprague River, Sycan River, and Williamson River sub-basins (Figure 2-15). The intent is to negotiate a settlement that resolves the off-Project irrigators' contests to claims in Tribal Cases under the Klamath Basin water rights adjudication process. In the event that not all such contests are resolved through this process, then the intent is to provide reciprocal assurances for maintenance of instream flows and reliable irrigation water deliveries to the Off-Project Area. Under the KBRA, the OPWAS would include the WURP. The anticipated schedule for development and implementation of the OPWAS is between 2012 and 2021 (KBRA Appendix C-2).

### Off-Project Reliance Program

The Off-Project Reliance Program is intended to avoid or mitigate the immediate effects of unexpected circumstances affecting water availability downstream of Upper Klamath Lake that could affect the amount of water available for irrigation in the Off-Project Area (KBRA Section 19.5). Due to the way that water rights are prioritized throughout the basin, circumstances that affect water availability for diversion to on-Project users could affect off-Project users upstream.

The program would be developed by the Upper Klamath Water Users Association with input and assistance from off-Project irrigators, Reclamation, and USFWS. The program is intended to be developed prior to the successful conclusion of the WURP but would not be implemented until a) 30,000 acre-feet of additional flow is added to Upper Klamath Lake through the WURP; b) the OWRD finds that additional instream flow has been added; and c) KBRA Appendix E-1 has become effective (i.e., the diversion limits to Reclamation's Klamath Project are fully implemented).

Actions that avoid the impacts of unexpected circumstances might include providing funding for water leasing to increase water availability for irrigation in the Upper Klamath Basin, or mitigating the economic impacts of lost agricultural production (KBRA Section 19.5). Because the Off-Project Reliance Program could not be implemented until the WURP was completed and Appendix E-1 was effective, it would not be likely to start until after 2021.

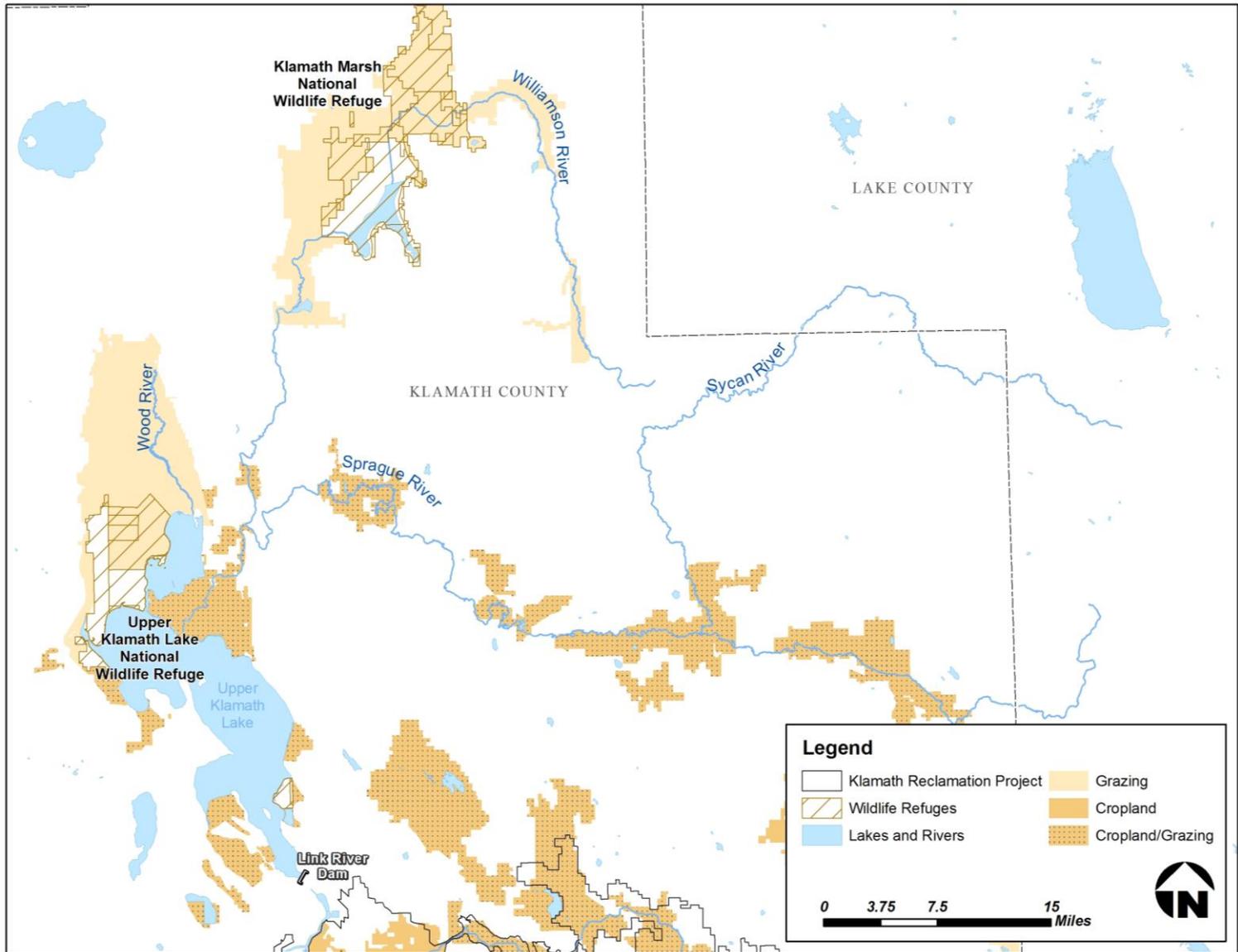


Figure 2-15. Off Project Irrigation Area

### **Power for Water Management Program**

The Power for Water Management program is intended to deliver power to eligible users at a cost that is targeted at or below the average cost for similarly situated Reclamation irrigation and drainage projects in the surrounding area. The goals of the program include providing affordable electricity for (i) efficient use, distribution, and management of water within Reclamation's Klamath Project and the Klamath Basin NWR System, and facilitate the return of water to the Klamath River as part of the implementation and administration of the On-Project Plan; (ii) implementation of the WURP and OPWAS; (iii) meeting the objectives of the Fisheries Restoration Program; and (iv) providing power cost security to assist in maintaining sustainable agricultural communities in the Upper Klamath Basin (KBRA Section 17.1).

Under the KBRA, a power management entity would be established to deliver affordable power to eligible users. The program includes three components: the Interim Power Program, a Federal Power Program, and a Renewable Power Program. The Interim Power Program is intended to maintain the power cost target for eligible users while the other program elements are implemented (KBRA Section 17.5). The anticipated schedule is between 2012 and 2021 (KBRA Appendix C-2), although the specific implementation steps are yet to be identified by the power management entity.

The Federal Power Program is intended to obtain and provide for the transmission and delivery of federal preference power to eligible power users (KBRA Section 17.6). The parties to the KBRA would need to request and be granted an allocation of federal power before this element could be fully implemented.

The Renewable Power Program would increase the efficiency of power users both on- and off-Project and generate renewable energy in order to reduce power costs for eligible power users (KBRA Section 17.7). Implementation of the Renewable Power Program includes development of a financial and engineering plan to identify specific renewable energy resources and energy efficiency measures to be developed or invested in. The financial and engineering plan would specifically evaluate the potential for development of a biomass energy project (KBRA Section 17.7.2). The renewable energy plan is intended to be completed by 2012 (KBRA Appendix C-2).

### **Drought Plan**

The Drought Plan is intended to provide a process to evaluate and adapt water resource management in the event of a drought or an extreme drought so as to avoid or minimize adverse effects. It would identify water and resource management actions such that no Klamath Basin interest shall bear an unreasonable portion of burdens imposed or the risk of loss or injury as a result of drought or extreme drought (KBRA Section 19.2). The Drought Plan would define what conditions constitute a drought year. The water years 1992 and 1994 are defined as representing extreme drought conditions.

Full implementation of the KBRA would include the availability of drought relief funds to help offset the impacts of a drought on water users. Measures suggested in the KBRA that might be taken in the event of a drought include conservation measures, the use of stored water developed for use on Reclamation's Klamath Project, water leasing, use of groundwater, exercise of water

rights priorities, and reduction in the diversion to Reclamation's Klamath Project (KBRA Section 19.2). The Drought Plan is intended to be completed in 2011 and implementation would be ongoing as needed.

### **Climate Change**

The KBRA provides for an assessment of how long-term climate change may affect fisheries and communities in the Klamath Basin (KBRA Section 19.4). The technical assessment of climate change is scheduled to occur in 2013 (KBRA Appendix C-2). Depending on the results of the technical assessment, the parties may need to negotiate supplemental terms to the KBRA in order to achieve the goals of the agreement.

### **Environmental Water Management**

Environmental water is the quantity and quality of instream water available to support fisheries and other aquatic resources. Section 20 of the KBRA lists the obligations of the parties to the KBRA to provide environmental water as described in various sections of the KBRA, including:

- Support dam removal under KHSA (KBRA Section 8).
- Limit diversions to Reclamation's Klamath Project (KBRA Section 15 and Appendix E-1).
- Retire water uses upstream of Upper Klamath Lake to produce additional instream flows and maintain lake levels through a voluntary WURP (KBRA Section 16.2.2).
- Develop additional water storage in the basin (KBRA Section 18).
- Develop and implement Fisheries Restoration Plans (KBRA Section 10).
- Develop and implement Fisheries Reintroduction Plans (KBRA Section 11).
- Provide for real-time management of stored environmental water (KBRA Section 20.3).
- Implement an Interim Flow and Lake Level Protection Program (KBRA Section 20.4).
- Support instream water rights applications (KBRA Section 20.5).
- Support the development and implementation of TMDLs on the Klamath River and actions that protect water quality generally (KBRA Section 20.5.4).
- Oppose proposals for additional out-of-basin transfers of water (KBRA Section 20.5.4).

Environmental water may be stored and managed by means such as the operation of the Agency Lake/Barnes Ranches project. In order to determine whether to store water at any particular time, the parties would need to understand the real-time water budget of the basin. Implementation of real-time water management would occur through installation of tools such as water flow monitoring gauges and snowpack gauges (Table 2-20).

Under the KBRA, flows for environmental water and lake level management would be increased by at least 30,000 acre-feet through the voluntary WURP. To achieve environmental water goals during the interim period, an Interim Flow and Lake Level Protection Program is proposed in the KBRA (KBRA Section 20.4). This program would purchase or lease water rights from willing sellers to increase the amount of water in the Klamath River and Upper Klamath Lake until permanent instream water supply enhancements could be put into effect.

**Table 2-20. KBRA Environmental Water Management Projects**

<b>KBRA Project</b>	<b>Anticipated Schedule</b>
Real Time Water Management	2012–2021
Water Flow Monitoring and Gauges	2012–2021
Snowpack Gauges	2012–2021
Adaptive Management: Science and Analysis	2012–2021
Calibration and improvements to KLAMSIM or other modeling and predictions	2012–2021
Interim Flow and Lake Level Program	2012–2021

*Source: KBRA Appendix C-2*

Under the KBRA, the parties agree to withdraw any contests to the existing Instream Water Rights applications filed by ODFW or the Oregon State Parks and Recreation Department and to support any other instream water right claims. The KBRA also includes a provision that the parties would support the conversion of existing PacifiCorp water rights to instream uses when the hydroelectric dams are removed from service.

Water protection and improvement are key objectives of the KBRA. However, the KBRA does not include a separately defined water quality program. KBRA Section 20.5 on the protection of environmental water includes general statements about the importance of protecting water quality and the agreement that the parties to the KBRA would support the development and implementation of appropriate TMDLs (KBRA Section 20.5.4). However, this section does not include any specific actions or prerequisites for other actions.

### **Regulatory Assurances Program**

The KBRA provides for reintroduction of salmon and other aquatic species in the Upper Basin, which continued to have potential regulatory or other legal consequences for land or water users upstream of the current site of Iron Gate Dam. Therefore, the KBRA includes a set of regulatory assurances to avoid or minimize new regulation or other legal or funding burdens that might occur to land or water users upstream of Iron Gate Dam from introduction or reintroduction of aquatic species. The KBRA does not supersede existing laws or regulations nor does it modify existing laws or create exemptions. Plans and projects to be developed under the auspices of the KBRA would still need to comply with laws and regulations in force when discretionary decisions are made on those projects and plans.

The KBRA includes a commitment from Reclamation, upon receipt of funding and in compliance with applicable law, to construct entrainment reduction facilities such as fish screens to prevent fish from entering diversion facilities on Reclamation's Klamath Project (KBRA Section 21.1.3). Entrainment would be specifically evaluated and addressed at a) Lost River diversion channel or associated diversion points; b) North Canal, c) ADY Canal; and d) other diversions from Reclamation or Reclamation contractor-owned facilities (Figure 2-13). The anticipated schedule for construction of these entrainment facilities would be between 2019 and 2020.

The parties to the KBRA have also agreed to coordinate with each other and communicate openly on a wide variety of issues in an effort to avoid surprises so that solutions can be sought without acrimony. The KBRA specifically mentions unforeseen circumstances and consequences of restoration and water delivery as situations that might require fresh coordination (KBRA Sections 21.1.4, 21.2, and 21.3).

Development of either a General Conservation Plan or a Habitat Conservation Plan is identified as a means to secure an incidental take permit under Section 10(a)(1)(B) of the Endangered Species Act. This would be one means to avoid or minimize regulatory burdens or costs arising from the reintroduction of fish species to the upper basin (KBRA Section 22). In that light, NOAA Fisheries Service and USFWS will lead the development of a General Conservation Plan or Plans for use by KBRA parties or others to apply for incidental take permits under the Endangered Species Act. While development of a conservation plan could begin as early as 2012, it would not be anticipated that a plan would be approved until the end of the interim period.

The KBRA identifies requirements related to incidental take authorizations under the California Endangered Species Act and provides for coordination between Federal and State agencies related to those authorizations. The California Department of Fish and Game may draft legislation regarding a limited authorization to incidentally take fully protected species that may be affected by implementation of the agreement (KBRA Section 24). The KBRA also contains a provision for consideration of any request that the Oregon Department of Environmental Quality perform a Use Attainability Analysis before proposing any new designated use due to the reintroduction of fish species (KBRA Section 25).

## **County and Tribal Programs**

### **County Programs**

The County Programs under the KBRA recognize that there may be impacts and opportunities for each of the counties within the Klamath Basin. Klamath County has agreed to develop a plan for economic development if funding is available (KBRA Section 27). Funding would potentially come from KBRA authorizations and from state business development programs. The California Water Bond funding legislation, scheduled for a vote in 2012, proposes funding for economic development within Siskiyou County. The KHSAs (Appendix G-1) describes this \$20 million in economic development funds that would be provided to Siskiyou County as a part of the dam removal action in the event of an Affirmative Determination and a positive vote on the Water Bond Fund. Humboldt and Del Norte Counties are not included in this economic development fund. Funds remaining in the Water Bond fund after covering facilities removal, CEQA mitigation, and actions to secure the City of Yreka's water supply, may be used for fish restoration projects within Siskiyou, Humboldt, and Del Norte Counties.

Similarly there may be property tax revenue losses and gains from the various effects of the KBRA. Property tax revenue changes could occur due to reduced agricultural land values from a) a reduction in water deliveries and b) the surrender of significant water rights. The Klamath County Program within the KBRA includes a provision to compensate Klamath County for these potential revenue changes upon the availability of funding. The anticipated schedule for identification of potential property tax impacts and compensation payments is 2016 (KBRA

Appendix C-2). County programs for Siskiyou, Humboldt, and Del Norte Counties do not include a provision for compensation for changes in property tax revenues that may result from the removal of the hydroelectric facilities.

### **Tribal Programs**

The KBRA includes provisions for each of the affected signatory tribes (the Klamath Tribes, Karuk Tribe, and Yurok Tribe) to receive assistance in developing their capacity to participate in both fisheries management and conservation management activities within the basin (KBRA Sections 31 and 32). In addition, each signatory tribe would prepare an economic development plan and work towards implementing that program (KBRA Sections 31 and 33). Preparation of economic development plans is anticipated to occur in 2013.

The Klamath Tribes have been working with the Trust for Public Lands and have acquired an option to purchase the Mazama Forest in the upper basin, once a part of the tribes' reservation lands. The parties to the KBRA agree to support the Tribes' efforts to secure funding and complete the purchase of this forestland (KBRA Section 33.2). Final acquisition of the Mazama Forest is anticipated to occur in 2012 or 2013. Complete funding to allow the Klamath Tribes to purchase the Mazama Forest is one of the key milestones towards the filing of KBRA Appendix E-1 and the full implementation of the diversion limits to Reclamation's Klamath Project.

Under Section 34 of the KBRA, the Klamath Tribes have petitioned the California Fish and Game Commission to establish an interim fishing site in the reach of the Klamath River between Iron Gate Dam and the Interstate 5 Bridge. The grant of this petition is one of the key milestones toward implementation of the KBRA.

### **2.4.4 Alternative 3: Partial Facilities Removal of Four Dams**

The primary purpose of removing dams on the Klamath River is to restore volitional fish passage and free-flowing river conditions at each dam site, in order to advance restoration of anadromous fish populations. The Partial Facilities Removal of Four Dams Alternative would achieve these goals by partially removing the Four Facilities. The Partial Facilities Removal of Four Dams Alternative satisfies the KHSAs and includes the same IMs as in the Proposed Action, implementation of the KBRA, transfer of Keno Dam to DOI, and decommissioning of PacifiCorp's East Side/West Side facilities. Inflows to Upper Klamath Lake and outflows from Keno Dam are assumed to be the same under the Partial Facilities Removal of Four Dams Alternative as described above for the Proposed Action. Flows through the Hydroelectric Reach and downstream from the Iron Gate Gauge would also be the same as those in the Proposed Action (see Figure 2-8).

The Partial Facilities Removal of Four Dams Alternative would include removal of enough of each dam to allow free-flowing river conditions and volitional fish passage at all times. Under this alternative, portions of each dam would remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. Some of these remaining features would likely require perpetual maintenance and security measures to prevent unauthorized entry. All tunnel openings would be sealed with reinforced concrete to eliminate trespass concerns. All oils, hydraulic fluids, and other potential contaminants found in

powerhouses and machinery would be removed prior to final decommissioning and securing of buildings. Table 2-21 provides a summary of facilities that would be removed or retained under the Partial Facilities Removal of Four Dams Alternative.

**Table 2-21. Summary of Features to be Removed or Retained with Alternative 3<sup>1,2</sup>**

Feature	J.C. Boyle	Copco 1	Copco 2	Iron Gate
Embankment/earth fill dam	Remove		Retain	Remove
Concrete dam structure	Remove	Remove	Remove	
Concrete wingwalls			Retain Right Wall	
Reservoir power intake structure	Retain	Retain	Retain	Remove
Spillway	Remove	Remove	Remove	Retain
Spillway control gates	Remove	Remove	Remove	
Concrete fish ladder	Remove			Remove
Concrete flume headgate structure	Retain			
Concrete canal intake screen	Retain			
Concrete flume	Remove Walls			
Concrete canal spillway	Remove			
Tunnel intake structure	Remove	Retain	Retain	Remove
Tunnel portals	Plug	Plug	Plug	Plug
Steel pipeline & supports	Retain			
Steel surge tank	Remove			
Wood-stave penstock			Remove	
Penstocks, supports, anchors	Remove	Retain	Retain	Remove
Powerhouse building		Retain	Retain	Retain
Powerhouse gantry crane	Remove			
Powerhouse concrete slab/structure	Retain	Retain	Retain	Retain
Powerhouse hazardous materials	Remove	Remove	Remove	Remove
Tailrace flume walls	Retain			
Tailrace channel	Fill	Fill	Fill	Fill
Switchyard	Remove	Remove	Retain	Remove
Warehouse & support buildings	Remove		Retain	
Fish Hatchery				Retain

Notes

1. Grayed-out cells indicate features that are not present at existing dam facilities and would therefore not need to be removed or retained.
2. Features indicated as retained under the Partial Facilities Removal of Four Dams Alternative are features that would be removed as part of the Proposed Action/Full Facilities Removal of Four Dams Alternative.

**2.4.4.1 Deconstruction Actions**

Deconstruction techniques for the Partial Facilities Removal of Four Dams Alternative are the same as for the Proposed Action, with no specialized means or methods necessary. Partial facilities removal would be completed during a 1-year period, and dam removal at each site would require the same equipment as the Proposed Action. The following sections describe the scope of work and features for partial removal of each dam under this alternative.

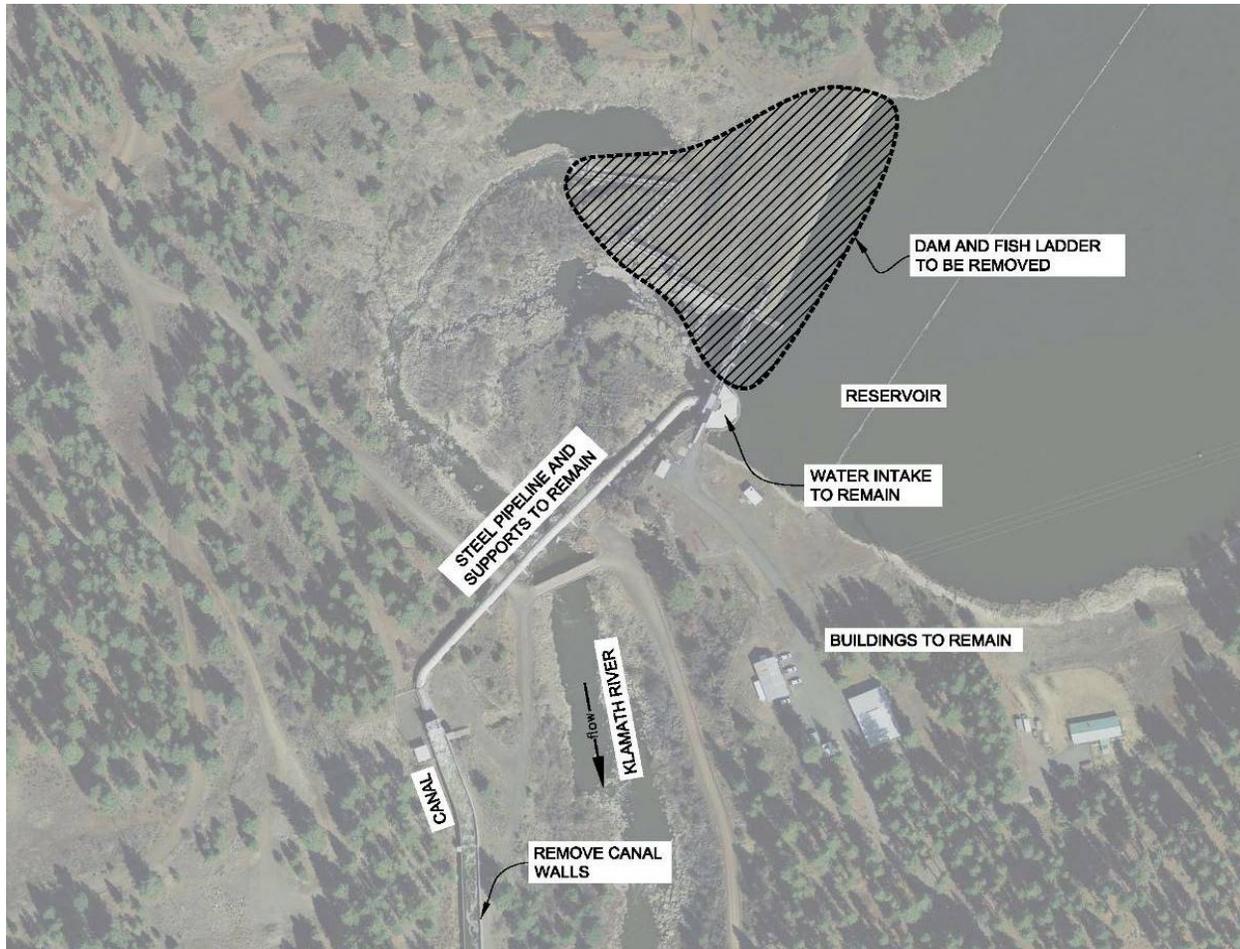
**J.C. Boyle**

Partial facilities removal would require the complete removal of the embankment section, gated concrete spillway section, and concrete cutoff wall to the bedrock foundation. The DRE would also do the following:

- Remove the lower portion of the fish ladder to prevent potential fish stranding during peak flow events.
- Remove the abutment wall and upper portion of the fish ladder, because they could become unstable after the removal of the embankment and spillway sections.
- Recoat the 14-foot-diameter steel pipeline and supports to encapsulate potential heavy metals.
- Remove concrete walls for the water conveyance canal to allow drainage and animal migration, and prevent collapse due to rockfall.
- Remove the 78-foot-tall steel surge tank and the 150-ton gantry crane to prevent a potential future stability problem during a large seismic event.
- Remove the penstocks to avoid long-term maintenance issues related to the steel, which likely has coatings containing heavy metals.
- Plug the downstream tunnel portal with concrete to avoid unauthorized entry.
- Remove the switchyard and warehouse building.
- Fence and seal the powerhouse

Under the Partial Facilities Removal of Four Dams Alternative, the DRE would not remove the water intake structure, left abutment concrete gravity section, concrete headgate structure, intake screen, steel pipeline and supports, tailrace walls, and powerhouse concrete slab and structure, as shown in Figure 2-16. The DRE would not fill and stabilize the headcut downstream of the forebay overflow discharge canal (as in the Proposed Action) because it would require a large quantity of material that would not be available; partial removal would not produce as much concrete rubble as full removal would.

The DRE would leave the mechanical and electrical equipment in place with all power connections to the outside removed; however, it would remove any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment. The DRE would also remove other mechanical and electrical equipment containing potentially hazardous materials.



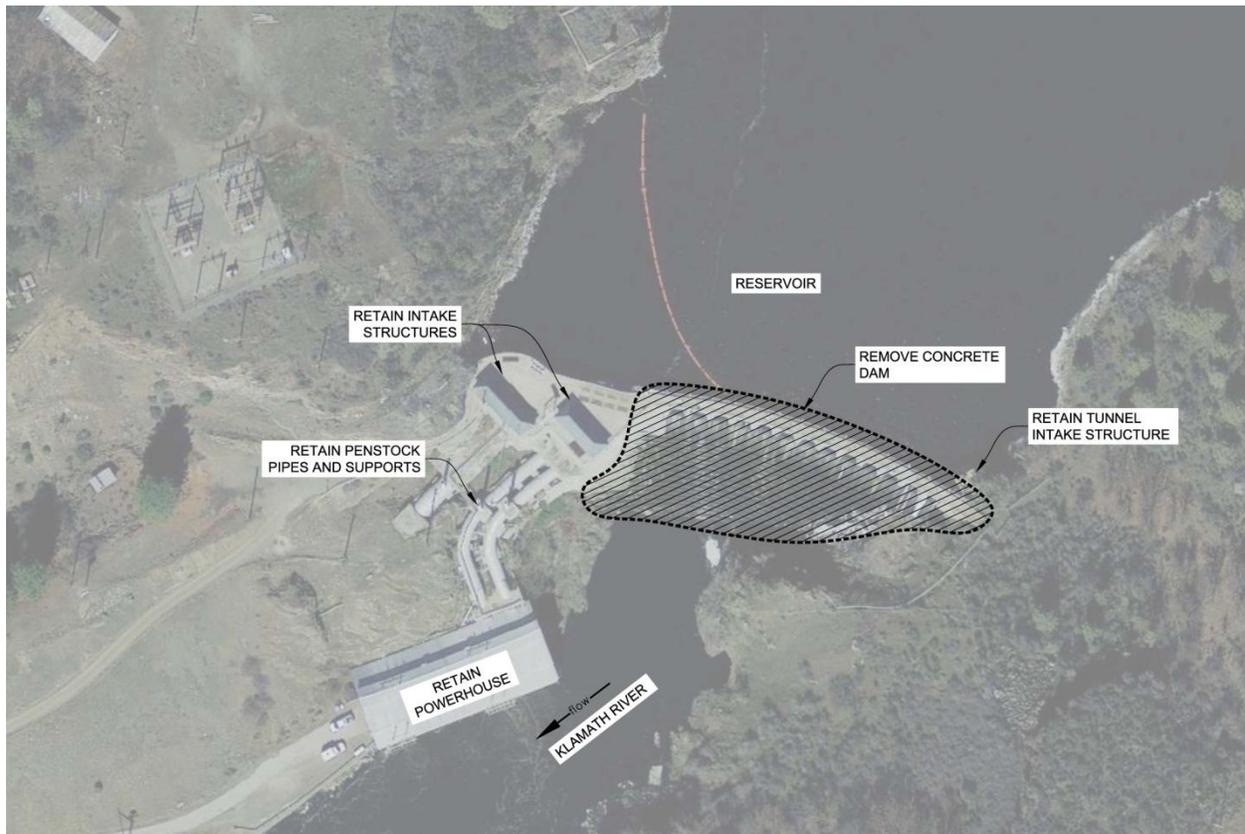
**Figure 2-16. View of J.C. Boyle Dam showing portion of dam and fish ladder to be removed for the Partial Facilities Removal Alternative**

**Copco 1 Dam and Powerhouse**

To create a free-flowing condition and volitional fish passage through the Copco 1 site, the DRE would:

- Remove the concrete gravity arch dam and associated facilities (spillway gates, bridge deck, and piers) between the left abutment rock and the concrete intake structure on the right abutment to 5 feet below the existing streambed level at the dam.
- Remove the two concrete gate houses on the right abutment intake structure if necessary to provide workspace for a large crane.
- Seal the downstream end of the intake tunnel portal with concrete to avoid unauthorized entry.
- Remove unused transmission lines, poles, and the switchyard.
- Seal and fence the powerhouse.

Under the Partial Facilities Removal of Four Dams Alternative, the DRE would not remove the power generation water intake structure, penstocks, and powerhouse (Figure 2-17). Retention of these structures would require long-term maintenance, including the preservation of any items with coatings containing heavy metals. The DRE would handle mechanical and electrical equipment and equipment containing potentially hazardous materials in the same manner as for the J.C. Boyle Dam removal under this alternative.

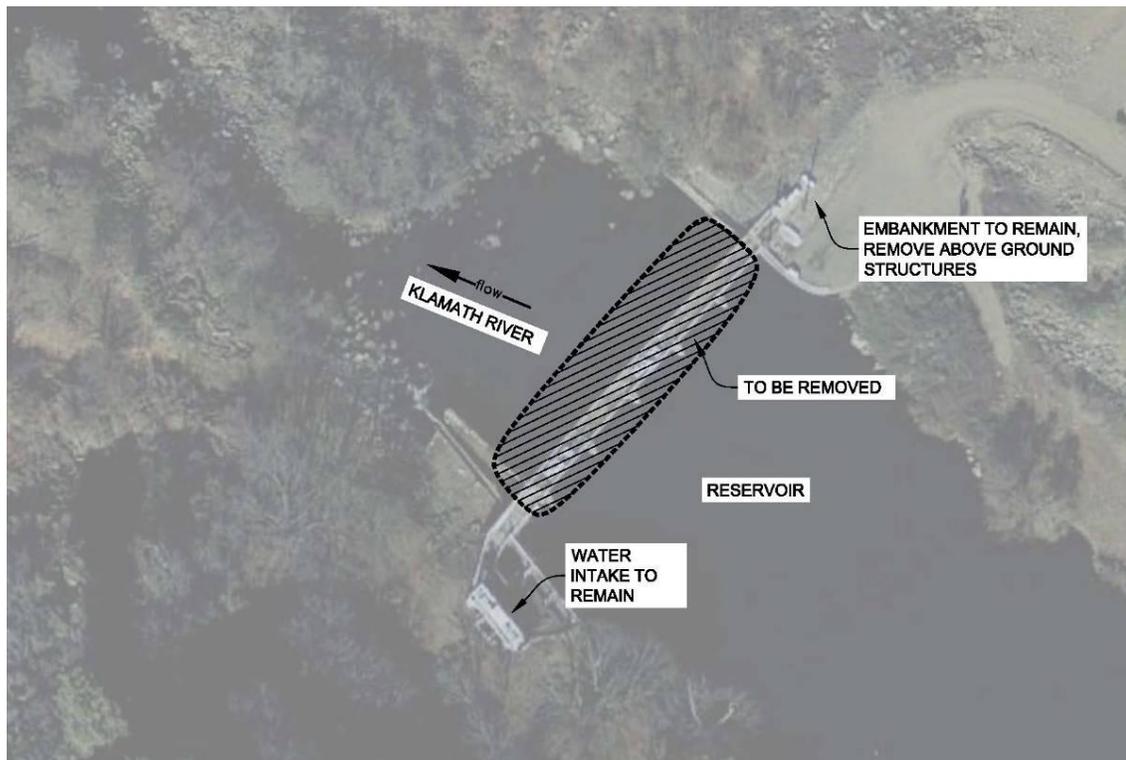


**Figure 2-17. Copco 1 showing portion of dam to be removed for the Partial Facilities Removal Alternative**

### **Copco 2 Dam and Powerhouse**

To create a free-flowing condition and volitional fish passage through the Copco 2 site, the DRE would take the following actions:

- Remove the concrete gated spillway structure and concrete end sill between the existing sidewalls (see Figure 2-18) as well as associated facilities (spillway gates, bridge deck, and piers).
- Remove wood-stave penstock.
- Remove equipment on the right abutment embankment section to facilitate construction access to the gated spillway.
- Seal and fence powerhouse.



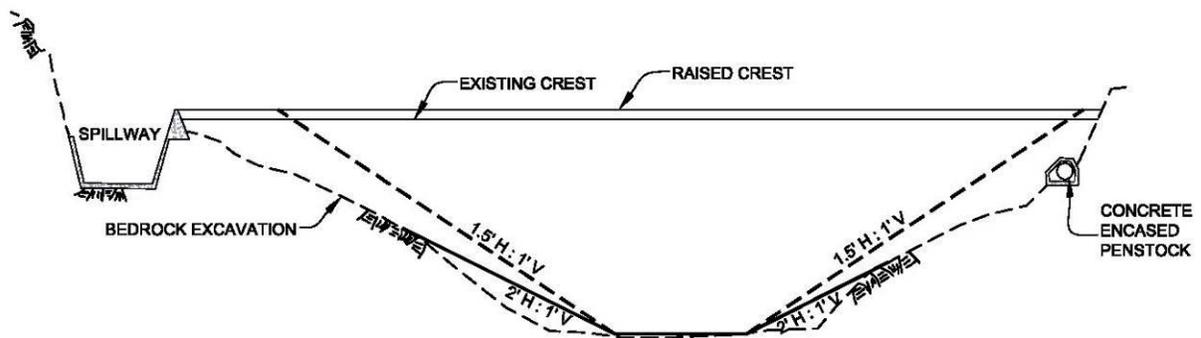
**Figure 2-18. Copco 2 dam showing portion of dam to be removed for the Partial Facilities Removal Alternative**

Under the Partial Facilities Removal of Four Dams Alternative, the embankment section on river right, intake structure on river left, conveyance system to the powerhouse, and powerhouse would remain in place. A small portion of the downstream basin apron slab would remain intact for structural stability of the right sidewall, provided that a potential fish barrier would not result.

The DRE would handle mechanical and electrical equipment and equipment containing potentially hazardous materials in the same manner as for the J.C. Boyle and Copco 1 Dam removals under this alternative.

### **Iron Gate Dam and Powerhouse**

Theoretically, the DRE could notch Iron Gate Dam instead of removing the full dam. The river channel would need a 100-foot opening to accommodate fish passage at high flows. Figure 2-19 shows Iron Gate Dam with a 100-foot-wide notch at the base of the dam with potential stable side slopes to the top of the dam. This figure illustrates that notching the dam would remove nearly the entire dam and would create the need to protect the newly exposed inner core of the dam for stability. The amount of effort required to notch the dam is comparable to removing the entire earthfill embankment. Likewise, the stabilization costs of the remaining structure would be comparable to the costs to remove the minor amount of remaining material. Therefore, under this alternative, the DRE would remove the entire embankment dam, concrete water intakes, water supply pipes, and fish facilities at the base of the dam, with methods and equipment requirements as described for the Proposed Action.



**Figure 2-19. Section view of Iron Gate Dam showing 100-foot-wide bottom notch with different potential side slopes**

Facilities that would remain include the existing concrete spillway and powerhouse (Figure 2-20). The DRE would fill the spillway and chute with material removed from the dam embankment. The DRE would seal all tunnels at the upstream and downstream openings using reinforced concrete plugs to prevent unauthorized entry.



**Figure 2-20. Iron Gate dam showing portion of dam to be removed for the Partial Facilities Removal Alternative**

The Iron Gate Fish Hatchery downstream of the dam would remain in place. The KHSA requires PacifiCorp to secure an alternate water source to replace the existing water supply pipe from Iron Gate Dam.

Retention of the Iron Gate powerhouse would require the structure to be sealed and fenced. The DRE would handle mechanical and electrical equipment and equipment containing potentially hazardous materials in the same manner as for the other dam removals under this alternative.

#### **2.4.4.2 Schedule**

The Partial Facilities Removal of Four Dams Alternative would follow a schedule similar to that of the Proposed Action. Figure 2-21 provides a schedule that is consistent with the schedule in Section 2.3.2 for Full Facilities Removal. The staging and methods would remain the same; however, the DRE would only remove portions of the dam and facilities. This alternative's schedule includes time to secure retained facilities by removing hazardous materials and installing fences and similar security features to prevent unwanted entry. Therefore, it is not



#### **2.4.4.5 Reservoir Restoration**

The Partial Facilities Removal of Four Dams Alternative would include the same reservoir restoration actions described above for the Proposed Action. The restoration actions would include bank stabilization, revegetation, and decommissioning and or modification to existing recreation facilities surrounding the reservoir. Securing facilities left in place following partial facilities removal is not considered a component of this reservoir restoration action and would be completed as described above for this alternative.

#### **2.4.4.6 Recreation Facilities**

Changes to the recreation facilities surrounding the existing reservoirs would be the same as those in the Proposed Action (see Table 2-13).

#### **2.4.4.7 Keno Transfer**

The Partial Facilities Removal of Four Dams Alternative would include the transfer of Keno Dam as a connected action in the same fashion as for the Proposed Action. The description of the transfer presented in Section 2.4.3.7 characterizes how the transfer would be executed under the Partial Facilities Removal of Four Dams Alternative.

#### **2.4.4.8 East Side/West Side Facility Decommissioning – Programmatic Measure**

The Partial Facilities Removal of Four Dams Alternative would include decommissioning the East Side and West Side Facilities in the same fashion as the Proposed Action. The description of the facility decommissioning presented in Section 2.3.2.8 characterizes how decommissioning would be completed under the Partial Facilities Removal of Four Dams Alternative.

#### **2.4.4.9 KBRA – Programmatic Measures**

The Partial Facilities Removal Alternative would include implementation of the KBRA in the same fashion as the Proposed Action. The description of the KBRA presented in Section 2.4.2.8 characterizes the plans, programs, and actions that would be pursued under the Partial Facilities Removal of Four Dams Alternative.

### **2.4.5 Alternative 4: Fish Passage at Four Dams**

Alternative 4 would provide upstream and downstream fish passage at the Four Facilities. The Fish Passage at Four Dams Alternative would not satisfy the KHSA; consequently, the KBRA would not be implemented (although ongoing restoration activities in the No Action/No Project Alternative may continue). For the purposes of this analysis, alternatives that would not result in full implementation of the KHSA do not include the KBRA as a connected action to the alternative. Additionally, the transfer Keno Dam to DOI would not move forward as a connected action.

The description of Alternative 4 uses information from the *United States Department of the Interior and National Marine Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis Pursuant to Section 18 and Section 33 of the Federal Power Act for the Klamath Hydroelectric Project (FERC Project No. 2082)* (DOI and NOAA Fisheries Service 2007) and from the *Modified Terms and Conditions and Prescriptions for Fishways filed pursuant to Sections 4(e) and 18 of the Federal Power Act* (DOI/BLM 2007). These fishway prescriptions and mandatory conditions were developed during the FERC relicensing process.

Issues of Material Fact associated with the prescriptions and mandatory conditions were challenged; the resulting Administrative Law Judge decision found that the Agencies met their burden of proof on most factual issues in dispute. Attachment B of Appendix A includes the full list of prescriptions and mandatory conditions; a key 4(e) condition requires at least 40 percent of J.C. Boyle inflow to be released into the Bypass Reach. Under this alternative, the J.C. Boyle Powerhouse would produce peaking power only one day a week to coincide with recreation releases. This alternative would generate less power than current production because of the change in peaking operations and the flow requirements for the J.C. Boyle Bypass Reach. Several of the prescriptions include studies to determine if features are necessary (such as spillway and tailrace modification). For the purposes of analysis in this EIS/EIR, Alternative 4 includes some specific fishway facility design and construction details beyond what are specifically required in the prescriptions and are based on designs of similar fishway facilities used at other hydroelectric facilities.

Flows within the Hydroelectric Reach would change compared to the No Action/No Project Alternative because of the prescriptions related to releases from J.C. Boyle Dam and Powerplant. Flows downstream from Iron Gate Dam, however, would be similar to those in the No Action/No Project Alternative (see Figure 2-7).

This alternative would be implemented through FERC licensure to an entity that would operate the Four Facilities (the “Hydropower Licensee”). The Hydropower Licensee would need to re-enter the FERC process to implement this alternative. Inflows to Upper Klamath Lake, and outflows from Iron Gate Dam are assumed to be the same under the Fish Passage at Four Dams Alternative as described above for the No Action/No Project Alternative.

This section describes general information about the fish passage facilities that would be constructed, and the following sections discuss aspects unique to each facility. Typical upstream fish passage facilities at each dam would consist of pool and weir type fish ladders to provide the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. This type of fish ladder is generally constructed from reinforced concrete and occasionally uses metal or wood hardware for adjustable components. In order to meet the prescribed fish passage criteria (DOI and NOAA Fisheries Service 2007), the fish ladders would use 6-inch steps between each weir that would result in an overall structure slope of 4 and 6 percent. At a minimum, each ladder bay would measure 8 feet long by 6 feet wide by 5 feet deep to meet the minimum pool requirements (NOAA Fisheries Service 2008), which would drive the structure slope of 4 to 6 percent. The FERC Final EIS identified a 10 percent slope, but that slope would not meet current requirements for fish ladders. Figure 2-22 shows an example of a cast-in-place pool and weir fish ladder that is similar to that proposed for upstream fish passage at the Four Facilities under this alternative. Final design of these structures would likely exceed this minimum pool dimension by 50 to 100 percent in order to meet all regulatory criteria and minimize turbulence in the ladder bays. Table 2-23 provides a minimum footprint for each upstream fish ladder.



Figure 2-22. Example of cast-in-place pool and weir fish ladder

**Table 2-23. Minimum Structure Footprint and Dimensions for Fish Ladders at Each Dam**

Dam	Vertical Drop (ft)	Min. Number of Pools	Min. Structure Length (ft)	Min. Structure Footprint (sq. ft.)
J.C. Boyle	61	122	1,089	8,712
Copco 1	124	249	2,241	17,928
Copco 2	22	44	396	3,168
Iron Gate	157	314	2,826	22,608

Vertical Drop Source: CH2M Hill 2003

The J.C. Boyle and Copco 2 fish ladders are well within typical pool and weir fish ladders being designed today to meet fish passage criteria for the vertical drop. The Copco 1 and Iron Gate fish ladders are substantially longer and have a bigger elevation differential; however, there are two successful examples in Oregon where bigger elevation differentials have been overcome with pool and weir fish ladders for upstream fish passage. The two examples are the Faraday/North Fork ladder on the Clackamas River (196 feet tall, 1.9 miles long) and the Pelton ladder on the Deschutes River (230 feet tall, 2.8 miles long) (Ratliff et. al. 1999). The Pelton ladder was shut down in 1968 primarily due to downstream juvenile passage and not upstream passage.

Fish ladders would be designed to allow passage 90 percent of the time that migratory fish would be present in the project area. For the extreme high and low flows, or 10 percent of the time, hydraulic conditions might prevent the ladders from meeting fish passage criteria. Fishway prescriptions require two downstream entrances and associated entrance pools for each fish ladder (DOI and NOAA Fisheries Service 2007). All fish ladders would require an auxiliary water supply (AWS) to ensure adequate attraction flows at the downstream and to draw fish into the fish ladder and moderate water temperatures. The AWS would consist of a pipeline or intake that draws water from the reservoir and releases it in the fish ladder and near the fishway entrance pools. To accommodate increased flows, the downstream bays of the fish ladder would be larger than upstream bays in the fish ladder.

Downstream fish passage facilities would vary at each dam. Generally, the facilities would include V-screens or floating surface bypass collectors (FSBC) to screen the fish away from the intake structures for the power generation facilities and the spillways (if they are unsuitable for downstream passage). Table 2-24 summarizes the fish passage facilities that would be required at each dam under this alternative.

**Table 2-24. Fish Passage Improvements under the Fish Passage at Four Dams Alternative**

Dam	Upstream Fish Passage	Spillway Modifications <sup>1</sup>	Tailrace Barrier <sup>1</sup>	Screens & Bypass
J.C. Boyle	New fish ladder over dam with auxiliary water supply (AWS) for attraction	Spillway modification to provide smooth transition	Extend river bank and install cutoff screen	New V-screen with fish bypass
Copco 1	New fish ladder over dam with AWS	Surface bypass collector		New V-screen with fish bypass
Copco 2	New fish ladder over dam with AWS		Extend river bank and install cutoff screen	New V-screen with fish bypass
Iron Gate	New fish ladder over dam with AWS, observation and sorting station in fish ladder	Spillway modification to provide smooth transition		New V-screen with fish bypass

Notes:

1. The prescriptions require studies to determine the need for and design of spillway modifications and tailrace barriers. For the purposes of analysis in this EIS/EIR, Alternative 4 includes some specific fishway facility design and construction details that are beyond those required in the prescriptions.

**2.4.5.1 Construction Details**

Construction of fish ladders represents the bulk of the work under this alternative. The Hydropower Licensee would construct the ladders from reinforced concrete using construction methods typical for civil infrastructure work.

Table 2-25 shows estimated quantities of concrete for each facility.

**Table 2-25. Estimated Minimum Amount of Reinforced Concrete Necessary For Fish Ladder at Each Dam**

Dam	Reinforced Concrete (yd <sup>3</sup> )
J.C. Boyle	2,800
Copco 1	5,800
Copco 2	1,000
Iron Gate	7,000

The Hydropower Licensee would need to control water and isolate the work area from flowing water and aquatic organisms throughout the duration of construction. Control mechanisms would be installed prior to starting work for each dam removal. The Hydropower Licensee could control water in most areas using gravity diversions; however, pumps could be required to dewater isolated ponding. Dewatering would require electric, gasoline, or diesel powered pumps, along with flexible hosing to convey water. Pumps would discharge water away from the river into upland areas to prevent discharge of fine sediments to waterways.

The Hydropower Licensee would work in wet conditions in areas that cannot be dried. For in-water work, the Hydropower Licensee would use physical barriers of a type and in a manner similar to that used under the dam removal alternatives.

The following sections provide a detailed description of necessary fish passage facilities for each dam under the Fish Passage at Four Dams Alternative.

### **J.C. Boyle Fish Passage Facilities**

The J.C. Boyle site has the best access for construction equipment and staging for construction. Equipment and materials could be brought into the site on existing gravel access roads and temporary access roads where necessary.

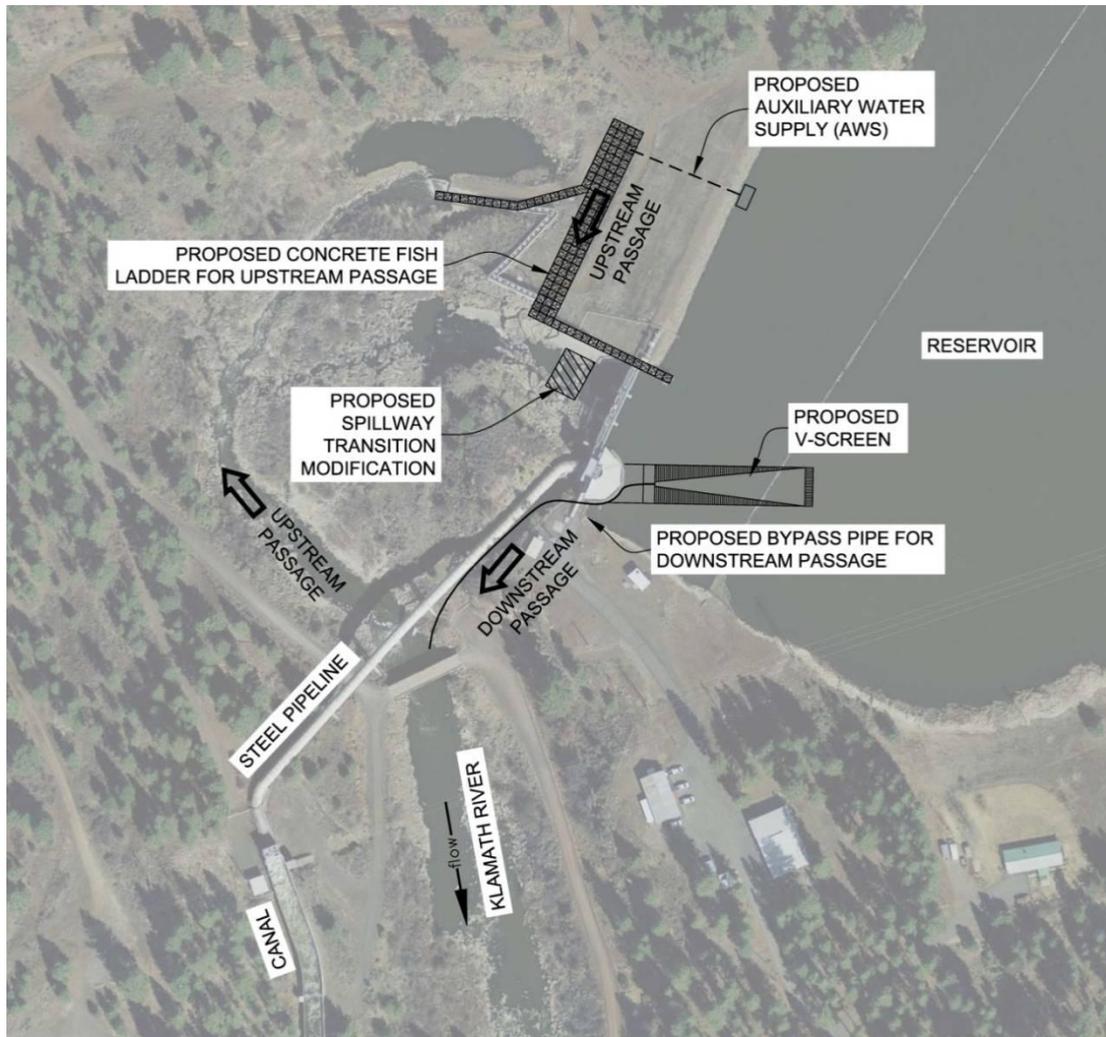
#### **Upstream Passage**

J.C. Boyle Dam has an existing pool and weir concrete fish ladder on the north side of the spillway, but it does not meet current design criteria and must be replaced because of its configuration and poor structural condition. The Fish Passage at Four Dams Alternative would include removal of the existing fish ladder structure and construction of a new pool, weir, and reinforced concrete fish ladder on the north side of the dam spillway, at or near the same location as the existing fish ladder (see Figure 2-23).

The overall difference in water levels from the downstream river to J.C. Boyle Reservoir ranges from 55 to 61 feet, depending on reservoir pool elevation. The new fish passage facilities would have multiple openings into the reservoir to accommodate the reservoir pool fluctuation while maintaining continual upstream passage. The new ladder would have two entrances to accommodate low flow and high flow conditions.

An AWS would be necessary for temperature and attraction flow mitigation. The AWS would draw water from the reservoir through a screened inlet and variable height intake structure to

provide water temperature control. The AWS would pipe water into the fish ladder at two locations.



**Figure 2-23. Conceptual Layout of J.C. Boyle Fish Passage Facilities**

Construction of these facilities would begin with demolition and removal of the existing fish ladder using mechanical means (such as hydraulic shears or hoe-ram). The Hydropower Licensee would then install the new reinforced concrete fish ladder by constructing concrete forms, laying the reinforcement, and pouring concrete. The Hydropower Licensee would construct a cofferdam around the area where the fish ladder enters the reservoir to allow construction in dry conditions.

**Downstream Fish Passage – Water Intake**

The existing water intake has a design flow of 3,000 cfs, which requires a minimum fish screen of 7,500 square feet based on an approach velocity of 0.4 feet per second (ft/s). The Fish Passage at Four Dams Alternative would include a conventional V-screen at the J.C. Boyle water

intake. The V-screen would terminate in a 36 inch diameter fish bypass pipe (approximately 40 cfs) that would run from the water intake to a bypass facility for recording downstream migrating fish and then continuing on to a controlled outfall in the river downstream of the dam. The V-screen would be stainless steel and the fish return pipe would be standard steel with concrete and steel support structures along the length of the pipe.

The V-screen would be fabricated offsite and installed by a crew of skilled workers using light equipment. This phase of construction would require extensive dewatering and work isolation effort in order to provide a dry or partially isolated work area. Dewatering could require reservoir water level manipulation or construction of coffer barriers with pumps to dewater the work area around the water intakes.

### **Downstream Fish Passage – Spillway**

Radial gates regulate discharge over the J.C. Boyle Dam's concrete spillway section that terminates in an abrupt drop onto bedrock. Modifications to the spillway would likely include removing the drop at the downstream end of the spillway by building a cast-in-place concrete transition and minor channel modifications. This design would likely reduce fish mortality on the rock outcrop below the spillway and provide a smooth transition for downstream passage. Construction would involve a small amount of demolition and concrete placement; methods would be similar to the work on the new fish ladder.

### **Tailrace Barrier**

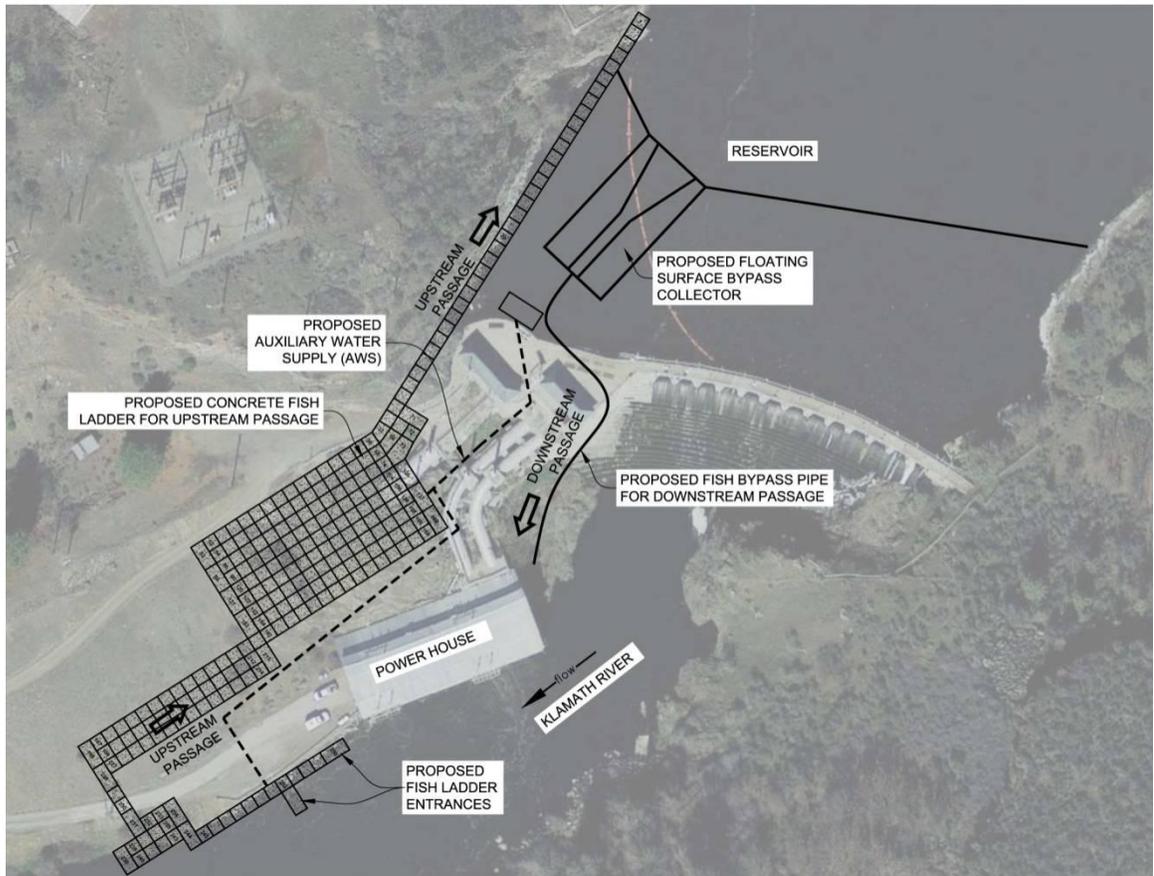
The power generation turbines at J.C. Boyle Powerhouse are several miles downstream from the dam with a large outlet bay, or tailrace area, that flows into the Klamath River (see Figure 2-2). This tailrace has the potential for false attraction waters and needs a barrier. The Fish Passage at Four Dams Alternative would include extension of the bank of the Klamath River and installation of a stainless steel, wedge-wire cutoff screen.

### **Copco 1 Fish Passage Facilities**

The Copco 1 Dam site has difficult site access because of steep canyon terrain. The Fish Passage at Four Dams Alternative would include construction of temporary roads for site access and other special provisions to move materials, such as a tower crane or aerial tramway.

### **Upstream Passage**

Fish Passage at Four Dams Alternative would include a new pool and weir fish ladder on the right side of Copco 1 Dam for upstream fish passage. The fish ladder would have an AWS plumbed into it at two locations to moderate water temperatures, flow in the fishway, and attraction flows at the downstream end of the fishway. The downstream entrance of the fish ladder would have two entrances for low water and high water conditions, as shown in Figure 2-24. The upstream end of the fish ladder that enters the reservoir area would also have multiple openings to accommodate water level fluctuations. Construction would require installation of the cast-in place concrete ladder and isolation of the area where the ladder connects to the reservoir.



**Figure 2-24. Copco 1 Fish Ladder Configuration and Floating Surface Bypass Collector**

### Downstream Fish Passage

The existing facilities at Copco 1 Dam are not conducive to downstream fish passage because the juvenile salmonids travelling downstream would flow through the intake to the power generation facility or over the dam spillway during high flows. The Fish Passage at Four Dams Alternative would include a V-screen as the primary measure to ensure safe downstream passage (DOI and NOAA Fisheries Service 2007).

Depending on the frequency of spill, an FSBC may also be necessary to prevent fish from moving toward the spillway area. For the purposes of this analysis, the Fish Passage at Four Dams Alternative includes construction of an FSBC that is integrated with the V-screen for Copco 1 Reservoir with full-depth nets. The FSBC would be placed on the reservoir surface to protect the entire spillway area. The FSBC would be fabricated off-site and shipped to the site using standard flatbed trucks. The Hydropower Licensee would assemble the pieces on-site to create the larger body of the FSBC. Once the structure was assembled, it would be floated into place near the water intake area and secured. Reservoir guide nets would facilitate fish passage through the bypass collector.

The FSBC would be a steel structure using a typical V-screen configuration similar to Upper Baker Dam in Washington (see Figure 2-25). The existing power generation water intake has a design flow of 3,200 cfs, which requires a minimum fish screen of 8,000 square feet based on an approach velocity of 0.4 ft/s. The main FSBC would be at the intake structure on the right side of the dam. The FSBC would be anchored to the existing rock and concrete dam structure to ensure stability. The FSBC would direct fish to an approximately 36 inch diameter bypass pipe with a capacity of more than 60 cfs.



**Figure 2-25. Example of Floating Surface Bypass Collector in Upper Baker Dam, Washington**

### **Tailrace Barrier**

The Copco 1 Powerhouse configuration is similar to the Iron Gate facility, which would not include a tailrace barrier based on observed conditions and past performance. Prescriptions include a study to determine if a tailrace barrier is necessary. Because of its similarities with Iron Gate, Alternative 4 does not include a tailrace barrier because the study is likely to find that it would not be necessary.

### **Copco 2 Fish Passage Facilities**

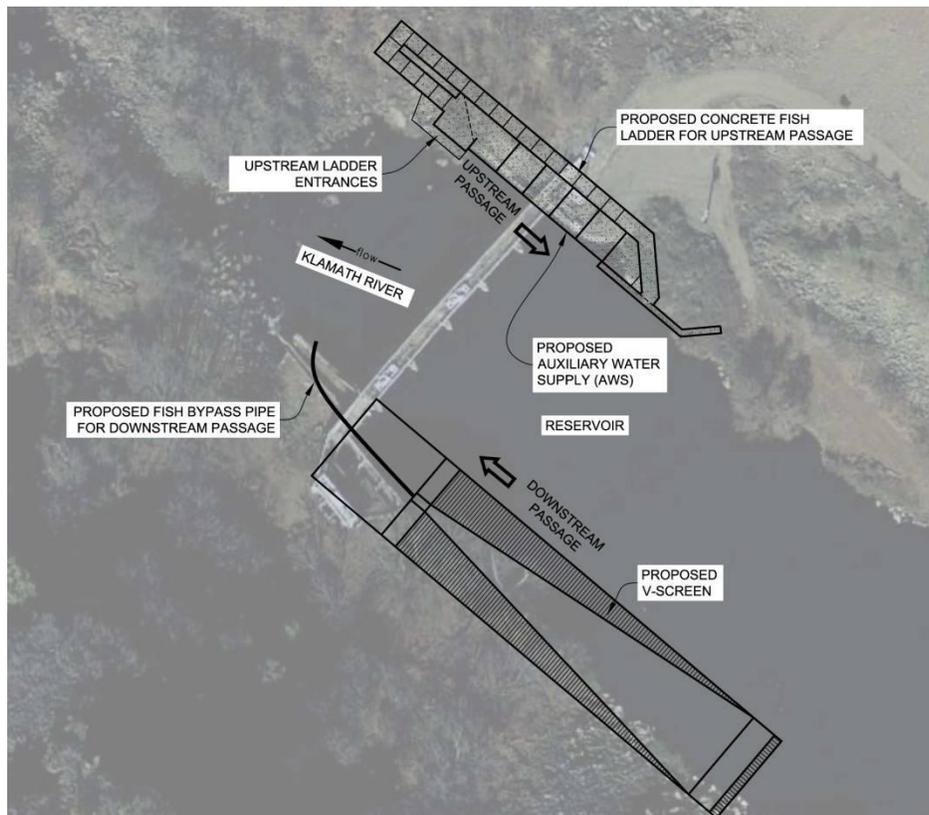
The Copco 2 site has difficult access because of the narrow canyon and relatively steep road access into the site. The existing access road would require upgrades such as gravel surfacing and grading.

### **Upstream Fish Passage**

The Fish Passage at Four Dams Alternative includes a concrete pool and weir fish ladder with 6-inch drops to provide volitional fish passage at Copco 2 Dam. The overall difference in water levels from the downstream river to Copco 2 Reservoir is about 20 to 25 feet, depending on

reservoir pool elevations. The new fish passage facilities would accommodate the reservoir pool fluctuation while maintaining continual upstream passage. Construction would require installation of the cast-in place concrete ladder and isolation of the area where the ladder connects to the reservoir.

The pool and weir fish ladder would be on the right side of the concrete spillway structure in the earth embankment. An AWS would be necessary for temperature and attraction flow mitigation. The AWS would draw water from the reservoir through a screened inlet. Figure 2-26 shows a conceptual layout for a fish ladder at Copco 2 Dam.



**Figure 2-26. Copco 2 Fish Ladder and V-screen, along the left side of the river, for power water diversion**

In addition to the fish ladder, a transverse bedrock sill approximately 0.5 miles upstream of the Copco 2 Powerhouse in the Bypass Reach could create a fish passage barrier. A new FERC license would likely increase flows in the Bypass Reach and this barrier would not likely exist. As part of the license renewal process, a study would determine whether corrective measures would be needed at this barrier to provide fish passage. According to the mandatory prescriptions, sufficient flow would need to be released into the Bypass Reach to attract upstream-migrating fish into the fishway entrance pools and ensure that flows are sufficient to attract fish at the point of confluence between the Bypass Reach and the downstream

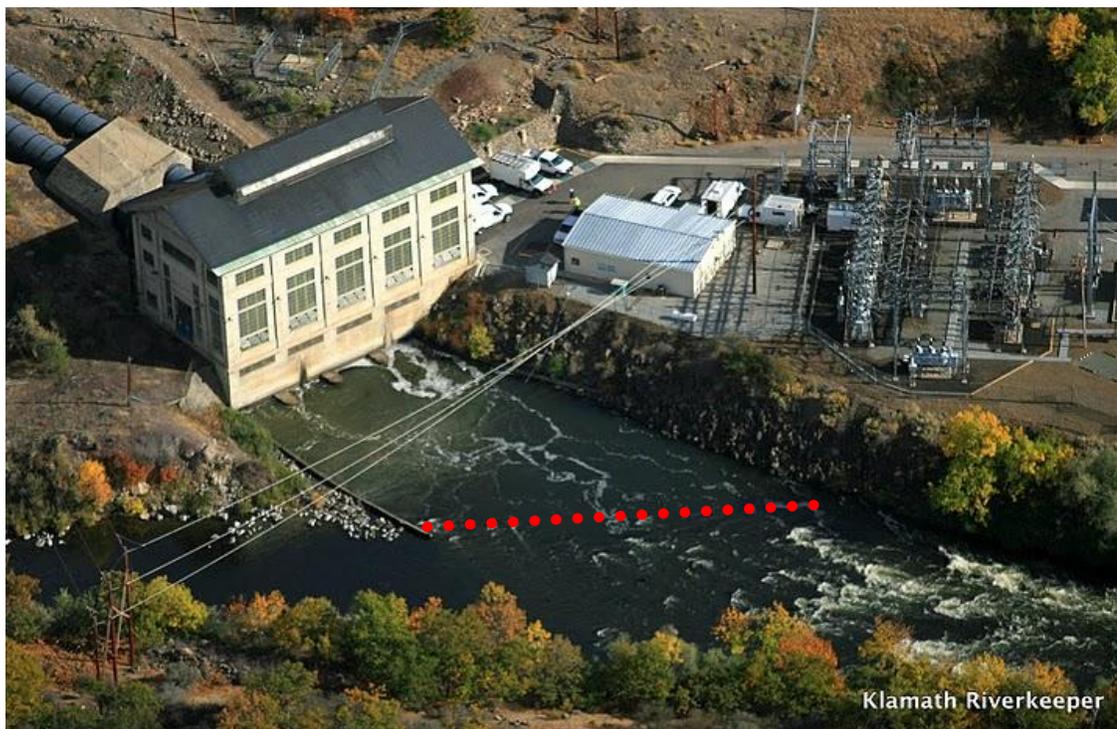
powerhouse discharges. The prescriptions do not specify a flow rate in the Bypass Reach, but modeling the recommendations indicates that minimum flows would be approximately 438 cfs.

### Downstream Fish Passage

The existing power generation water intake at Copco 2 Dam is on the left side of the concrete spillway structure. The water diversion capacity is 3,200 cfs, which would require a minimum 8,000 square feet of screen. A conventional V-screen for the water intake would minimize the length of the screen. The V-screen would terminate in an approximately 36-inch fish bypass pipe that would flow over the dam and into the downstream river area. As with the V-screen for the J.C. Boyle Development, the V-screen would be fabricated off-site and installation would require dewatering and isolation to provide a dry or partially isolated work area.

### Tailrace Barrier

The power generation turbines for Copco 2 are several miles downstream from the dam with a large tailrace area that flows back into the Klamath River. The water flowing out through this tailrace has the potential to attract fish to a false pathway. Prescriptions require a tailrace barrier unless studies prove otherwise (DOI and NOAA Fisheries Service 2007); Alternative 4 includes a tailrace barrier because the orientation and nature of the tailrace area indicate that a barrier would likely be necessary. The Fish Passage at Four Dams Alternative includes extending the bank line of the Klamath River and installing a cutoff screen to prevent fish from straying into the tailrace area (see Figure 2-27).



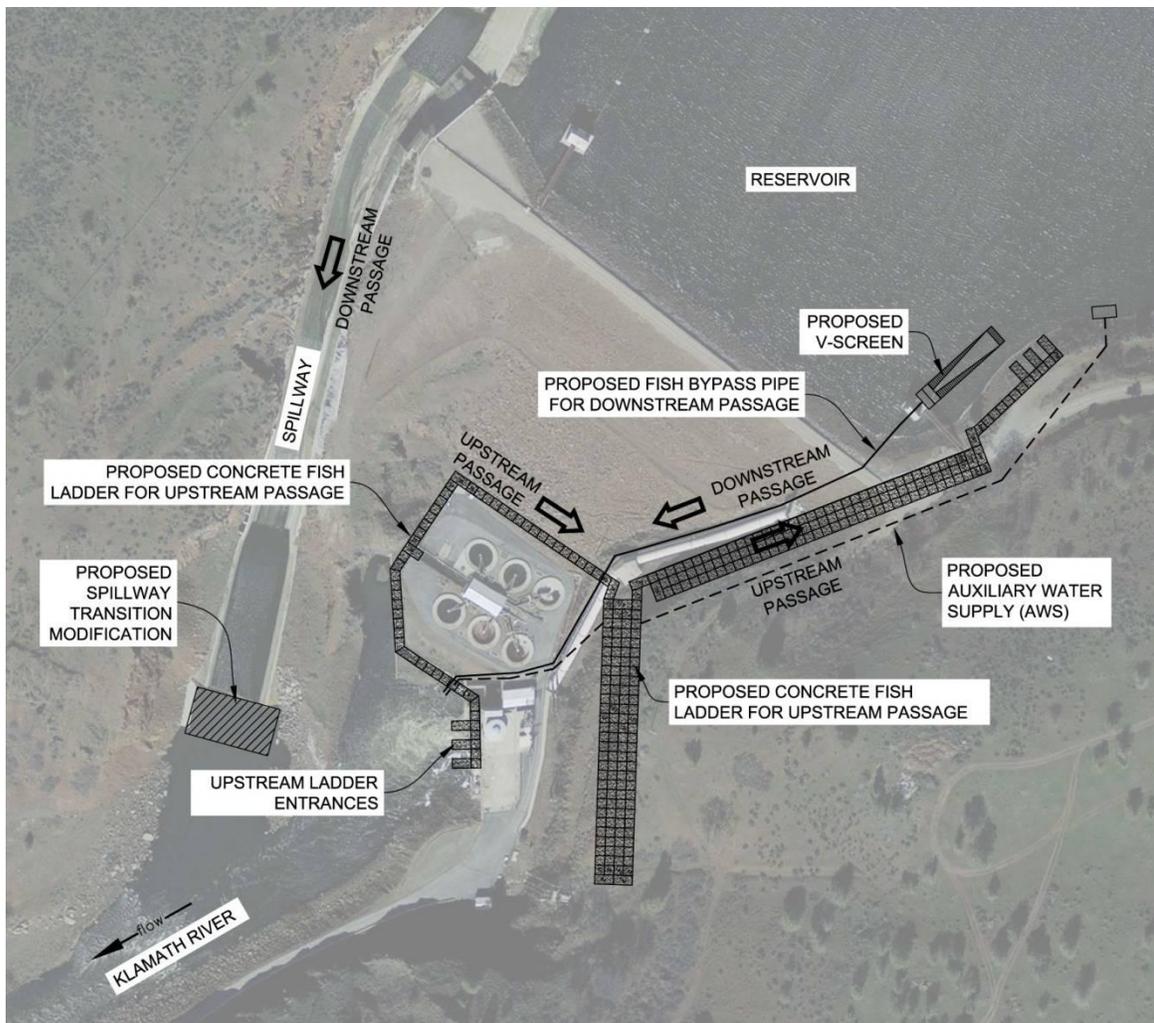
**Figure 2-27. Modifications at the tailrace of the Copco 2 Powerplant would extend the bank and install a tailrace barrier screen (red dots)**  
(Source: Klamath Riverkeeper)

**Iron Gate Dam Fish Passage Facilities**

The Iron Gate Development has difficult site access because of steep canyon terrain. It would require construction of temporary roads for site access and a tower crane or aerial tramway to move construction materials.

**Upstream Fish Passage**

The Fish Passage at Four Dams Alternative would include installation of a fish ladder on the left side of Iron Gate Dam near the existing penstock pipe, as shown in Figure 2-28. The fish ladder would have two entrances with entrance pools at the downstream end of the fish ladder. An AWS would feed water into the fish ladder at two locations to help with attraction flows and water temperatures. Multiple openings would be necessary where the fish ladder connects to the reservoir to allow for water level fluctuation. Construction would require installation of the cast-in place concrete ladder and isolation of the area where the ladder connects to the reservoir.



**Figure 2-28. Conceptual fish passage facilities layout for Iron Gate Dam showing fish ladder, water intake screen, and spillway transition modifications**

### Downstream Fish Passage – Water Intake

The existing power generation water intake structure at Iron Gate Dam is on the left side of the embankment dam. The water intake design flow is 1,735 cfs and would require a minimum fish screen of 4,340 square feet based on an approach velocity of 0.4 ft/s. A conventional V-screen would be the best option for screening the water intake to address the substantial size of the screen. The V-screen would terminate in a 36 inch diameter fish bypass pipe (approximately 40 cfs) that would run from the water intake to a fish bypass facility for identification of downstream migrating juveniles and then continue downstream to the river below the dam. The V-screen would be stainless steel and the fish return pipe would be standard steel with concrete and steel support structures along the length of the pipe. As with the V-screen for the J.C. Boyle facility, the V-screen would be fabricated off-site and installation would require dewatering and isolation to provide a dry or partially isolated work area.

### Downstream Fish Passage – Spillway

The Iron Gate spillway is an unregulated, free overflow from the reservoir area. Likely modifications to the spillway would include building a smoother transition at the downstream end using cast-in-place concrete to form an ogee-type drop structure that would connect the downstream river levels to the free flowing spill conditions. This modification would reduce fish mortality on the rock outcrop below the spillway. In addition, the Hydropower Licensee would use concrete to fill the area just upstream of the free outfall at the downstream end of the spillway to make a consistent hydraulic transition and reduce potential harm during downstream passage of primarily juvenile fish.

#### 2.4.5.2 Schedule

The schedule would likely follow the schedule prescribed in the FERC relicensing process. The prescriptions include a schedule for implementation and recommend that downstream facilities be installed prior to upstream passage facilities (DOI and NOAA Fisheries 2007). Table 2-26 shows the schedule for construction of the fish passage facilities at each dam, based on these constraints.

**Table 2-26. Timetable for Fish Passage Improvements at each Dam from Date of FERC License Renewal**

Dam	Upstream Fish Passage	Spillway Modifications	Tailrace Barrier	Screens & Bypass
J.C. Boyle	4 years	4 years	4 years	4 years
Copco 1	6 years	6 years	N/A	6 years
Copco 2	6 years	6 years	8 years	6 years
Iron Gate	5 years	5 years	N/A	5 years

Key:  
N/A: Not Applicable

### 2.4.5.3 Workforce

Table 2-27 shows the estimated workforce necessary for construction at each facility. Each facility would also have 5 to 10 on-site construction administrative personnel (e.g., inspectors, field engineers) for the duration of the project.

**Table 2-27. Estimated Average Construction Workforce for Fish Passage at Four Dams**

Facility	Estimated Construction Workforce	Duration
J.C. Boyle	10 to 20 people	4-6 months
Copco 1	15 to 25 people	9 months
Copco 2	10 to 20 people	4-6 months
Iron Gate	15 to 30 people	12 months

### 2.4.5.4 Environmental Measures

The Fish Passage at Four Dams Alternative would incorporate standard measures to reduce environmental effects. These measures would be the same as those included in the Proposed Action (see Section 2.4.3).

### 2.4.5.5 Trap and Haul around Keno Impoundment – Programmatic Measure

NOAA Fisheries Service prescriptions include a measure to trap and haul fall-run Chinook salmon upstream and downstream around Keno Impoundment. The prescriptions call for seasonal trap and haul operations from June 15 to November 15 when water quality conditions are not suitable for fish (dissolved oxygen concentration less than 20 mg/l or temperature above 20 degrees Celsius) (DOI and NOAA Fisheries Service 2007). Upstream operations would include construction of a collection and handling facility downstream of Keno Dam; these fish would be released upstream of Link River Dam. Downstream operations would include construction of a collection and handling facility at Link River Dam that would also collect fish from the East Side and West Side canals. These fish would be released downstream from Keno Dam. The exact details of the collection facilities, haul routes, or necessary road improvements are not yet defined; therefore, this measure is analyzed in this EIS/EIR at a programmatic level.

## 2.4.6 Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative consists of the full removal of Iron Gate and Copco 1 facilities and installation of upstream and downstream fish passage facilities at both the J.C. Boyle and Copco 2 Dams. On Copco 2 and J.C. Boyle Dams, ladders would be less complex to construct and provide volitional fish passage because of dam height and reservoir length. Iron Gate and Copco 1 Dams also provide less power; therefore, removal would have less effect on power generation. Removing Iron Gate and Copco 1 Reservoirs, the two largest impoundments in the Hydroelectric Reach, would also address water quality problems driven by reservoir size, such as increased water temperature, low dissolved oxygen, and toxic algal blooms in the summer and fall.

In order to meet current criteria for volitional fish passage, J.C. Boyle and Copco 2 Dams would require new upstream and downstream fish passage facilities. The fish passage facilities at J.C. Boyle and Copco 2 Dams would be the same as in the Fish Passage at Four Dams Alternative; Section 2.4.1 describes these facilities in detail. Similar to the Fish Passage at Four Dams Alternative, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would incorporate most of the prescriptions from the FERC relicensing process related to fish passage at J.C. Boyle and Copco 2 Dams (see Attachment B of Appendix A for a list of prescriptions). Alternative 5 would not incorporate the prescriptions related to peaking power at J.C. Boyle and recreation releases. In Alternative 5, Copco 2 Dam would be the only dam remaining downstream from J.C. Boyle Dam. Copco 2 Reservoir is very small, and does not have adequate capacity to reregulate flows associated with peaking operations so that they are suitable for fish downstream. Therefore, Alternative 5 would not include peaking operations or recreation releases on any days at J.C. Boyle Dam.

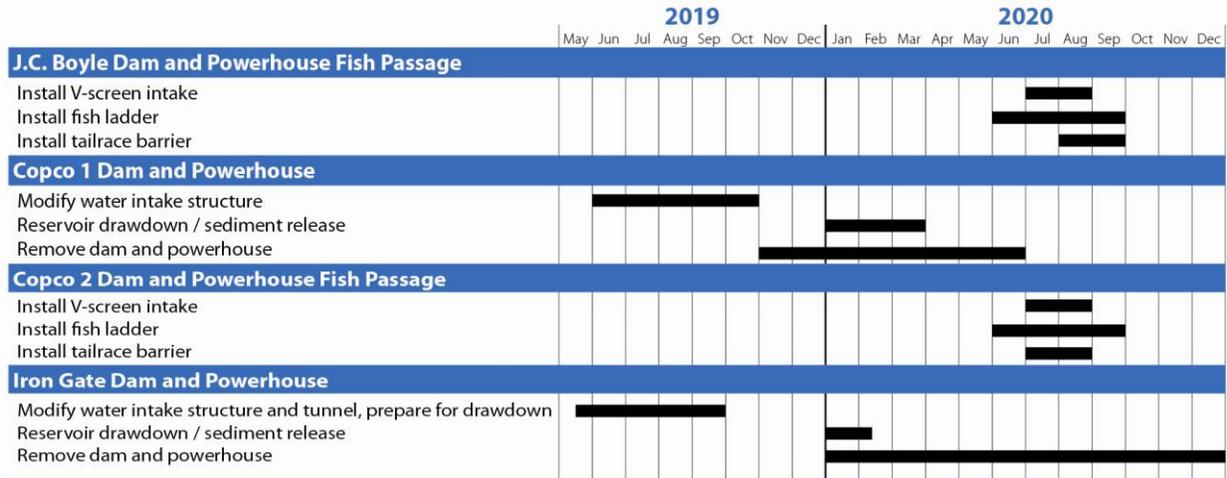
Alternative 5 flows would be driven by releases from J.C. Boyle Dam because of the lack of downstream reregulation. The prescriptions would require 40 percent of J.C. Boyle releases to enter the Bypass Reach; therefore, these flows would be greater than the No Action/No Project Alternative. Flows at the Iron Gate Gauge would be generally similar to the No Action/No Project Alternative to maintain suitable flows for fish, although they may experience small variations because Iron Gate and Copco 1 Dams would not be in place to control flow patterns.

Removal of Iron Gate and Copco 1 Dams would be the same as in the Proposed Action; Section 2.4.3 describes the removal plans in more detail. Inflows to Upper Klamath Lake, and outflows from Copco 2 Dam and fish ladder and the Copco 2 Powerhouse are assumed to be nearly the same under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as described above for the No Action/No Project Alternative.

A Hydropower Licensee would implement this alternative and would be responsible for its long term operation and maintenance. The Hydropower Licensee would need to re-enter the FERC process to implement this alternative. Implementation of the KBRA is not included in the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would not satisfy the KHSA; consequently, the KBRA would not be implemented (although ongoing restoration activities in the No Action/No Project Alternative may continue). For the purposes of this analysis, alternatives that would not result in full implementation of the KHSA do not include the KBRA as a connected action to the alternative. Additionally, the transfer Keno Dam to DOI would not move forward as a connected action.

#### **2.4.6.1 Schedule**

This alternative would follow a schedule similar to that of the Proposed Action, because two of the dams are being removed and fish passage would be necessary as soon as possible after dam removal. Similar to Alternative 4, downstream fishways at each site would be completed before upstream fishways. Figure 2-29 shows the schedule for construction of the fish passage facilities at two dams and for removal of the remaining two dams, based on these constraints.



**Figure 2-29. Anticipated schedule for Fish Passage at J.C. Boyle and Copco 2 Dams with Removal of Copco 1 and Iron Gate Dams**

**2.4.6.2 Workforce**

Table 2-28 shows the estimated workforce necessary for each facility under this alternative. In addition to the average construction workforce, there would be 5 to 10 on-site construction management staff (e.g., inspectors, field engineers) at each site for the duration of the project. The deconstruction efforts at Copco 1 and Iron Gate Dams would constitute the bulk of the efforts in this alternative.

**Table 2-28. Estimated Construction Workforce for Full Removal of Iron Gate and Copco 1 Dams with Fish Passage at Copco 2 and J.C. Boyle Dams**

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle	10 to 15 people	4 to 6 months	15–20	Jul 2020–Sep 2020
Copco 1	30 to 35 people	12 months	50–55	Nov 2019–Apr 2020
Copco 2	10 to 15 people	4 to 6 months	15–20	Jul 2020–Sep 2020
Iron Gate	35 to 40 people	18 months	75–80	Jun 2020–Sep 2020

**2.4.6.3 Environmental Measures**

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would incorporate standard measures to reduce environmental effects. These measures would be the same as those included in the Proposed Action (see Section 2.4.3).

**2.4.6.4 Recreation Facilities**

Recreation facilities near J.C. Boyle Reservoir would stay intact, and the Copco 2 area does not have any developed recreation facilities. Recreation facilities at Iron Gate and Copco 1 (see Table 2-29) would be removed.

**Table 2-29. Recreation Facility Changes under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative**

Site Name	Existing Facilities	Facilities Following Dam Removal
<i>Sites at Copco 1 Reservoir (California)</i>		
Mallard Cove	Day-use picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Copco Cove	Picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
<i>Sites at Iron Gate Reservoir (California)</i>		
Fall Creek Trail	Day-use area and trail	This site would remain, there would be no improvements or changes
Jenny Creek	Day-use area and campground	This site would remain, there would be no improvements or changes
Wanaka Springs	Day-use area, campground, boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Camp Creek	Day-use area, campground, boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Juniper Point	Primitive campground and boat dock	All facilities would be removed. Parking area would be regraded, seeded, and planted
Mirror Cove	Campground and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Overlook Point	Day-use area	All facilities would be removed. Parking area would be regraded, seeded, and planted
Long Gulch	Picnic area and boat launch	All facilities would be removed. Parking area would be regraded, seeded, and planted
Dutch Creek	Day-use area	All facilities would be removed. Parking area would be regraded, seeded, and planted
Iron Gate Fish Hatchery Public Use Area	Day-use area and boat launch	This site would remain, there would be no improvements or changes

Source: O'Meara 2010

#### **2.4.6.5 Trap and Haul around Keno Impoundment – Programmatic Measure**

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would include trap and haul measures to move fish around Keno Impoundment when water quality is not suitable for fish. The measures would be the same as those described in the Fish Passage at Four Dams Alternative (see Section 2.4.5). The exact details of the collection facilities, haul routes, or necessary road improvements are not yet defined; therefore, this measure is analyzed in this EIS/EIR at a programmatic level.

## **2.5 Preferred Alternative**

The DOI has not identified a Preferred Alternative. After receiving public comment on this Draft EIS/EIR and further consultation with cooperating agencies and other stakeholders, the DOI will either adopt one of the existing alternatives (potentially modified) or a new alternative as its Preferred Alternative. The Preferred Alternative or new alternative may be a combination of existing alternatives or an alternative within the spectrum of alternatives already analyzed.

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# Chapter 3

## Affected Environment/Environmental Consequences

### 3.1 Introduction

This chapter describes, for each resource area, the affected environment or environmental setting for the region of the Klamath Basin potentially affected by the dam removal and connected actions, should they be implemented. This chapter presents the analyses of the impacts that would result from the No Action/No Project Alternative or implementation of the Proposed Action and alternatives described in Chapter 2. This chapter also presents mitigation measures to reduce or eliminate the impacts. The sections of this chapter, by resource area, are as follows:

- |      |  |      |   |
|------|--|------|---|
| 3.2  | Water Quality                          | 3.14 | Land Use, Agricultural and Forest Resources                                 |
| 3.3  | Aquatic Resources                      | 3.15 | Socioeconomics  |
| 3.4  | Algae                                  | 3.16 | Environmental Justice   |
| 3.5  | Terrestrial Resources                  | 3.17 | Population and Housing  |
| 3.6  | Flood Hydrology                        | 3.18 | Public Health and Safety, Utilities and Public Services, Solid Waste, Power |
| 3.7  | Groundwater                            | 3.19 | Scenic Quality  |
| 3.8  | Water Supply/Water Rights              | 3.20 | Recreation  |
| 3.9  | Air Quality                            | 3.21 | Toxic/Hazardous Materials   |
| 3.10 | Greenhouse Gases/Global Climate Change | 3.22 | Traffic and Transportation  |
| 3.11 | Geology, Soils, and Geologic Hazards   | 3.23 | Noise and Vibration   |
| 3.12 | Tribal Trust                           |      |   |
| 3.13 | Cultural and Historical Resources      |      |   |

Paleontological resources, which may appear in an Environmental Impact Statement (EIS) or an Environmental Impact Report (EIR) for other projects, were not considered in detail in this Klamath Facilities Removal EIS/EIR, with the exception of their potential presence in a diatomite bed near Copco Reservoir, because the Lead Agencies determined that the volcanic nature of the local geology at the dam sites precluded the presence of these resources in the project area. The potential for project related effects on paleontological resources at this diatomite deposit are described in Section 3.11, Geology, Soils, and Geologic Hazards.

### **3.1.1 Format of the Environmental Analysis**

#### **3.1.1.1 Area of Analysis**

This document defines and describes an area of analysis for each resource area. In some cases, the area of analysis consists only of facility deconstruction/construction areas, or nearby areas that would be affected directly by the effects of deconstruction/construction, such as for the analysis of noise impacts. More often, the area of analysis includes the entire Klamath Basin. The area of analyses for water supply/water rights and for land use, agricultural and forest resources, for example, includes the entire Klamath Basin because implementation of the Klamath Hydroelectric Settlement Agreement (KHSA) and Klamath Basin Restoration Agreement (KBRA) could affect these resources not only at the project sites, but also in areas upstream and downstream of them. In a few cases, the area of analysis is even more geographically broad, such as for socioeconomics.

#### **3.1.1.2 Regulatory Framework**

Each resource area is evaluated within the existing framework of federal, state, and local laws, regulations, policies, and plans. For each resource area, the sub-sections of this chapter briefly list the laws and regulations that are relevant and applicable to the affected environment, area of analysis, and analysis of impacts. Chapter 6 of this EIS/EIR provides further discussion on how laws, regulations, policies, and plans would be addressed through implementation of the Proposed Action or alternatives.

#### **3.1.1.3 Wild and Scenic River Act Component Analysis**

The analysis of potential effects on Wild and Scenic River components is presented in Section 3.20, Recreation. The specific subsection and page numbers of this analysis are:

- Scenic Quality - Section 3.20.4.3, pages 3.20-47 and 59
- Recreation - Section 3.20.4.3, pages 3.20-50 and 59
- Fisheries - Section 3.20.4.3, pages 3.20-52 and 59
- Wildlife - Section 3.20.4.3, pages 3.20-55 and 59

#### **3.1.1.4 Coastal Zone Management Act Consistency Determination**

The Coastal Zone Management Act (CZMA) requires any applicant seeking a Federal License or permit that could affect land or water uses or resources of the California coastal zone to perform a Federal Consistency Determination for the proposed project. The determination provides a certification that the proposed action will be conducted in a manner that to the maximum extent possible is consistent with the policies of the California Coastal Management Program as outlined in the California Coastal Act (CCA) of 1976. The analysis of the consistency between the policies of the California Coastal Act and the Proposed Action is discussed in the following section:

- Discussion of CCA Section 30231 - Section 3.3.4.3 page 134
- Discussion of CCA Section 30236 - Section 3.3.4.3 page 135

The focused analysis in Section 3.3.4.3 considers at specific CCA policies; however, this information supplements the more comprehensive analysis of the near-shore impacts in Section 3.2, Water Quality and Section 3.3, Aquatic Resources.

#### **3.1.1.5 Basis of Comparison for the Affected Environment/Environmental Setting**

The analysis of impacts requires a basis for comparison of conditions during project construction and post-project. The National Environmental Policy Act (NEPA) basis of comparison is the No Action Alternative. Under the California Environmental Quality Act (CEQA), the basis of comparison is conditions at the time of the Notice of Preparation. As discussed in Chapter 2, the No Action Alternative is similar to conditions at the time of the Notice of Preparation; therefore, the basis of comparison for NEPA and CEQA are generally the same for this document. The impact analysis for each resource considered both the NEPA and CEQA basis of comparison together and, in cases where these baselines differ, further discussion is provided.

#### **3.1.1.6 Environmental Consequences/Environmental Impacts**

The methods used to evaluate impacts are described for each resource area. In general, the Lead Agencies identified the impacts that would result from implementation of each of the alternatives within the context of the environmental baseline and regulatory framework. The Lead Agencies used a variety of data sources, models, design documents, interviews, and various other types of research and analysis to predict the impacts. The Lead Agencies then determined the magnitude or significance of the impacts based on significance criteria, where required.

#### **Significance Criteria**

For each resource area, this chapter presents specific significance criteria that the Lead Agencies used to assess the significance level of the impacts under CEQA. Pursuant to NEPA, significance is used to determine whether an EIS or some other level of documentation is required, and once the decision to prepare an EIS is made, the magnitude of the impact is evaluated and no further judgment of significance is required. Therefore, any determinations of significance are for CEQA purposes only.

#### **Impact Discussion**

The impacts of each alternative are discussed in Chapter 3 by resource area and alternative. Each resource area section is structured so that an *italicized* impact statement introduces potential changes that could occur from implementation of each alternative. A discussion of how the resource area would be affected by the impact then follows this initial statement. The impact discussion is concluded with a **bold** significance determination that indicates if there is no impact to a resource area or if the impact to a resource area is beneficial, less than significant, or significant.

#### **Mitigation Measures**

For those impacts that would be significant, the Lead Agencies identified feasible mitigation measures, if they exist, to reduce the level of the impact. The discussion of mitigation measures presented in this chapter includes an assessment of which, if any, significant impacts would remain after mitigation. Chapter 5, Other Required

Disclosures, describes any irreversible and irretrievable commitments of resources that the Lead Agencies identified as part of this analysis.

Although existing adverse conditions associated with the No Action/No Project Alternative identified in this chapter would continue, it is not necessary or appropriate to formulate a mitigation measure and ascribe mitigation responsibility for these impacts. In accordance with the intent and requirements of CEQA (Guidelines Section 15126.6), delineating the nature and significance of impacts associated with the No Action/No Project Alternative serves to provide a basis for comparing the impacts of approving the proposed project with the impacts of not approving the proposed project. In particular, the evaluation of alternatives, including the “no project” alternative, serves to determine whether the significant impacts of the alternatives can be avoided or substantially lessened. The analysis presented for the No Action/No Project Alternative in this chapter has determined that the existing adverse conditions would continue for reasons not attributable to the Proposed Action or alternatives; this provides information to be considered by decision-makers in evaluating the impacts that are attributable to the Proposed Action.

### **Scope of the KBRA Evaluation**

This EIS/EIR provides a project-level analysis of the KHSAs and alternatives<sup>1</sup>, but it evaluates the KBRA on a programmatic level. While the general goals of the KBRA actions and programs are known, the specific actions that would occur are not yet defined, and additional environmental analyses according to NEPA, CEQA, and other permits and authorizations would be required as necessary once the KBRA activities are defined at a project-level. The Lead Agencies considered the goals, programs, and plans as described in KBRA Appendix C-3 (summarized in this EIS/EIR in Chapter 2) in the impact analyses to determine their anticipated direct, indirect, and cumulative effects on each resource. Additionally, each section contains an analysis of the potential combined effects of KBRA actions and facility removal actions in the KHSAs. These combined effects are described as a part of the programmatic significance determination on the specific KBRA actions. The KBRA programs described at a sufficient level of detail to support the programmatic analysis completed in this EIS/EIR are outlined in Table 3.1-1:

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<sup>1</sup>With the exceptions of the East and West Side Facility Decommissioning, a component of the Proposed Action and Alternative 3, and the trap and haul program included in Alternatives 4 and 5 which are both analyzed at the programmatic level.

**Table 3.1-1 KBRA Plans and Programs Analyzed**

KBRA Program	Sections Analyzed
Phase 1 Fisheries Restoration Plan	3.2 Water Quality, 3.3 Aquatic Resources, 3.4 Algae, 3.5 Terrestrial Resources, 3.6 Flood Hydrology, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.11 Geology and Soils, 3.13 Cultural and Historic Resources, 3.15 Socioeconomics, 3.16 Environmental Justice, 3.17 Population and Housing, 3.18 Utilities and Public Services, Solid Waste, Power, 3.19 Scenic Quality, 3.20 Recreation, 3.21 Toxic and Hazardous Materials, 3.22 Traffic and Transportation, 3.23 Noise and Vibration
Phase 2 Fisheries Restoration Plan	3.2 Water Quality, 3.3 Aquatic Resources, 3.4 Algae, 3.5 Terrestrial Resources, 3.6 Flood Hydrology, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.11 Geology and Soils, 3.13 Cultural and Historic Resources, 3.15 Socioeconomics, 3.16 Environmental Justice, 3.17 Population and Housing, 3.18 Utilities and Public Services, Solid Waste, Power, 3.19 Scenic Quality, 3.20 Recreation, 3.21 Toxic and Hazardous Materials, 3.22 Traffic and Transportation, 3.23 Noise and Vibration
Fisheries Monitoring Plan	3.3 Aquatic Resources, 3.15 Socioeconomics
Fisheries Reintroduction and Management Plan	3.2 Water Quality, 3.3 Aquatic Resources, 3.5 Terrestrial Resources, 3.8 Water Rights/Water Supply, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.13 Cultural and Historic Resources, 3.14 Land Use, Agricultural and Forest Resources, 3.15 Socioeconomics, 3.16 Environmental Justice, 3.19 Scenic Quality, 3.20 Recreation, 3.21 Toxic and Hazardous Materials, 3.22 Traffic and Transportation, 3.23 Noise and Vibration
Wood River Wetland Restoration	3.2 Water Quality, 3.4 Algae, 3.5 Terrestrial Resources, 3.6 Flood Hydrology, 3.8 Water Rights/Water Supply, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.13 Cultural and Historic Resources, 3.15 Socioeconomics, 3.17 Population and Housing, 3.18 Utilities and Public Services, Solid Waste, Power, 3.19 Scenic Quality, 3.20 Recreation, 3.22 Traffic and Transportation, 3.23 Noise and Vibration
Water Diversion Limitations	3.2 Water Quality, 3.3 Aquatic Resources, 3.6 Flood Hydrology, 3.7 Groundwater, 3.8 Water Rights/Water Supply, 3.14 Land Use, Agricultural and Forest Resources, 3.15 Socioeconomics, 3.19 Scenic Quality, 3.20 Recreation
On-Project Plan	3.3 Aquatic Resources, 3.5 Terrestrial Resources, 3.6 Flood Hydrology, 3.7 Groundwater, 3.8 Water Rights/Water Supply, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.13 Cultural and Historic Resources, 3.15 Socioeconomics, 3.17 Population and Housing, 3.18 Utilities and Public Services, Solid Waste, Power, 3.19 Scenic Quality, 3.20 Recreation, 3.21 Toxic and Hazardous Materials, 3.22 Traffic and Transportation, 3.23 Noise and Vibration
Future Storage Opportunities	3.6 Flood Hydrology, 3.8 Water Rights/Water Supply, 3.15 Socioeconomics
Water Use Retirement Program	3.2 Water Quality, 3.3 Aquatic Resources, 3.4 Algae, 3.5 Terrestrial Resources, 3.6 Flood Hydrology, 3.7 Groundwater, 3.8 Water Rights/Water Supply, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.13 Cultural and Historic Resources, 3.14 Land Use, Agricultural and Forest Resources, 3.15 Socioeconomics, 3.17 Population and Housing, 3.18 Utilities and Public Services, Solid Waste, Power, 3.19 Scenic Quality, 3.20 Recreation, 3.21 Toxic and Hazardous Materials, 3.22 Traffic and Transportation, 3.23 Noise and Vibration

**Table 3.1-1 KBRA Plans and Programs Analyzed**

<b>KBRA Program</b>	<b>Sections Analyzed</b>
Power for Water Management	3.14 Land Use, Agricultural and Forest Resources, 3.15 Socioeconomics, 3.18 Utilities and Public Services, Solid Waste, Power
Off-Project Water Settlement	3.8 Water Rights/Water Supply, 3.15 Socioeconomics
Off-Project Water Reliance Program	3.8 Water Rights/Water Supply, 3.15 Socioeconomics, 3.16 Environmental Justice
Emergency Response Plan	3.6 Flood Hydrology, 3.7 Groundwater, 3.8 Water Rights/Water Supply, 3.15 Socioeconomics, 3.18 Utilities and Public Services, Solid Waste, Power
Climate Change Assessment and Adaptive Management	3.6 Flood Hydrology, 3.8 Water Rights/Water Supply, 3.20 Recreation, 3.15 Socioeconomics
Interim Flow and Lake Level Program	3.2 Water Quality, 3.4 Algae, 3.5 Terrestrial Resources, 3.6 Flood Hydrology, 3.7 Groundwater, 3.8 Water Rights/Water Supply, 3.15 Socioeconomics, 3.16 Environmental Justice, 3.19 Scenic Quality, 3.20 Recreation
Fish Entrainment Reduction	3.3 Aquatic Resources, 3.9 Air Quality, 3.10 Global Climate Change/Greenhouse Gases, 3.13 Cultural and Historic Resources, 3.15 Socioeconomics, 3.17 Population and Housing, 3.18 Utilities and Public Services, Solid Waste, Power, 3.19 Scenic Quality, 3.21 Toxic and Hazardous Materials, 3.22 Traffic and Transportation, 3.23 Noise and Vibration
Upper Klamath Lake and Keno Nutrient Reduction	3.2 Water Quality, 3.3 Aquatic Resources, 3.4 Algae, 3.15 Socioeconomics
Tribal Fisheries and Conservation Management Program	3.12 Tribal Trust, 3.15 Socioeconomics, 3.16 Environmental Justice
Tribal Programs Economic Revitalization	3.15 Socioeconomics, 3.16 Environmental Justice
Klamath River Tribes Interim Fishing Site	3.3 Aquatic Resources, 3.12 Tribal Trust, 3.13 Cultural and Historic Resources, 3.15 Socioeconomics, 3.17 Population and Housing, 3.19 Scenic Quality, 3.22 Traffic and Transportation
Mazama Forest Project	3.5 Terrestrial Resources, 3.12 Tribal Trust, 3.13 Cultural and Historic Resources, 3.14 Land Use, Agricultural and Forest Resources, 3.15 Socioeconomics
Klamath County Economic Development Plan	3.15 Socioeconomics, 3.16 Environmental Justice
California Water Bond Legislation	3.15 Socioeconomics, 3.16 Environmental Justice

## 3.2 Water Quality

This section describes the effects of the Proposed Action and alternatives on water temperature, suspended sediments, nutrients (total phosphorus [TP], total nitrogen [TN], ortho-phosphorus, nitrate, and ammonium), dissolved oxygen, pH, algal toxins and chlorophyll-*a*, and inorganic and organic contaminants within the area of analysis. Effects of the Proposed Action and alternatives on the algal community (phytoplankton, aquatic macrophytes, riverine phytoplankton and periphyton) in the area of analysis are discussed in Section 3.4, Algae. Algal toxins are a water quality concern that affect designated beneficial uses of water, so this section also includes a brief analysis of project effects on algal toxins as related to beneficial uses. Similarly, water quality parameters relevant to the analysis of fish disease and parasitism (e.g., water temperature, nutrient availability) are included here as part of the Proposed Action effects analysis; the full analysis of fish disease and parasitism is in Section 3.3, Aquatic Resources.

### 3.2.1 Area of Analysis

The area of analysis for water quality includes the Upper and Lower Klamath Basins (see Figure 3.2-1), which for the purposes of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) are organized into the following analysis segments:

#### Upper Klamath Basin

- Wood, Williamson, and Sprague Rivers
- Upper Klamath Lake
- Link River Dam to Klamath River upstream of J.C. Boyle Reservoir
- Hydroelectric Reach (J.C. Boyle Reservoir to Iron Gate Reservoir)

#### Lower Klamath Basin

- Iron Gate Dam to Salmon River
- Salmon River to Klamath Estuary
- Klamath Estuary
- Marine nearshore

Table 3.2-1 lists the river mile (RM) locations of the above reaches and of features relevant to the water quality area of analysis.

**Table 3.2-1. Location of Klamath Basin Features Relevant to the Water Quality Area of Analysis**

Feature	River Mile <sup>1</sup>
<b>Upper Klamath Basin</b>	
Wood River	282.3+
Williamson, and Sprague rivers	272.3+
Upper Klamath Lake/Agency Lake	254.3 to 282.3
Link River Dam	253.7
Keno Impoundment (including Lake Ewauna)	233.0 to 253 (Lake Ewauna ≈247 to 253)
Keno Impoundment at Miller Island	246
Klamath Straits Drain (at Pumping Plant F)	240.5
J.C. Boyle Reservoir	224.7 to 228.3
Oregon-California state line	208.5
Copco 1 Reservoir	198.6 to 203.1
Copco 2 Reservoir	198.3 to 198.6
Iron Gate Reservoir	190.1 to 196.9
<b>Lower Klamath Basin</b>	
Klamath River confluence with Shasta River	176.7
Klamath River confluence with Scott River	143.0
Seiad Valley	129.4
Klamath River confluence with Salmon River	66.0
Hoopa Valley Tribe	≈45 to 46
Weitchpec	43.5
Klamath River confluence with Trinity River	42.5
Klamath River at Turwar	5.8
Klamath Estuary	0 to ≈2

Notes:

<sup>1</sup> River Mile (RM) refers to distance upstream from the mouth of the Klamath River.

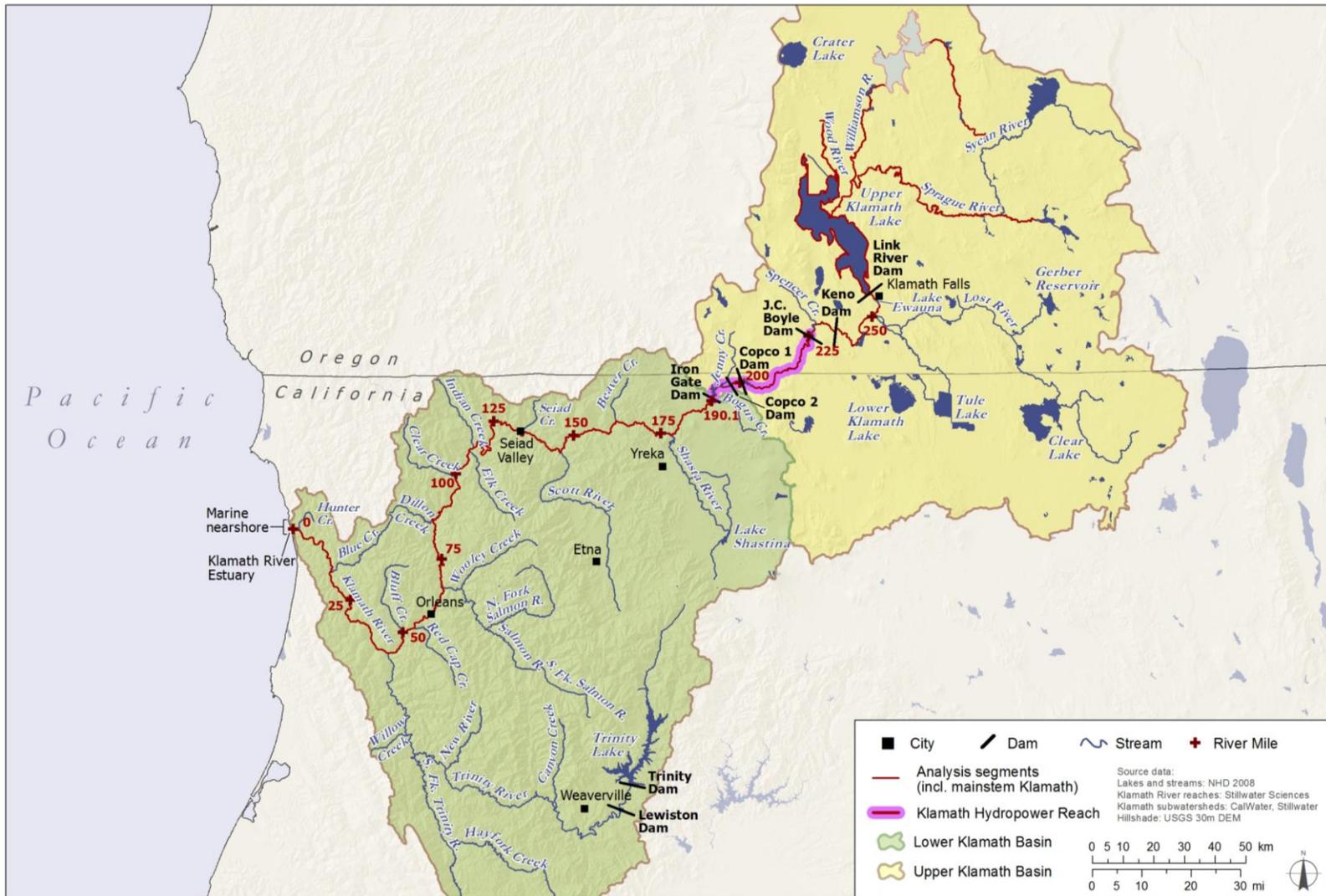


Figure 3.2-1. Water Quality Area of Analysis

### 3.2.2 Regulatory Framework

Multiple federal, state, and tribal programs and planning documents are applicable to the regulation and protection of water quality in the area of analysis, including but not limited to the following:

- Clean Water Act (Title 33 U.S.C. §1313 [1972])
- Safe Drinking Water Act (Title 42 U.S.C. Chapter 6A §300f-j [1973 as amended])
- Oregon Administrative Rules for Water Pollution Control (OAR 340-041)
- North Coast Region Basin Plan (as required by Sections 13240–13247 of Porter-Cologne Water Quality Act)
- Hoopa Valley Tribe Water Quality Control Plan
- Coastal Zone Management Act
- California Ocean Plan (C.W.C. §13170.2)

#### 3.2.2.1 Designated Beneficial Uses of Water

Beneficial uses of water are designated by the Oregon Department of Environmental Quality (ODEQ), the State and Regional Water Quality Control Boards, and the Hoopa Valley Tribe. Other tribal water quality programs, including the development and adoption of beneficial uses, are underway by the Karuk Tribe, the Resighini Rancheria, and the Yurok Tribe. These tribes have not yet completed processes for United States Environmental Protection Agency (USEPA) approved delegation under the Clean Water Act (CWA) (North Coast Regional Water Quality Control Board [NCRWQCB] 2010a). Approved beneficial uses within the area of analysis are presented below (Table 3.2-2).

**Table 3.2-2. Designated Beneficial Uses of Water in the Area of Analysis**

Upper Klamath Lake and Tributaries and Klamath River in Oregon (Oregon Department of Environmental Quality [ODEQ] OAR 340-41-0180)	Klamath River in California (North Coast Regional Water Quality Control Board 2006a)	Hoopa Valley Tribe Beneficial Uses (Hoopa Valley Tribe Environmental Protection Agency [HVTEPA] 2008)	Ocean Plan Beneficial Uses (State Water Resources Control Board [SWRCB] 2001)
<b>Aesthetics and Cultural</b>			
Aesthetic Quality	N/A	Wild and Scenic (W&S)	N/A <sup>1</sup>
N/A	Native American Culture (CUL)	Ceremonial and Cultural Water Use (CUL)**	N/A
<b>Agricultural Water Supply</b>			
Irrigation	Agricultural Supply (AGR)	Agricultural Supply (AGR)*	N/A
Livestock Watering			
<b>Commercial</b>			
Fishing	Commercial and Sport Fishing (COMM)	N/A	Commercial and Sport Fishing (COMM)

**Table 3.2-2. Designated Beneficial Uses of Water in the Area of Analysis**

Upper Klamath Lake and Tributaries and Klamath River in Oregon (Oregon Department of Environmental Quality [ODEQ] OAR 340-41-0180)	Klamath River in California (North Coast Regional Water Quality Control Board 2006a)	Hoopa Valley Tribe Beneficial Uses (Hoopa Valley Tribe Environmental Protection Agency [HVTEPA] 2008)	Ocean Plan Beneficial Uses (State Water Resources Control Board [SWRCB] 2001)
N/A	Shellfish Harvesting (SHELL)	N/A	Shellfish Harvesting (SHELL)
N/A	Aquaculture (AQUA)	N/A	N/A
<b>Fish &amp; Wildlife</b>			
Fish & Aquatic Life <sup>2</sup>	Warm Freshwater Habitat (WARM)	N/A	N/A
	Cold Freshwater Habitat (COLD)	Cold Freshwater Habitat (COLD)	N/A
	Migration of Aquatic Organisms (MIGR)	Migration of Aquatic Organisms (MIGR)	Migration of Aquatic Organisms (MIGR)
	Spawning, Reproduction, and/or Early Development (SPWN)	Spawning, Reproduction, and/or Early Development (SPWN)	Fish Spawning (SPAWN)
N/A	Estuarine Habitat (EST)	N/A	N/A
N/A	Marine Habitat (MAR)	N/A	Marine Habitat (MAR)
Wildlife & Hunting	Wildlife Habitat (WILD)	Wildlife Habitat and Endangered Species (WILD)	N/A
N/A	N/A	N/A	Preservation and Enhancement of Designated Areas of Special Biological Significance (BIOL)
N/A	Rare, Threatened, or Endangered Species (RARE)	Preservation of Threatened and Endangered Species (T&E)	Rare and Endangered Species (RARE)
<b>Potable Water Supply</b>			
Public Domestic Water Supply	Municipal and Domestic Supply (MUN)	Municipal and Domestic Supply (MUN)*	N/A
Private Domestic Water Supply			
<b>Industrial Water Supply</b>			
Industrial Water Supply	Industrial Service Supply (IND)	Industrial Service Supply (IND)	Industrial Water Supply (IND)
	Industrial Process Supply (PROC)	Industrial Process Supply (PROC)	
Hydro Power <sup>3</sup>	Hydropower Generation (POW)	N/A	N/A
<b>Navigation</b>			
Commercial Navigation & Transportation <sup>3</sup>	Navigation (NAV)	N/A	Navigation (NAV)

**Table 3.2-2. Designated Beneficial Uses of Water in the Area of Analysis**

Upper Klamath Lake and Tributaries and Klamath River in Oregon (Oregon Department of Environmental Quality [ODEQ] OAR 340-41-0180)	Klamath River in California (North Coast Regional Water Quality Control Board 2006a)	Hoopa Valley Tribe Beneficial Uses (Hoopa Valley Tribe Environmental Protection Agency [HVTEPA] 2008)	Ocean Plan Beneficial Uses (State Water Resources Control Board [SWRCB] 2001)
<b>Replacement/Recharge</b>			
N/A	Groundwater Recharge (GWR)	Groundwater Recharge (GWR)	N/A
N/A	Freshwater Replenishment (FRSH)	N/A	N/A
<b>Recreation</b>			
Water Contact Recreation	Water Contact Recreation (REC-1)	Water Contact Recreation (REC-1)	Water Contact Recreation (REC-1), including Aesthetic Enjoyment
Boating	Non-contact Water Recreation (REC-2)	Non-contact Water Recreation (REC-2)	Non-contact Water Recreation (REC-2), including Aesthetic Enjoyment

Notes:

<sup>1</sup> See also Recreation REC-2 designation including “aesthetic enjoyment.”

<sup>2</sup> Designated basin-specific beneficial uses for the Klamath Basin (OAR 340-041-0180) include specific fish uses to be protected (i.e., bull trout spawning and juvenile rearing, core cold-water habitat, redband trout, and cool water species [no salmonid use]) and are depicted in Oregon DEQ 2004.

<sup>3</sup> Applicable for mainstem Klamath River from Upper Klamath Lake to Keno Dam (RM 255 to 232.5) (Oregon DEQ 340-041-0180)

Key:

OAR: Oregon Administrative Rules

N/A: Not applicable

\* = Proposed Beneficial Use

\*\* = Historical Beneficial Use

### **3.2.2.2 Water Quality Standards**

#### **3.2.2.2.1 Freshwater**

Water quality standards for fresh surface waters have been established by ODEQ, NCRWQCB, and the Hoopa Valley Tribe to protect the designated beneficial uses listed in Table 3.2-2.

Oregon administrative ruling ORS 468B.025(1) states “...no person shall: (a) Cause pollution of any waters of the state or place or cause to be placed any wastes in a location where such wastes are likely to escape or be carried into the waters of the state by any means; and, (b) Discharge any wastes into the waters of the state if the discharge reduces the quality of such waters below the water quality standards established by rule for such waters by the Environmental Quality Commission.”

The California Porter-Cologne Act defines water quality using chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water that affect its use. It further defines water quality objectives as the limits or levels of

water quality constituents or characteristics that are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area.

Water quality objectives adopted by the Hoopa Valley Tribe establish water quality objectives for those portions of the Trinity and Klamath rivers under the jurisdiction of the tribe. The Yurok and Karuk Tribes have also adopted water quality objectives, as has the Resighini Rancheria; however, the associated water quality plans have not yet been approved by USEPA (NCRWQCB 2010a, see also discussion regarding tribal beneficial uses in Section 3.2.2.1). Surface-water quality objectives relevant to the Proposed Action and alternatives are listed in Table 3.2-3 through 3.2-7.

**Table 3.2-3. Oregon Surface-Water Quality Objectives Relevant to the Proposed Action and Alternatives.**

<b>Parameter</b>	<b>Criteria/Description<sup>1</sup></b>
Biocriteria OAR 340-041-0011	Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.
Dissolved Oxygen OAR 340-041-0016	Sufficient concentrations of dissolved oxygen are necessary to support aquatic life.
	<b>Coldwater aquatic life</b> 8.0 mg/L minimum
	<b>Cool water aquatic life</b> 6.5 mg/L minimum
	<b>Warm water aquatic life</b> 5.5 mg/L minimum
	<b>Spawning</b> 11.0 mg/L minimum
	<b>Spawning</b> 8.0 mg/L minimum intergravel
Nuisance Algae Growth OAR 340-041-0019	Algal growth which impairs the recognized beneficial uses of the water body is not allowed.  For natural lakes that do not thermally stratify, reservoirs, rivers and estuaries, average chlorophyll-a concentrations at or above 0.015 mg/l identify water bodies where phytoplankton may impair the recognized beneficial uses.
pH OAR 340-041-0021 & OAR 340-041-0185	pH values may not fall outside the range of 6.5–9.0. When greater than 25 percent of ambient measurements taken between June and September are greater than pH 8.7, and as resources are available according to priorities set by the Department, the Department will determine whether the values higher than 8.7 are anthropogenic or natural in origin.  Waters impounded by dams existing on January 1, 1996, which have pHs that exceed the criteria are not in violation of the standard, if the Department determines that the exceedance would not occur without the impoundment and that all practicable measures have been taken to bring the pH in the impounded waters into compliance with the criteria.
Temperature OAR 340-041-0028 & OAR 340-041-0185	Water temperature must support all life stages of temperature-sensitive aquatic communities.  Natural Conditions Criteria. Where the department determines that the natural thermal potential of all or a portion of a water body exceeds the biologically-based criteria, the natural thermal potential temperatures supersede the biologically-based criteria, and are deemed to be the applicable temperature criteria for that water body.

**Table 3.2-3. Oregon Surface-Water Quality Objectives Relevant to the Proposed Action and Alternatives.**

Parameter	Criteria/Description <sup>1</sup>
	<p>From June 1 to September 30, no NPDES point source that discharges to the portion of the Klamath River designated for cool water species may cause the temperature of the water body to increase more than 0.3°C (0.5°F) above the natural background after mixing with 25% of the stream flow. Natural background for the Klamath River means the temperature of the Klamath River at the outflow from Upper Klamath Lake plus any natural warming or cooling that occurs downstream. This criterion supersedes OAR 340-041-0028(9)(a) during the specified time period for NPDES permitted point sources.</p> <p><b>Salmon/steelhead spawning</b> 13°C (55.4 F)</p> <p><b>Core coldwater habitat</b> 16°C (60.8 F)</p> <p><b>Salmon/trout rearing</b> 18°C (64.4 F)</p> <p><b>Redband trout habitat</b> 20°C (68 F)</p> <p><b>Bull trout spawning and juvenile rearing</b> 12°C (53.6 F)</p>
<p>Turbidity OAR 340-041-0036</p>	<p>Numeric criterion generally prohibits turbidity increases which exceed 10-percent above background.</p> <p>Dredging, Construction or other Legitimate Activities: Permit or certification authorized under terms of CWA Section 401 or 404 (Permits and Licenses, Federal Water Pollution Control Act) or OAR 14I-085-0100 et seq. (Removal and Fill Permits, Division of State Lands), with limitations and conditions governing the activity set forth in the permit or certificate.</p>
<p>Toxic material OAR 340-041-0033</p>	<p>Toxic substances may not be introduced above natural background levels in waters of the state in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife, or other designated beneficial uses) Levels of toxic substances may not exceed the criteria listed in Table 20 [from the OAR] and the new Table 40<sup>2</sup></p>

Source: Oregon DEQ (OAR 340-041).

<sup>1</sup> Relevant beneficial uses are shown in bold and all caps. If no beneficial use is specified, the objective or criteria applies to all beneficial uses.

<sup>2</sup> On June 16, 2011, Oregon DEQ revised human health criteria for toxic pollutants using a fish consumption rate of 175 grams per day, which is based on tribal consumption rates for tribes that live in Oregon. The new criteria will be applicable for purposes of the Clean Water Act following approval by USEPA. This section also applies to the revised iron, manganese, and arsenic criteria the commission adopted in December 2010 and April 2011, respectively.

**Table 3.2-4. California Surface-Water Quality Objectives**

Parameter	Description <sup>1</sup>
Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Settleable Material	Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.
Sediment	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Turbidity	Turbidity shall not be increased more than 20% above naturally occurring background levels. Allowable zones of dilution within which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.
Temperature	<b>COLD, WARM</b> (for nontidal waters) The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the NCRWQCB that such alteration in temperature does not adversely affect beneficial uses. The temperature of any cold or warm freshwater habitat shall not be increased by more than 2.8°C (5°F) above natural receiving water temperature.
Dissolved Oxygen	<b>WARM, MAR, SAL, COLD, SPWN</b> Klamath River Mainstem Specific Water Quality Objectives based on natural receiving water temperatures (see Table 3.2-5 for minimum DO concentrations in mg/L) <ul style="list-style-type: none"> <li>• From Oregon-California state line (RM 208.5) to the Scott River (RM 143), 90% saturation October 1-March 31 and 85% saturation April 1-September 30.</li> <li>• From Scott River (RM 143) to Hoopa Valley Tribe boundary (≈RM 45), 90% saturation year round.</li> <li>• From Hoopa Valley Tribe boundary to Turwar (RM 5.8), 85% saturation June 1-August 31 and 90% saturation September 1-May 31.</li> <li>• For upper and middle Klamath River Estuary (RM 0-2), 80% saturation August 1-August 31, 85% saturation September 1-October 31 and June 1-July 31, and 90% saturation November 1-May 31.</li> <li>• <b>EST</b> For lower Klamath River Estuary (RM 0), DO content shall not be depressed to levels adversely affecting beneficial uses as a result of controllable water quality factors.</li> </ul>
Biostimulatory Substances	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.
Nitrate – N	<b>MUN</b> 45 mg/L as NO <sub>3</sub> <sup>2</sup>
Nitrate + Nitrite	<b>MUN</b> 10 mg/L as N <sup>3</sup>
pH	The pH shall not be depressed below 6.5 units nor raised above 8.5 units
	<b>COLD, WARM</b> Changes in normal ambient pH levels shall not exceed 0.2 units within the range specified above.
	For the Klamath River upstream of Iron Gate Dam, including Iron Gate & Copco reservoirs, and the Klamath River downstream of Iron Gate Dam pH shall not be depressed below 7 units nor raised above 8.5 units.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.

**Table 3.2-4. California Surface-Water Quality Objectives**

Parameter	Description <sup>1</sup>
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no bioaccumulation of pesticide concentrations found in bottom sediments or aquatic life. Waters designated for use as domestic or municipal supply shall not contain concentrations of pesticides in excess of the limiting concentrations set forth in California Code of Regulations, Title 22, Division 4, Chapter 15, Article 4, Section 64444.5 (Table 5), and listed in Table 3-2 of the Basin Plan.
Chemical Constituents	Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Division 4, Article 4, Section 64435 (Tables 2 and 3), and Section 64444.5 (Table 5), and listed in Table 3-2 of the Basin Plan.  Waters designated for use as agricultural supply (AGR) shall not contain concentrations of chemical constituents in amounts which adversely affect such beneficial use.

Source: NCRWQCB 2010a unless otherwise noted.

<sup>1</sup> Relevant beneficial uses are shown in bold and all caps. If no beneficial use is specified, the objective or criteria applies to all beneficial uses.

<sup>2</sup> Maximum contaminant level for domestic or municipal supply.

<sup>3</sup> Maximum contaminant level (shall not be exceeded in water supplied to the public) as specified in Table 64431-A (Inorganic Chemicals) of Section 64431, Title 22 of the California Code of Regulations (CCR), as of April 23, 2007.

**Table 3.2-5. Minimum DO Concentrations Based on Percent Saturation Criteria<sup>1</sup> (NCRWQCB 2010a).**

DO Concentrations (mg/L)	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
<b>Stateline to Scott River – 90% October 1 through March 31 and 85% April 1 through September 30</b>												
Stateline	10.4	9.6	8.5	7.6	7.0	6.3	6.3	6.4	6.9	7.8	9.5	10.6
Downstream Copco Dam	10.4	9.6	8.5	7.6	6.9	6.3	6.3	6.4	6.9	7.8	9.5	10.6
Downstream Iron Gate Dam	10.8	9.9	8.8	7.8	7.1	6.5	6.5	6.5	7.1	8.1	9.7	10.9
Upstream Shasta River	10.8	10.0	8.9	7.9	7.1	6.6	6.4	6.4	7.1	7.9	9.6	10.8
Downstream Shasta River	10.8	10.1	9.0	7.9	7.2	6.7	6.5	6.5	7.2	8.0	9.7	10.9
Upstream Scott River	10.9	10.2	9.1	8.1	7.2	6.7	6.4	6.5	7.1	7.9	9.8	10.9
<b>Scott River to Hoopa – 90% all year</b>												
Downstream Scott River	10.8	10.2	9.3	8.7	7.9	7.3	6.9	6.9	7.6	8.0	9.8	10.9
Seiad Valley	10.9	10.2	9.3	8.8	7.8	7.2	6.9	6.9	7.5	7.9	9.9	10.9
Upstream Indian Creek	11.0	10.3	9.4	8.9	8.0	7.3	7.0	7.0	7.5	7.9	9.9	10.8
Downstream Indian Creek	11.0	10.3	9.5	9.0	8.1	7.4	7.0	7.0	7.6	8.0	9.9	10.8
Upstream Salmon River	11.2	10.6	9.8	9.3	8.4	7.5	7.2	7.2	7.7	8.2	10.0	11.0
Downstream Salmon River	11.1	10.6	9.9	9.4	8.5	7.6	7.2	7.2	7.7	8.2	10.0	10.9
<b>Hoopa to Turwar – 90% September 1 through May 31 and 85% June 1 through August 31</b>												
Hoopa	11.0	10.6	10.0	9.5	8.5	7.2	7.0	6.9	7.8	8.3	10.1	11.0
Upstream Trinity River	11.0	10.6	10.0	9.5	8.5	7.2	7.0	6.9	7.8	8.3	10.0	11.0
Downstream Trinity River	10.9	10.6	9.9	9.5	8.6	7.4	7.1	7.0	7.9	8.4	10.0	10.9
Youngsbar	10.9	10.6	9.9	9.5	8.7	7.4	7.1	7.0	7.9	8.4	10.0	10.9
Turwar	10.9	10.5	9.9	9.5	8.6	7.2	6.9	6.8	7.6	8.1	9.8	10.8
<b>Upper and Middle Estuary – 90% November 1 through May 31, 85% September 1 through October 31 and June 1 through July 31, 80% August 1 through August 31</b>												
Upper Estuary	10.9	10.6	10.1	9.5	8.6	7.3	7.1	6.7	7.6	8.0	10.0	10.7
Middle Estuary	10.9	10.6	10.1	9.6	8.6	7.3	7.2	6.8	7.8	8.2	10.1	10.8
<b>Lower Estuary – Narrative Objective</b>												

<sup>1</sup> The "Alternative 3" analysis conducted by the NCRWQCB (2010a) to arrive at the DO concentrations listed in this table is not the same as the Alternative 3 referred to in the Klamath Facilities Removal EIS/EIR. Estimates of site-specific natural temperatures inherent to the DO percent saturation estimates are derived from the T1BSR run of the Klamath TMDL model (NCRWQB 2010a).

**Table 3.2-6. Hoopa Valley Tribe Surface-Water Quality Objectives**

Parameter	Criteria/Description <sup>1</sup>
Ammonia (NH <sub>3</sub> , as mg/L N)	<b>COLD</b> Because ammonia toxicity to fish is influenced by pH, waters designated for the purpose of protection of threatened and endangered fish species in cold freshwater habitat shall meet conditions for ammonia based on maximum one-hour (acute) and 30-day average (chronic) concentrations linked to pH by a formula (HVTEPA 2008).
Periphyton	150 mg chlorophyll-a /m <sup>2</sup>
Dissolved oxygen <sup>2</sup>	<b>COLD</b> 8.0 mg/L minimum
	<b>SPWN</b> 11.0 mg/L minimum
	<b>SPWN</b> 8.0 mg/L minimum in inter-gravel water
Total Nitrogen (TN) <sup>3,4</sup>	0.2 mg/L
Total Phosphorous (TP)	0.035 mg/L
pH	The pH in the Klamath River shall be between 7.0 and 8.5 at all times
Microcystis aeruginosa cell density	<b>MUN, REC-1</b> <5,000 cells/mL for drinking water <40,000 cells/mL for recreational water
Microcystin toxin Concentration	<b>MUN, REC-1</b> <1µg/L total microcystins for drinking water <8 µg/L total microcystins for recreational water
Total potentially toxigenic cyanobacteria species <sup>5</sup>	<b>MUN, REC-1</b> <100,000 cells/mL for recreational water
Cyanobacterial scums	<b>MUN, REC-1</b> There shall be no presence of cyanobacterial scums
Nitrate	<b>MUN</b> 10 mg/L

Source: HVTEPA (2008)

<sup>1</sup> Relevant beneficial uses are shown in bold and all caps. If no beneficial use is specified, the objective or criteria applies to all beneficial uses.

<sup>2</sup> HVTEPA (2008) includes a natural conditions clause stating “If dissolved oxygen standards are not achievable due to natural conditions, then the COLD and SPAWN standard shall instead be dissolved oxygen concentrations equivalent to 90% saturation under natural receiving water temperatures.” USEPA has approved the Hoopa Valley Tribe definition of natural conditions; the provision that site-specific criteria can be set equal to natural background and the procedure for defining natural background have not been finalized as of June 2011.

<sup>3</sup> HVTEPA (2008) includes a natural conditions clause stating “If total nitrogen and total phosphorus standards are not achievable due to natural conditions, then the standards shall instead be the natural conditions for total nitrogen and total phosphorus.” USEPA has approved the Hoopa definition of natural conditions; the provision that site-specific criteria can be set equal to natural background and the procedure for defining natural background have not been finalized as of June 2011.

<sup>4</sup> 30-day mean of at least two sample per 30-day period.

<sup>5</sup> Includes: *Anabaena*, *Microcystis*, *Planktothrix*, *Nostoc*, *Coelosphaerium*, *Anabaenopsis*, *Aphanizomenon*, *Gloeotrichia*, and *Oscillatoria*.

**3.2.2.2.2 Marine**

Narrative and numeric water quality objectives to support designated beneficial uses under the Ocean Plan are listed below in Table 3.2-7.

**Table 3.2-7. California Marine Water Quality Objectives Relevant to the Proposed Action and Alternatives.**

Water Quality Objective <sup>1</sup>	Description
Physical Characteristics	<ul style="list-style-type: none"> <li>● Floating particulates and grease and oil shall not be visible.</li> <li>● The discharge of waste shall not cause aesthetically undesirable discoloration of the ocean surface.</li> <li>● Natural light shall not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste.</li> <li>● The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.</li> </ul>
Chemical Characteristics	<ul style="list-style-type: none"> <li>● The dissolved oxygen concentration shall not at any time be depressed more than 10% from that which occurs naturally, as the result of the discharge of oxygen demanding waste materials.</li> <li>● The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.</li> <li>● The dissolved sulfide concentration of waters in and near sediments shall not be significantly increased above that present under natural conditions.</li> <li>● The concentration of substances set forth in Chapter II, Table B (SWRCB 2001), in marine sediments shall not be increased to levels which would degrade indigenous biota. The concentration of organic materials in marine sediments shall not be increased to levels that would degrade marine life.</li> <li>● Nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota.</li> <li>● Numerical Water Quality Objectives for discharges are listed in California State Water Resources Control Board (SWRCB) (2001), including objectives for the protection of marine aquatic life (i.e., metals, inorganics, organics, chronic and acute toxicity, pesticides and PCBs, radioactivity) and objectives for the protection of human health (noncarcinogenic and carcinogenic compounds).</li> </ul>

Source: SWRCB (2001) unless otherwise noted.

<sup>1</sup> WQOs for bacterial characteristics and elevated temperature (thermal) wastes are not included, as these water quality parameters are not anticipated to be affected by the Project.

**3.2.2.3 Water Quality Impairments**

Section 303(d) of the CWA requires states to identify water bodies that do not meet water quality objectives and are not supporting their designated beneficial uses. These water bodies are considered to be impaired with respect to water quality. ODEQ and NCRWQCB have both included the Klamath Basin and specifically, the Klamath and Lost Rivers on their CWA Section 303(d) lists of water bodies with water quality impairments (see Table 3.2-8).

**Table 3.2-8. Water Quality Impaired Water Bodies within the Area of Analysis**

Water Body Name	Water Temperature	Sedimentation	pH	Organic Enrichment/ Low Dissolved Oxygen	Nutrients	Ammonia	Chlorophyll-a	Microcystin
<b>Oregon<sup>1</sup></b>								
Sprague River and tributaries	X <sup>s</sup>		X <sup>s</sup>	X <sup>s</sup>				
Williamson River and tributaries	X							
Upper Klamath Lake and Agency Lake			X	X			X	
Upper Klamath River (Keno Dam to Link River Dam, including Keno Impoundment and Lake Ewauna)			X <sup>s</sup>	X <sup>sp,s,f,w (2)</sup>		X <sup>sp,s,f,w</sup>	X <sup>s</sup>	
Upper Klamath River Oregon-California state line to Keno Dam (including J.C. Boyle Reservoir) <sup>(3)</sup>	X <sup>sp,s,f,w (4)</sup>			X <sup>sp,s,f,w (2)</sup>				
<b>California</b>								
Middle Klamath River Oregon-California state line to Iron Gate Dam (including Copco Lake Reservoir [1 and 2] and Iron Gate Reservoir)	X			X	X			X
Middle Klamath River Iron Gate Dam to Scott River Reach <sup>5</sup>	X			X	X			X
Shasta River	X			X				
Scott River	X	X						
Salmon River	X							
Middle and Lower Klamath River Scott River to Trinity River Reach <sup>6</sup>	X			X	X			X
Lower Klamath River-Trinity River to Mouth	X	X		X	X			

Notes:

<sup>1</sup> Oregon lists specific reaches of the Klamath River by river mile and includes specific seasons, in some cases (Kirk et al. 2010).

<sup>2</sup> Listed for dissolved oxygen only (non-spawning) (Kirk et al. 2010).

<sup>3</sup> Oregon defines particular river miles for their listings.

<sup>4</sup> Non-spawning (Kirk et al. 2010).

<sup>5</sup> Selected minor tributaries to the Middle and Lower Klamath River that are impaired for sediment and sedimentation include Beaver Creek, Cow Creek, Deer Creek, Hungry Creek, and West Fork Beaver Creek (USEPA 2010a).

<sup>6</sup> Minor tributaries to the Middle and Lower Klamath River that are impaired for sediment and sedimentation include China Creek, Fort Goff Creek, Grider Creek, Portuguese Creek, Thompson Creek, and Walker Creek (USEPA 2010a).

Key:

- Sp = Listed for spring season
- S = Listed for summer season
- F = Listed for fall season
- W = Listed for winter season

**3.2.2.4 Total Maximum Daily Loads**

For water quality impaired water bodies (i.e., 303[d]-listed water bodies), Total Maximum Daily Loads (TMDLs) must be developed by the state with jurisdiction over the water body to protect and restore beneficial uses of water. TMDLs (1) estimate the water body’s capacity to assimilate pollutants without exceeding water quality standards; and, (2) set limits on the amount of pollutants that can be added to a water body while still protecting identified beneficial uses. ODEQ and the NCRWQCB cooperated on the development of TMDLs for the impaired water bodies of the Klamath Basin (see Table 3.2-8). Table 3.2-9 lists the status of TMDLs in the Klamath Basin. Table 3.2-9 is followed by a brief narrative summary of TMDLs for each water body to provide relevant context for TMDL-related discussions in Section 3.2.4.3, Effects Determinations. Additional information regarding the Oregon TMDLs can be found on ODEQ’s website (<http://www.deq.state.or.us/WQ/TMDLs/klamath.htm>) and for the California TMDLs on the North Coast Regional Water Quality Control Board website ([http://www.swrcb.ca.gov/northcoast/water\\_issues/programs/tmdls/index.shtml](http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/index.shtml)).

**Table 3.2-9. Status of TMDLs in the Klamath Basin**

Water Body	Pollutant/Stressor	Agency	Original Listing Date	TMDL Completion Date <sup>1</sup>
<b>Oregon</b>				
Upper Klamath Lake Drainage	Temperature, dissolved oxygen, and pH	ODEQ	1998	2002
Upper Klamath and Lost Rivers	Temperature, dissolved oxygen, pH, ammonia toxicity, and chlorophyll- <i>a</i>	ODEQ	1998	2011
<b>California</b>				
Lower Lost River <sup>2</sup>	pH and nutrients	USEPA	1992	2008
Klamath River	Temperature, organic enrichment/low dissolved oxygen, nutrient, and microcystin	NCRWQCB	1996, 1998, 2006, and 2008	2010
Shasta River	Temperature and dissolved oxygen	NCRWQCB	1998 and 2008	2007
Scott River	Temperature and sediment	NCRWQCB	1992, 1996, and 1998	2006
Salmon River	Temperature	NCRWQCB	1996	2005
Trinity	Sediment	USEPA	1994 and 2006	2001
South Fork Trinity	Sediment	USEPA	1994 and 2002	1998

Notes:

<sup>1</sup> The TMDL completion date is the year the USEPA approved or is expected to approve the TMDL.

<sup>2</sup> The Upper Lost River upstream of the Oregon border, Clear Lake Reservoir, and tributaries are listed for water temperature and nutrients. In 2004, North Coast Regional Board staff completed an analysis of beneficial uses and water quality conditions in the Upper Lost River watershed and concluded that the listing is not warranted.

Key:

TMDL: Total Maximum Daily Load

ODEQ: Oregon Department of Environmental Quality

USEPA: U.S. Environmental Protection Agency

NCRWQCB: North Coast Regional Water Quality Control Board

#### **3.2.2.4.1 Upper Klamath Lake Drainage TMDLs**

The Upper Klamath Lake TMDLs cover temperature, dissolved oxygen, and pH. The geographic extent of the Upper Klamath Lake TMDLs includes the northern portion of the Upper Klamath Basin, which comprises three sub-basins (i.e., Upper Klamath Lake, Williamson River, and Sprague River). TMDL targets were developed for (1) TP loading as the primary method of improving pH and dissolved oxygen conditions in Upper Klamath and Agency Lakes; (2) heat loads for anthropogenic and background nonpoint sources throughout the basin; (3) dissolved oxygen in the Sprague River (USEPA 1987); and, (4) pH in the Sprague River. Specific implementation actions, including designated Best Management Practices (BMPs), are under development by the designated management agencies (DMAs) (ODEQ 2002).

#### **3.2.2.4.2 Upper Klamath River and Lost River TMDLs**

The Upper Klamath River and Lost River TMDLs cover temperature, dissolved oxygen, pH, ammonia toxicity, and chlorophyll-*a*. ODEQ approved the Upper Klamath and Lost River subbasins TMDLs in December 2010 and USEPA is expected to approve these TMDLs in 2011 (S. Kirk, pers. comm., 9 March 2011). The TMDLs cover the southern portion of the Upper Klamath Basin including (1) the Klamath River from Upper Klamath Lake to the Oregon-California state line and (2) impounded and riverine sections of the Lost River from the state line downstream of the Malone Dam to the state line upstream of Tule Lake, and the Klamath Straits Drain from the state line to the confluence with the Klamath River. The TMDLs require reductions in phosphorus, nitrogen, and biochemical oxygen demand (BOD) loading from both point sources and nonpoint sources in the Upper Klamath River, as well as augmentation of dissolved oxygen in the impoundments. There are no permitted point sources of elevated water temperatures for these TMDLs. The heat load allocation for nonpoint sources is equivalent to 0.2°C (0.4 F) above applicable criteria. Once the TMDLs are final, specific implementation actions, including designated BMPs, will be developed by the DMAs (Kirk et al. 2010).

#### **3.2.2.4.3 Lower Lost River TMDLs**

The Lower Lost River TMDLs cover pH and nutrients. The geographic extent of the Lower Lost River TMDLs in California includes the Lost River from the Oregon-California state line near Anderson-Rose Dam to the Klamath Straits Drain at the Oregon-California state line, including the Tule Lake and Lower Klamath National Wildlife Refuge areas. Water from the Lower Lost River can be diverted into the Klamath River via the Lost River Diversion Dam and the Klamath Straits Drain (after passing through Tule Lake, the P Canal system, and, in some cases, the Lower Klamath National Wildlife Refuge). The TMDLs were designed to ensure that California's numeric dissolved oxygen water quality standard would be attained in the Lower Lost River. Implementation measures focus on water quality effects from Reclamation's Klamath Project, the U.S. Fish and Wildlife Service (USFWS) Klamath Refuges, and the Tulelake Wastewater Treatment Plant (USEPA 2008).

#### **3.2.2.4.4 Klamath River TMDLs**

The Klamath River TMDLs cover temperature, organic enrichment/low dissolved oxygen, nutrient, and microcystin. The geographic extent of the California Klamath River TMDL analyses includes the river from state line to the Pacific Ocean. The TMDLs do not specifically address existing sedimentation/siltation impairments in the Klamath River from the Trinity River to the Pacific Ocean; currently, sediment TMDLs for the Trinity and South Fork Trinity Rivers address these impairments. Additionally, the Action Plans do not cover tribal lands. The TMDLs assign three load allocations to the Klamath Hydroelectric Project (KHP) in California (NCRWQCB 2010a):

- Create a compliance lens in Copco and Iron Gate Reservoirs, such that water temperature and dissolved oxygen conditions are suitable for cold water fish during the critical summer period.
- Annual TP and TN loading reduction (TP=22,367 lbs and TN=120,577 lbs) to offset the reduced nutrient assimilative capacity in the reservoirs (as compared to a free-flowing river condition) that is associated with nuisance blooms of green algae and cyanobacteria in the reservoirs. TMDL targets are established for chlorophyll-*a*, *Microcystis aeruginosa* cell density, and microcystin.
- Daily average (and daily maximum) increase in water temperatures relative to inflow temperatures for reservoir tailrace waters (0.1°C [0.18°F] for Iron Gate and 0.5°C [0.9°F] for Copco 1 and 2).

The first two load allocations include a provision for the use of reservoir management measures to achieve the TMDL targets. Numerous implementation actions are described in NCRWQCB (2010b).

#### **3.2.2.4.5 Shasta River TMDLs**

The Shasta River TMDLs for temperature and dissolved oxygen cover the Shasta River, a tributary to the mainstem Klamath River, located in the central portion of the Lower Klamath Basin. The TMDL extends from the headwaters to the confluence with the Klamath River, and includes tributaries to the Shasta River and Lake Shastina. Implementation actions build upon ongoing watershed restoration and enhancement work (e.g., increasing riparian vegetation to decrease water temperature and improve bank stability; controlling tailwater discharges to prevent the release of elevated temperature and nutrient enriched waters; promoting efficient water use to increase dedicated cold water flow; addressing proximal land use activities that contribute to low dissolved oxygen and high water temperatures in the watershed, such as timber harvest and road building) (NCRWQCB 2006b, 2007).

#### **3.2.2.4.6 Scott River TMDLs**

The Scott River TMDL for temperature and sediment covers the Scott River, a tributary to the mainstem Klamath River, located in the central portion of the Lower Klamath Basin. The TMDL extends from the headwaters of the Scott River to its confluence with the mainstem Klamath River. Implementation of the Scott River TMDL is expected to achieve water quality standards for water temperature and sediment within 40 years of plan approval. Implementation actions include the following (NCRWQCB 2007):

- Controlling road-caused sediment;
- Reviewing dredge mining effects;
- Promoting the preservation of riparian vegetation and regulating its suppression and/or removal;
- Implementing water conservation practices;
- Studying groundwater uses and effects;
- Ensuring flood control and bank stabilization activities
- Minimizing vegetation removal/suppression and sediment delivery;
- Regulating discharges related to timber harvest; and,
- Minimizing the effect of grazing.

#### **3.2.2.4.7 Salmon River TMDL**

The Salmon River TMDL for temperature covers the Salmon River, a tributary to the mainstem Klamath River located in the southern portion of the Lower Klamath Basin. The Salmon River TMDL target for water temperature applies throughout the Salmon River watershed and is necessary to achieve the Basin Plan water quality objective for temperature. The Basin Plan criterion requires no alteration of temperature without demonstrations that an increase will not adversely affect beneficial uses nor may the temperature of any cold water be increased by more than 5°F above natural receiving temperature (NCRWQCB 2005).

#### **3.2.2.4.8 Trinity River TMDL**

The Trinity River TMDL for sediment covers the portions of the mainstem Trinity River watershed governed by California water quality standards (i.e., not lands under tribal jurisdiction) in the southern portion of the Lower Klamath Basin, to the confluence of the Trinity and Klamath rivers; the TMDL does not apply to the South Fork Trinity River. The Trinity River TMDL target for sediment is a set loading capacity of 125 percent of the background sediment delivery rate (USEPA 2001). Examples of ongoing implementation actions include, but are not limited to, completing watershed and road analyses in United States Forest Service (USFS) and Bureau of Land Management (BLM) lands, watershed restoration, limiting suction dredge operations, comprehensive aquatic monitoring, improving Timber Harvest Plan (THP)s, and continued road/erosion control and fuels management.

#### **3.2.2.4.9 South Fork Trinity River TMDL**

The South Fork Trinity River TMDL for sediment covers the South Fork Trinity River from its headwaters in the North Yolla Bolly Mountains in the southern portion of the Lower Klamath Basin, to the confluence with the Trinity River, and includes Hayfork Creek and other smaller tributaries. The TMDL for sediment is approximately 737 tons per square mile per year. Ongoing implementation actions include encouraging landowner-based sediment reduction plans, specifying requirements for sediment reduction plans, and providing alternative land management guidelines (USEPA 1998). Additional actions include developing a monitoring process for the basin.

### 3.2.3 Existing Conditions/Affected Environment

#### 3.2.3.1 Overview of Water Quality Processes in the Klamath Basin

Water quality in the Klamath River is affected by the geology and meteorology of the Klamath Basin, as well as current and historical land- and water-use practices. Cold air temperatures and precipitation generally occur from November to March (see Section 3.6, Flood Hydrology), corresponding to periods of higher flows and colder water temperatures. Warmer air temperatures and drier conditions occur from April to October (see Section 3.6, Flood Hydrology), corresponding to periods of lower flows and warmer water temperatures. The relatively low relief, volcanic terrain of the upper Klamath Basin (see Section 3.11, Geology, Soils, and Geologic Hazards) supports large, shallow natural lakes (Upper Klamath Lake, Agency Lake, Tule Lake, Lower Klamath Lake) and wetlands, with soils that are naturally high in phosphorus. Human activities in the upper basin, including wetland draining, agriculture, ranching, logging, and water diversions have altered seasonal stream flows and water temperatures, increased concentrations of nutrients (nitrogen and phosphorus) and suspended sediment in watercourses, and degraded other water quality parameters such as pH and dissolved oxygen concentrations. The lower Klamath Basin is composed of generally steeper, mountainous terrain (see Section 3.11, Geology, Soils, and Geologic Hazards), where historical hillslope and in-channel gold mining and extensive logging have occurred, along with agricultural and ranching activities that divert water in many of the lower tributary basins. These activities have altered streamflows, increased concentrations of suspended sediment and nutrients in watercourses, and increased summer water temperatures.

The presence and operation of the Four Facilities in the Klamath Hydroelectric Reach of the upper Klamath Basin affect many aspects of water quality in the Klamath River. The most common effects of hydroelectric projects on water quality result from changes in the physical structure of the aquatic ecosystem. Dams slow the transport of water downstream, intercept and retain sediment, organic matter, nutrients, and other constituents that would otherwise be transported downstream, as well as alter seasonal water temperatures when compared to free-flowing stream reaches.

- **River and reservoir water temperatures.** The primary effects of hydroelectric project operations on the natural temperature regime of streams and rivers are related to alterations in water surface area, depth, and velocity due to water diversions into or out of the stream corridor, including reservoir impoundments and conveyance through pipelines or penstocks. These changes influence the amount of heat entering and leaving water bodies (such as from solar radiation and nighttime re-radiation), which determines the water temperature. Because reservoirs are often deep, they can retain their water temperature for weeks or months, thereby shifting the natural water temperature patterns below reservoirs. For example, water released from reservoirs in the springtime is typically cooler than would naturally occur because the reservoir retains some of the cold water it received in the winter. Similarly, water released from reservoirs in the fall is typically warmer than would naturally occur because the reservoir still contains water that was heated during the summer months. Additionally, due to surface

heating of the reservoir in the late spring and summer, a warmer, less dense water layer forms on the reservoir surface (the epilimnion), which overlies colder, denser water (the hypolimnion). This process is called thermal stratification and often persists for months.

- **Reservoir mixing and dissolved oxygen.** The water column in most deep reservoirs has a characteristic thermal and chemical structure that is independent of the size of the reservoir. With thermal stratification (in summer and fall), the isolated deeper water is not exposed to the atmosphere and often completely loses its supply of dissolved oxygen over a period of weeks or months as organic matter in bottom sediments decays. Releases of this deeper, oxygen-depleted water from the bottom of the reservoir can cause serious problems for downstream fish and other aquatic biota. In the fall, thermal stratification typically breaks down as the surface layer cools and wind mixing of the water column occurs. This process is called reservoir turnover.
- **Algae in reservoirs.** Because large reservoirs have long retention times for water and thermally stratify in the summer months, they often provide ideal conditions for the growth of suspended algae (phytoplankton) in the epilimnion. Depending upon available nutrients, extensive phytoplankton blooms can develop in these reservoirs. Algal photosynthesis during the day releases dissolved oxygen and consumes carbon dioxide. At night, algal respiration consumes dissolved oxygen and releases carbon dioxide. This can result in wide swings in dissolved oxygen and pH, which is stressful to aquatic biota. Under nutrient-rich conditions, harmful blooms of blue-green algae can occur, producing cyanotoxins (e.g., cyclic peptide toxins that act on the liver such as microcystin, alkaloid toxins such as anatoxin-a and saxitoxin that act on the nervous system). Cyanotoxins have been found to be harmful to a wide range of biota including exposed fish, shellfish, livestock, and humans. Releases of impounded waters can transport algae and/or toxins to downstream waters and algal blooms can die abruptly (“crash”), releasing cyanotoxins into the water column. The subsequent decomposition of organic matter associated with algal remains can create periods of low dissolved oxygen in reservoir bottom waters.
- **Nutrient cycling in reservoirs and internal loading.** Nutrients entering reservoirs can undergo many changes and be involved in many biochemical processes. On an annual basis, the majority of nutrients entering a reservoir from a watershed are eventually discharged downstream, with only a small fraction being retained in the reservoir bottom sediments. Dissolved nutrients (e.g., ortho-phosphorus, nitrate, and ammonium) entering a reservoir can be used directly by algae when growing conditions are good. Some of these algae eventually die and settle to the bottom of reservoirs, also contributing nutrients (and organic matter) to the bottom sediments. Under low oxygen conditions, nutrients contained within bottom sediments can be re-released to the water column, creating a source of internal nutrient loading to the reservoir. This is particularly important for phosphorus and results in highly enriched bottom waters during periods of reservoir stratification. At turnover, these nutrient rich waters are mixed throughout the reservoir, can be released downstream, and can result in a secondary (fall) algae bloom.

- **Sediment deposition in reservoirs.** The characteristically slow-moving waters in reservoirs result in trapping of deposition of fine sediments and organic particulate matter. Contaminants found in the bottom sediments of reservoirs are typically transported from the watershed in association with particulate matter. Trace metals are mostly attached to (inorganic) clays and silts. Organic contaminants, such as pesticides and dioxin, are attached (adsorbed) to organic matter.

The following sections summarize general water quality trends by parameter in the Klamath River, from the upper basin to the lower basin. Additional detail, including data from multiple agency and tribal monitoring programs throughout the Klamath Basin, is presented in Appendix C.

### **3.2.3.2 Water Temperature**

Water temperatures in the Klamath Basin vary seasonally and by location. In the Upper Klamath Basin, water temperatures are typically very warm in summer months as ambient air temperatures heat surface waters. Water temperatures (measured as 7-day-average maximum values) in Upper Klamath Lake and much of the reach from Link River Dam to the Oregon-California state line exceed 20°C (68°F) in June through August. Both Upper Klamath Lake and the Keno Impoundment undergo periods of intermittent, weak summertime stratification, but water temperatures in these water bodies are generally similar throughout the water column and among the warmest in the Klamath Basin (peak values >25°C [>77°F]). Upper basin locations influenced by groundwater springs, such as the Wood River and the mainstem Klamath River downstream of J.C. Boyle Dam, have relatively constant water temperatures year-round and can be 5–15°C (9–27°F) cooler than other local water bodies during summer months, depending on the location.

Water temperatures in the Klamath Hydroelectric Reach are influenced by the presence of the Four Facilities. The relatively shallow depth and short hydraulic residence times in J.C. Boyle Reservoir do not support thermal stratification (Federal Energy Regulatory Commission [FERC] 2007; Raymond 2008, 2009, 2010) and this reservoir does not directly provide a source of cold water to downstream reaches during summer (National Research Council [NRC] 2003). However, current power-peaking operations at the J.C. Boyle Powerhouse contribute to the availability of cold water in the river just downstream of the dam (≈RM 221), where cold groundwater springs enter the river. During daily peaking operations at J.C. Boyle Powerhouse, warm reservoir discharges are diverted from the bypass reach allowing cold groundwater to dominate flows in the river (PacifiCorp 2006a). Water temperatures in the bypass reach can decrease by 5–15°C (9–27°F) when peaking operations are underway (Kirk et al. 2010).

Iron Gate and Copco 1 Reservoirs are the two deepest reservoirs in the Klamath Hydroelectric Reach. These reservoirs thermally stratify beginning in April/May and the surface and bottom waters do not mix again until October/November (Raymond 2008, 2009, 2010). The large thermal mass of the stored water in the reservoirs delays the

natural warming and cooling of riverine water temperatures on a seasonal basis such that spring water temperatures in the Klamath Hydroelectric Reach are generally cooler than would be expected under natural conditions, and summer and fall water temperatures are generally warmer (NCRWQCB 2010a). In the Hydroelectric Reach, maximum weekly maximum temperatures (MWMTs), which generally occur in late July, regularly exceed the range of chronic effects temperature thresholds (13–20°C [55.4–68°F]) for full salmonid support in California (NCRWQCB 2010a).

The temporal water temperature pattern of the Hydroelectric Reach is repeated in the Klamath River immediately downstream of Iron Gate Dam, where water released from the reservoirs is 1–2.5°C (1.8–4.5°F) cooler in the spring and 2–10°C (3.6–18°F) warmer in the summer and fall as compared to modeled conditions without the dams (PacifiCorp 2004a, Dunsmoor and Huntington 2006, NCRWQCB 2010a). This trend is discussed in more detail in Section 3.2.4.3.2.1, Lower Klamath Basin. Immediately downstream of Iron Gate Dam (RM 190.1), water temperatures are also less variable than those documented farther downstream in the Klamath River (Karuk Tribe of California 2009, 2010).

Farther downstream, the presence of the Four Facilities exerts less influence and water temperatures are more influenced by the natural heating and cooling regime of ambient air temperatures and tributary inputs of surface water. Meteorological control of water temperatures result in increasing temperature with distance downstream of Iron Gate Dam. For example, daily average temperatures between June and September are approximately 1–4°C (1.8–7.2°F) higher near Seiad Valley (RM 129.4) than those just downstream of the dam (Karuk Tribe of California 2009, 2010; see Appendix C for more detail). By the Salmon River (RM 66), the affects of the dams on water temperature are not discernable.

Downstream of the Salmon River (RM 66), summer water temperatures begin to decrease slightly with distance as coastal meteorology (i.e., fog and lower air temperatures) decrease longitudinal warming (Scheiff and Zedonis 2011) and cool water tributary inputs increase the overall flow volume in the river. In general, however, the slight decrease in water temperatures in this reach is not sufficient to support cold water fish habitat during summer months. Daily maximum summer water temperatures have been measured at values greater than 26°C (78.8°F) just upstream of the confluence with the Trinity River (Weitchpec [RM 43.5]), decreasing to 24.5°C (76.1°F) near Turwar Creek (RM 5.8) (Yurok Tribe Environmental Program [YTEP] 2005, Sinnott 2010). As is the case further upstream, MWMTs in the Klamath River downstream of Iron Gate Dam to the Klamath River estuary regularly exceed the range of chronic effects temperature thresholds (13–20°C [55.4–68°F]) for full salmonid support in California (NCRWQCB 2010a).

Water temperatures in the Klamath River estuary are linked to temperatures and flows entering the estuary, salinity of the estuary and resulting density stratification, as well as the timing and duration of the formation of a sand berm across the estuary mouth. When the estuary mouth is open, denser salt water from the ocean sinks below the lighter fresh

river water, resulting in a salt wedge that moves up and down the estuary with the daily tides (Horne and Goldman 1994, Wallace 1998, Hiner 2006). The salt water wedge results in thermal stratification of the estuary with cooler, high salinity ocean waters remaining near the estuary bottom, and warmer, low salinity river water near the surface. Under low-flow summertime conditions, when the mouth can closed, surface water temperatures in the estuary have been observed at 18–24°C (64.4–75.2°F) and greater (Wallace 1998, Hiner 2006, Watercourse Engineering, Inc. 2011). Input of cool ocean water and fog along the coast minimizes extreme water temperatures much of the time (Scheiff and Zedonis 2011).

### **3.2.3.3 Suspended Sediments**

For the purposes of the Klamath Facilities Removal EIS/EIR, suspended sediment refers to settleable suspended material in the water column. Bed materials, such as gravels and larger substrates, are discussed in Section 3.3.3.2, Aquatic Resources – Existing Conditions/Affected Environment – Physical Habitat Descriptions. Two types of suspended material are important to water quality in the Klamath Basin and are discussed below: algal-derived (organic) suspended material and mineral (inorganic) suspended material. Sources of each type of suspended material differ, as do spatial and temporal trends for each, within the Upper and Lower Klamath Basins.

Suspended sediments in the tributaries to the Upper Klamath Lake are generally derived from mineral (inorganic) materials, with peak values associated with winter and spring high flows. Of the three main tributaries to the Upper Klamath Lake, the Sprague River has been identified as a primary source of sediment to Upper Klamath Lake. Because phosphorus is naturally high in Klamath Basin sediments, the Sprague River is also an important source of this nutrient to the lake (Gearheart et al. 1995, ODEQ 2002, Connelly and Lyons 2007). Sources of the sediment inputs within the Sprague River drainage include agriculture, livestock grazing and forestry activities, and road-related erosion (ODEQ 2002, Connelly and Lyons 2007, Rabe and Calonje 2009).

Between Link River at Klamath Falls (RM 253.1) and the upstream end of J.C. Boyle Reservoir (RM 224.7), algal-derived (organic) suspended material is the predominant form of suspended material affecting water quality. Summer and fall algal-derived (organic) suspended materials decrease with distance downstream, as algae are exported from Upper Klamath Lake and into Lake Ewauna and the Keno Impoundment, where they largely settle out of the water column (Sullivan et al. 2009). Data from June through November during 2000-2005 indicate that the largest relative decrease in mean total suspended solids (TSS) in the upper Klamath River occurs between Link River Dam and Keno Dam (see Appendix C for more detail). Suspended materials generally continue to decrease through the Hydroelectric Reach (PacifiCorp 2004b), where further interception, decomposition, and retention of algal-derived (organic) suspended materials originating from Upper Klamath Lake occurs, as well as dilution from the springs downstream of J.C. Boyle Dam. However, increases in suspended material can occur in Copco 1 and Iron Gate reservoirs due to *in situ* summertime algal blooms, which can adversely affect beneficial uses. In the winter months, suspended material in the Hydroelectric Reach is

dominated by mineral sediment loads transported during high flow events, which can also settle out in the KHP reservoirs (see Appendix C for more detail).

Just downstream of Iron Gate Dam (RM 190.1), summer and fall suspended sediment concentrations become relatively low. Between Iron Gate Dam and Seiad Valley (RM 129.4), suspended materials can increase due to the transport of in-reservoir algal blooms to downstream reaches of Klamath River, as well as river bed scour and resuspension of previously settled materials (YTEP 2005, Sinnott 2007, Armstrong and Ward 2008, Watercourse Engineering, Inc. 2011). Further downstream, near the confluence with the Scott River (RM 143.0) concentrations of suspended materials tend to decrease with distance as suspended materials gradually settle out of the water column farther downstream or are diluted by tributary inputs (see Appendix C for more detail).

Mineral (inorganic) suspended sediments begin to have prominence again in the Klamath River downstream of Iron Gate Dam, as major tributaries to the mainstem contribute large amounts of mineral (inorganic) suspended sediments to the river during winter and spring (Armstrong and Ward 2008). Steeper terrain and land use activities such as timber harvest and road construction result in high sediment loads during high-flow periods. Two of the three tributaries that contribute the largest amount of sediment to the Klamath River are in this reach; the Scott River (RM 143) (607,300 tons per year or 10 percent of the cumulative average annual delivery from the basin), and the Salmon River (RM 66.0) (320,600 tons per year or 5.5 percent of the cumulative average annual delivery from the basin) (Stillwater Sciences 2010). The Trinity River contributes 3,317,300 tons per year of sediment to the Klamath River or 57 percent of the cumulative average annual delivery from the basin (Stillwater Sciences 2010) (see Appendix C for more detail).

#### **3.2.3.4 Nutrients**

Primary nutrients including nitrogen and phosphorus are affected by the geology of the surrounding watershed of the Klamath River, upland productivity and land uses, as well as a number of physical processes affecting aquatic productivity within reservoir and riverine reaches. Nitrogen arriving in Upper Klamath Lake has been attributed to upland soil erosion, runoff and irrigation return flows from agriculture, as well as *in situ* nitrogen fixation by cyanobacteria (ODEQ 2002). Although the relatively high levels of phosphorus present in the Upper Klamath Basin's volcanic rocks and soils have been identified as a major contributing factor to phosphorus loading to the lake (ODEQ 2002), land use activities in the Upper Klamath Basin have also been linked to increased nutrient loading (Kann and Walker 1999, Snyder and Morace 1997; see Appendix C, Section C.3.1.2 for more detail), subsequent changes in its trophic status, and associated degradation of water quality. Extensive monitoring and research has been conducted for development of the Upper Klamath Lake TMDLs (ODEQ 2002) that shows the lake is a major source of nitrogen and phosphorus loading to the Klamath River (see Appendix C for additional details).

Allowing for seasonal reservoir dynamics in the Hydroelectric Reach, nutrient levels in the Klamath River generally decrease with distance downstream of Upper Klamath Lake due to particulate trapping in reservoirs, dilution, and uptake along the river channel. In a recent study of nutrient dynamics in the Klamath River, May through December nutrients for 2005–2008 followed a decreasing longitudinal pattern, with the highest concentrations (approximately 0.1–0.5 mg/L TP and 1–4 mg/L TN) measured in the Klamath River downstream of Keno Dam (RM 228–233) (Asarian et al. 2010). On an annual basis, nutrients typically decrease through the Hydroelectric Reach due to the dilution by the springs downstream of J.C. Boyle Reservoir and settling of particulate matter and associated nutrients in Copco 1 and Iron Gate reservoirs. On a seasonal basis, TP, and to a lesser degree, TN can increase in this reach due to the release (export) of dissolved forms of phosphorus (ortho-phosphorus) and nitrogen (ammonium) from reservoir sediments during periods of summer and fall hypolimnetic anoxia (see Appendix C for additional details). The seasonal nutrient releases can occur during periods of in-reservoir algal growth, or can be transported downstream to the lower Klamath River where they may stimulate periphyton growth.

Downstream of the Four Facilities, TP values typically range 0.1–0.25 mg/L in the Klamath River between Iron Gate Dam and Seiad Valley, with the highest values occurring just downstream of the dam. TN concentrations in the river downstream of Iron Gate Dam generally range from <0.1 to over 2.0 mg/L and are generally lower than those in upstream reaches due to reservoir retention and dilution by springs in the Hydroelectric Reach (Asarian et al. 2009) (see Appendix C for additional details). Further decreases in TN occur in the mainstem river due to a combination of tributary dilution and in-river nitrogen removal processes such as denitrification and/or storage related to biomass uptake (Asarian et al. 2010). Ratios of nitrogen to phosphorus (TN:TP) measured in the Klamath River downstream of Iron Gate Dam suggest the potential for nitrogen-limitation of primary productivity with some periods of co-limitation by both nitrogen and phosphorus. However, concentrations of both nutrients are high enough that other factors (i.e., light, water velocity, or available substrate) may be more limiting to primary productivity than nutrients are, particularly in the vicinity of Iron Gate Dam (FERC 2007, Hoopa Valley Tribe Environmental Protection Agency [HVTEPA] 2008, Asarian et al. 2010) (see Appendix C for additional details). This is particularly important with regard to factors controlling periphyton growth in this portion of the Klamath River (see Section 3.4, Algae).

Downstream of the confluence with the Salmon River, nutrient concentrations continue to decrease in the Klamath River as compared with those measured farther upstream due to tributary dilution and nutrient retention. Contemporary data (2005–2008) indicate that TP concentrations in this reach are generally 0.05–0.1 mg/L with peak values occurring in September and October. For TN, contemporary data indicate that on a seasonal basis, this nutrient increases from May through November, with peak concentrations (<0.5 mg/L) typically observed during September and October. Relative to the higher concentrations measured near Iron Gate Dam, these lower nutrient concentrations may be limiting periphyton growth in this portion of the river. Both TP and TN are at or above

the Hoopa Valley Tribe numeric criterion of 0.2 mg/L TN and 0.035 mg/L TP (see Table 3.2-6).

Nutrient levels in the Klamath Estuary experience inter-annual and seasonal variability. Measured levels of TP in the estuary are typically below 0.1 mg/L during summer and fall (June–September) and TN levels are consistently below 0.6 mg/L (June–September) (Sinnott 2011); however, as with upstream reaches, these levels do not meet the narrative California Basin Plan water quality objective for biostimulatory substances due to the promotion of algal growth at levels that cause nuisance effects or adversely affect beneficial uses (see Table 3.2-4).

### **3.2.3.5 Dissolved Oxygen**

Dissolved oxygen concentrations in the Klamath Basin depend on several factors, including water temperature (colder water absorbs more oxygen), water depth and volume, stream velocity (as related to mixing and re-aeration), atmospheric pressure, salinity, and the activity of organisms that depend upon dissolved oxygen for respiration. This last factor (respiratory consumption) is strongly influenced by the availability of nitrogen and phosphorus for supporting algal and aquatic plant growth.

In tributaries to Upper Klamath Lake, limited data indicate that dissolved oxygen varies from <7–13 mg/L (Kann 1993, ODEQ 2002). Concentrations in the lake itself exhibit high seasonal and spatial variability, ranging from less than 4 mg/L to greater than 10 mg/L. High nutrient loading is the primary cause of eutrophication and subsequent low dissolved oxygen levels in Upper Klamath Lake. Water quality data collected by the Klamath Tribes contains periods of weeks during the summer months when dissolved oxygen levels in the lake are continuously below the ODEQ criterion of 5.5 mg/L for support of warm water aquatic life (Kann et al. 2010). Low (0–4 mg/L) dissolved oxygen concentrations occur most frequently in August, the period of declining algal blooms in the lake and warm water temperatures (ODEQ 2002, Walker 2001) (see Appendix C for additional details).

In the downstream Keno Impoundment (including Lake Ewauna), dissolved oxygen reaches very low levels (< 1–2 mg/L) during July–October as algae transported from Upper Klamath Lake settle out of the water and decay. Four facilities discharge treated wastewater to the Keno Impoundment; however, these facilities contribute a very small amount (<1.5% of the organic material loading) to the overall oxygen demand in the Keno Reach. Decomposition of algae transported from Upper Klamath Lake appears to be the primary driver of low oxygen in the Keno Impoundment (including Lake Ewauna) (Sullivan et al. 2009, et al. 2011; Kirk et al. 2010).

During summer, the reservoirs of the Four Facilities exhibit varying degrees of dissolved oxygen super-saturation (i.e., >100% saturation) in surface waters (due to high rates of internal photosynthesis by algae) and hypolimnetic oxygen depletion in bottom waters (due to microbial decomposition of dead algae). Although J.C. Boyle Reservoir, a relatively long, shallow reservoir, does not stratify, large variations in dissolved oxygen

are observed at its discharge due to conditions in the upstream reach from Link River Dam through the Keno Impoundment (including Lake Ewauna), and in Upper Klamath Lake (see Appendix C for more detail). Copco 1 and Iron Gate Reservoirs thermally stratify beginning in April/May and do not mix again until October/November (FERC 2007). Dissolved oxygen in Iron Gate and Copco 1 surface waters during summer months is generally at or, in some cases above, saturation while levels in hypolimnetic waters reach minimum values near 0 mg/L by July (see Appendix C for more detail).

Based upon measurements collected immediately downstream of Iron Gate Dam, dissolved oxygen concentrations regularly fall below 8 mg/L (the Basin Plan minimum dissolved oxygen criterion is now based on percent saturation, see Table 3.2-5) (Karuk Tribe of California 2001, 2002, 2007, 2009). Continuous Sonde data collected at other Klamath River locations downstream of Iron Gate Dam during summer 2004–2006, show that roughly 45 to 65 percent of measurements immediately downstream of the dam did not achieve 8 mg/L. Daily fluctuations of up to 1–2mg/L measured in the Klamath River downstream of Iron Gate Dam (RM 190.1) have been attributed to daytime algal photosynthesis and nighttime bacterial respiration (Karuk Tribe of California 2002, 2003; YTEP 2005; NCRWQCB 2010a). Farther downstream in the mainstem Klamath River, near Seiad Valley (RM 129.4), dissolved oxygen concentrations increase relative to the reach immediately downstream of Iron Gate Dam, but continue to exhibit variability, with mean daily values ranging from approximately 6.5 mg/L to (supersaturated concentrations of) approximately 10.5 mg/L, from June through November, 2001–2002 and 2006–2009 (Karuk Tribe of California [2001, 2002, 2007, 2009]).

Measured concentrations of dissolved oxygen in the mainstem Klamath River downstream of Seiad Valley (RM 129.4) continue to increase with increasing distance from Iron Gate Dam. Dissolved oxygen concentrations near Orleans (RM 59) continue to be variable, with typical daily values ranging from approximately 6.5 mg/L to (supersaturated concentrations of) 11.5 mg/L from June through November, 2001–2002 and 2006–2009 (Karuk Tribe of California [2001, 2002, 2007, 2009], Ward and Armstrong 2010, NCRWQCB 2010a). Further downstream, near the confluence with the Trinity River (RM 42.5) and at the Turwar gage (RM 5.8), minimum dissolved oxygen concentrations below 8 mg/L (the Basin Plan minimum dissolved oxygen criterion prior to 2010) have been observed for extended periods of time during late summer/early fall (YTEP 2005, Sinnott 2010). In 2010, minimum dissolved oxygen concentrations remained above 2010 amended Basin Plan minimum dissolved oxygen concentration criteria based on percent saturation (see Appendix C for additional details).

Dissolved oxygen concentrations in the Klamath Estuary vary both temporally and spatially; concentrations in the deeper, main channel of the estuary are generally greater than 6 to 7 mg/L throughout the year (Hiner 2006, YTEP 2005). Low dissolved oxygen concentrations (<1 to 5 mg/L) have been observed during summer months in the relatively shallow, heavily vegetated south slough (Hiner 2006, Wallace 1998). The low levels of dissolved oxygen observed in the slough are likely due to high rates of growth and subsequent decomposition of algae and macrophytes, which are not abundant elsewhere in the estuary.

### **3.2.3.6 pH**

Levels of pH in the Klamath Basin vary daily, seasonally, and by location. In the Upper Klamath Basin, summertime pH levels are elevated above neutral (i.e., up to 8.2 in the Wood River subbasin and 8.5–9.5 in the Sprague River). These elevated pH levels have been linked primarily to high rates of photosynthesis by periphyton (i.e., benthic or attached algae) (ODEQ 2002). During November–April, pH levels in Upper Klamath Lake are near neutral (Aquatic Scientific Resources [ASR] 2005) but increase to very high levels (>10) in summer (ODEQ maximum pH is 9.0, see Table 3.2-3). Extended periods of pH greater than 9 have been associated with large summer algal blooms in Upper Klamath Lake (Kann 2010). On a daily basis, algal photosynthesis can elevate pH levels by up to 2 pH units over a 24-hour period. Generally, pH in the reach from Link River Dam through the Keno Impoundment increases from spring to early summer and decreases in the fall; however, there are site-dependent variations in the observed trend. Peak values can exceed the ODEQ maximum of 9.0 (see Appendix C for additional details).

In the Hydroelectric Reach, pH is seasonally variable, with levels near neutral during the winter, increasing in the spring and summer. Peak values (8–9.2) have been recorded during the months of May and September with lower values documented June through August (7.5–8) (Raymond 2010), where the ODEQ pH maximum is 9 units (for the Klamath River upstream of the Oregon-California state line; Table 3.2-3) and the California pH maximum is 8.5 units (for the river downstream of state line; Table 3.2-4). Longitudinally, the lowest pH values were recorded downstream of J.C. Boyle Reservoir and the highest values in Copco and Iron Gate Reservoirs (Raymond 2008, 2009, 2010). High pH levels typically coincide with high algal photosynthesis rates at or near the water surface during periods of thermal stratification and high nutrient concentrations in the KHP reservoirs (Raymond 2008).

In the Lower Klamath Basin, seasonally high pH values continue to occur, with the highest pH values generally occur during late-summer and early-fall months (August–September). Daily cycles in pH also occur in this reach, with pH usually peaking during later afternoon or early evening, following the period of maximum photosynthesis (NCRWQCB 2010a). The California North Coast Basin Plan pH maximum of 8.5 units (Table 3.2-4) is regularly exceeded in the Klamath River downstream of Iron Gate Dam for the May–October 2005 dataset (see Appendix C for more detail). The most extreme pH exceedances typically occur just upstream of Shasta River; values generally decrease with distance downstream (FERC 2007; Karuk Tribe of California 2007, 2009, 2010). During the summer months, pH values also are elevated in the lower Klamath River from Weitchpec downstream to approximately Turwar Creek (see Appendix C for more detail).

In the Klamath Estuary, pH ranges between approximately 7.5 and 9, with peak values also occurring during the summer months (YTEP 2005). Daily variations in pH are typically on the order of 0.5 pH units, and fluctuations tend to be somewhat larger in the late summer and early fall. When large daily fluctuations are observed, they are likely caused by algal blooms that are transported into the estuary.

### 3.2.3.7 Chlorophyll-*a* and Algal Toxins

As primary producers, algae are critical components of riverine and lacustrine ecosystems. Their presence and abundance affect food web dynamics as well as physical water quality parameters (e.g., dissolved oxygen, pH, turbidity, and nutrients), the latter through rates of photosynthesis, respiration, and decay of dead algal cells (Horne and Goldman 1994). Cyanobacteria are also photosynthetic and can often be a nuisance aquatic species, occurring as large seasonal blooms that alter surrounding water quality. Some cyanobacteria species, such as *M. aeruginosa*, produce cyanotoxins (e.g., cyclic peptide toxins that act on the liver such as microcystin, alkaloid toxins such as anatoxin-a and saxitoxin that act on the nervous system) that can cause irritation, sickness, or in extreme cases, death to exposed organisms, including humans (World Health Organization [WHO] 1999).

Chlorophyll-*a*, a pigment produced by photosynthetic organisms including algae and cyanobacteria, is often used as a surrogate measure of algal biomass. Algae suspended in the water column (phytoplankton) can be represented as a concentration of chlorophyll-*a* (mg/L), while algae attached to bottom sediments or channel substrate (periphyton) can be represented as an areal biomass (mg chl-*a*/m<sup>2</sup>). Periphyton data are discussed in Section 3.4, Algae.

In the tributaries to Upper Klamath Lake, algae are generally present as periphyton (i.e., benthic or attached algae) species. Periphyton in these streams can cause water quality impairments for dissolved oxygen and pH (see Appendix C for more detail). In Upper Klamath Lake, algae are dominated by phytoplankton or suspended algae. Large summertime blooms of cyanobacteria are typically dominated by *Aphanizomenon flos-aquae*, with relatively smaller amounts of *M. aeruginosa* present. Despite this, *M. aeruginosa* is believed to be responsible for the production of microcystin in the lake, with concentrations in 2007-2008 equal to or greater than the World Health Organization (WHO) limit for drinking water (1 µg/L) and peaked at 17 µg/L, which is above the Oregon Department of Public Health guidelines for issuing public health advisories. Additional microcystin data collection in Upper Klamath Lake is ongoing, including measurement of toxin levels in native suckers (Vanderkooi et al. 2010, see Section 3.3, Aquatic Resources for more detail).

High (i.e., near 300 µg/L) summer chlorophyll-*a* concentrations in the Keno Impoundment (including Lake Ewauna) are due to large populations of algae, predominantly *A. flos-aquae*, entering the Klamath River from Upper Klamath Lake in summer (Kann 2006, Sullivan et al. 2008, et al. 2009, et al. 2010, FERC 2007). Such high concentrations do not persist farther downstream in J.C. Boyle Reservoir; however, in the two largest reservoirs (i.e., Copco 1 and Iron Gate) in the Hydroelectric Reach, chlorophyll-*a* concentrations increase again. Levels in Copco 1 and Iron Gate Reservoirs can be 2 to 10 times greater than those documented in the mainstem river, although they are not as high as those found in the Keno Impoundment (NCRWQCB 2010a) (see Appendix C for more detail). High levels of microcystin also occur during summer months in Copco 1 and Iron Gate Reservoirs; peak measured concentrations exceeded the California State Water Resources Control Board (SWRCB)/ Office of Environmental

Health and Hazard Assessment (OEHHA) public health threshold of 8 µg/L by over 1000 times in Copco 1 Reservoir during 2006–2009 and extremely high concentrations (1,000–73,000 µg/L) were measured during summer algal blooms in both Copco 1 and Iron Gate Reservoirs during 2009 (Watercourse Engineering 2011, see Appendix C for more detail).

Throughout the Klamath River, high chlorophyll-*a* concentrations have been shown to correlate with the toxigenic cyanobacteria blooms where *M. aeruginosa* was present in high concentrations and sharp increases in microcystin levels above WHO numeric targets (Kann and Corum 2009) and SWRCB, California Department of Public Health, and OEHHA guidelines (Draft Voluntary Statewide Guidance for Blue-Green Algae Blooms [SWRCB 2010]). Since 2007, high levels of microcystin have prompted the posting of public health advisories around the reservoirs and along the length of the Klamath River during summer months. In 2010, the KHP reservoirs and the entire river downstream of Iron Gate Dam (including the estuary) were posted to protect public health due to elevated cyanobacteria cell counts and cyanotoxin concentrations.

Microcystin can also bioaccumulate in aquatic biota (Kann 2008, Kann et al. 2011); 85 percent of fish and mussel tissue samples collected during July through September 2007 in the Klamath River, including Iron Gate and Copco 1 Reservoirs, exhibited microcystin bioaccumulation (Kann 2008) (see Appendix C for more detail). Estuarine and marine nearshore effects (e.g., sea otter deaths) from cyanobacteria exposure have been reported in other California waters; however, none have been documented to date for the Klamath Estuary or marine nearshore (Miller et al. 2010). Section 3.3.3.2, Physical Habitat Descriptions - Water Quality - Algal Toxins presents a discussion of algal toxins as related to fish health.

### **3.2.3.8 Inorganic and Organic Contaminants**

In general, information regarding contaminants in the Upper Klamath Basin upstream of the Hydroelectric Reach is unavailable. Human activities such as illegal dumping may be a source of inorganic and organic contaminants to the lower Sprague and Williamson river sub-basins (Rabe and Calonje 2009). The exception to this is arsenic; natural geologic sources of arsenic may be causing relatively high levels of this chemical element in the Upper Klamath Basin, as is the case in other south central and southeastern Oregon basins (Sturdevant 2010).

#### **3.2.3.8.1 Water Column Contaminants**

Existing water quality data are available from the California Surface Water Ambient Monitoring Program (SWAMP). SWAMP data from 2001 through 2005 indicate that at eight monitoring sites from the California-Oregon state line (RM 208.5) to Klamath River at Klamath Glen (RM 5.8) the majority of inorganic constituents (i.e., arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc), were in compliance with water quality objectives. Aluminum concentrations in some samples may have been slightly elevated above USEPA freshwater aquatic life and secondary standards for drinking water, where a greater sampling frequency would be required to

determine actual exceedances. Grab samples were analyzed for 100 pesticides, pesticide constituents, isomers, or metabolites; 50 polychlorinated biphenyls (PCBs) congeners; and 6 phenolic compounds. Results indicated no PCBs and only occasional detections of pesticides (NCRWQCB 2008) (see Appendix C for more detail).

#### **3.2.3.8.2 Sediment Contaminants**

To investigate the potential for toxicity of the sediments trapped in the reservoirs of the Four Facilities, Shannon & Wilson, Inc. (2006) collected sediment samples from J.C. Boyle, Copco 1, and Iron Gate Reservoirs during 2004–2005 and analyzed them for contaminants including acid volatile sulfides, metals, pesticides, chlorinated acid herbicides, PCBs, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), cyanide, and dioxins. No herbicides or PCBs were found above screening levels and only one sample exceeded applicable screening levels for VOCs ethyl benzenes and total xylenes (Shannon & Wilson, Inc. 2006). While cyanide was detected in multiple sediment cores, it was not found in the bioavailable toxic free cyanide form (HCN or CN<sup>-</sup>).

Dioxin, a known carcinogen, was also measured in the Shannon & Wilson (2006) study. Long-term exposure to dioxin in humans is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. In the 2004–2005 reservoir samples, measured levels were 2.48–4.83 pg/g (picograms per gram or parts per trillion [ppt] expressed as Toxic Equivalent Concentrations) and did not exceed applicable screening levels for human health and ecological receptors (Shannon & Wilson, Inc. 2006, Dillon 2008, USEPA 2010b) or estimated background dioxin concentrations (2–5 ppt) for non-source-impacted sediments throughout the U.S. and specifically in the western U.S. (USEPA 2010b) (see Appendix C for more detail). The measured levels did exceed Oregon human health and bioaccumulation thresholds; however, Oregon’s human health thresholds include risk-based values for subsistence fishers as well as the general consuming public and are quite a bit lower (0.0011–1.1 pg/g dry weight (DW) Toxicity equivalency quotient [TEQ]) than many other screening levels (ODEQ 2007) (see Appendix C for more detail).

As part of the Klamath Dam Removal Secretarial Determination studies, a sediment evaluation was undertaken during 2009–2011 to evaluate potential environmental and human health impacts of the downstream release of sediment deposits currently stored behind the dams under the Proposed Action<sup>1</sup>. Sediment cores were collected during 2009–2010 at multiple sites and at various sediment depths per site in J.C. Boyle Reservoir, Copco 1 Reservoir, Iron Gate Reservoir, and the Klamath Estuary (Department of the Interior [DOI] 2010). A total of 501 analytes were quantified in the sediment samples, including metals, poly-aromatic hydrocarbons (PAHs), PCBs, pesticides/herbicides, phthalates, VOCs, SVOCs, dioxins, furans, and polybrominated diphenyl ethers (PBDEs) (i.e., flame retardants). Samples were analyzed for sediment

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<sup>1</sup> Estimates of the volume of sediment deposits stored within J.C. Boyle, Copco 1 and 2, and Iron Gate Reservoirs include 10.0 million m<sup>3</sup> (13.1 million yd<sup>3</sup>) (Greimann et al. 2010), 11.1 million m<sup>3</sup> (Eilers and Gubala 2003), and 15.6 million m<sup>3</sup> (GEC 2006) (14.5 to 20.4 million yd<sup>3</sup>). See also Section 3.11 of this Klamath Facilities Removal EIS/EIR.

chemistry and elutriate (pore water) chemistry, and bioassays were conducted on the sediment and elutriate using fish and invertebrate national benchmark toxicity species (see below for discussion of the bioaccumulation component of this study). Five exposure scenarios were evaluated, which generally correspond to potential effects evaluated in this Klamath Facilities Removal EIS/EIR. Based on comparisons of sediment chemistry to screening levels (SLs) and the results of bioassays (see Section C.7.1.1. for more detail), the reservoir sediments do not appear to be highly contaminated. No consistent pattern of elevated chemical composition was observed across discrete sampling locations within a reservoir and no single reservoir was observed to be consistently more or less contaminated. Where elevated concentrations of chemicals in sediment were found, the degree of exceedance based on comparisons of measured detected chemical concentrations to SLs was small and in several cases (i.e., arsenic, mercury, 2,3,7,8-TCDD, total PCBs) may reflect regional background conditions (CDM 2011; see Section C.7.1.1 for more detail).

Toxicity tests generally indicated low potential for sediment toxicity to benchmark benthic indicator species; the exception to this occurred in a single sample from J.C. Boyle Reservoir, where survival of the benthic amphipod *Hyaella azteca* indicated a moderate potential for sediment toxicity (CDM 2011). TEQs for dioxin, furan, and dioxin-like PCBs in reservoir and estuary sediment samples were within the range of local background values and suggest a limited potential for adverse effects for fish exposed to reservoir sediments (CDM 2011). Lastly, sediment samples were also evaluated for levels of known bioaccumulative compounds; ODEQ bioaccumulation sediment screening level values (SLVs) were not exceeded in J.C. Boyle Reservoir sediments, with the exception of a small number of samples for dichlorodiphenyltrichloroethane (DDT)s (see Section C.7.1.1 for more detail).

#### **3.2.3.8.3 Contaminants in Aquatic Biota**

Assessments of contaminants in fish tissue for the Hydroelectric Reach have been undertaken by SWAMP and PacifiCorp. SWAMP data include sport fish tissue samples collected during 2007 and 2008 to evaluate accumulated contaminants in nearly 300 lakes statewide. Sport fish were sampled to provide information on potential human exposure to selected contaminants and to represent the higher aquatic trophic levels (i.e., the top of the aquatic food web).

In the Hydroelectric Reach, fish tissue samples were collected in Copco 1 and Iron Gate Reservoirs and analyzed for total mercury, selenium, and PCBs (Iron Gate Reservoir only) (Davis et al. 2010). SWAMP data for Iron Gate and Copco reservoirs indicate mercury tissue concentrations above the USEPA criterion of 300 ng/g methylmercury (for consumers of noncommercial freshwater fish); and greater than OEHHA public health guideline levels advisory tissue levels (Klasing and Brodberg 2008) for consumption for 3 and 2 servings per week (70 and 150 ng/g wet weight, respectively) and the fish contaminant goal (220 ng/g wet weight). Measured selenium concentrations were 3–4 orders of magnitude lower than OEHHA thresholds of concern (2,500–15,000 ng/g wet weight) and PCB concentrations were below the lowest OEHHA threshold (i.e., fish contaminant goal of 3.6 ng/g wet weight) (Davis et al. 2010).

In a screening-level study of potential chemical contaminants in fish tissue in Keno, J.C. Boyle, Copco, and Iron Gate Reservoirs, and in Upper Klamath Lake, PacifiCorp analyzed metals (i.e., arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc), organochlorine (pesticide) compounds, and PCBs in largemouth bass (*Micropterus salmoides*) and black bullhead catfish (*Ameiurus melas*) (PacifiCorp 2004c). PacifiCorp reported that, in general, contaminant levels in fish tissue were below screening level values for protection of human health (USEPA 2000) and recommended guidance values for the protection of wildlife (MacDonald 1994). Exceptions to this include some tissue samples for total mercury, arsenic, total DDTs and total PCBs, when compared to screening levels for wildlife and subsistence fishers (individual comparisons are shown in Appendix C for more detail). Dioxins were not tested.

To supplement existing fish tissue data and provide additional lines of evidence in the Secretarial Determination sediment evaluation (see above and Section C.7.1.1), the potential for chemicals in sediment and elutriate samples to bioaccumulate in aquatic species at concentrations above screening levels for ecological receptors (i.e., fish, birds, humans/mammals) was investigated. Bioaccumulation studies were conducted using laboratory invertebrates exposed to reservoir-derived sediments and two species of field-caught fish collected during late September 2010 from J.C. Boyle, Copco 1, and Iron Gate reservoirs (CDM 2011, see Section C.7.1.1 for more detail). Results indicate that multiple chemicals were found in invertebrate (acenaphthene, arsenic, benzo(a)pyrene, DDD/DDE, endosulfan I, endosulfan II, endosulfan sulfate, fluoranthene, hexachlorobenzene, lead, mercury, phenanthrene, pyrene, total PBDEs, total PCBs) and fish (i.e., 2,3,7,8-TCDD, arsenic, DDE/DDT, dieldrin, endrin, mercury, mirex, selenium, and total PCBs) tissue under current conditions (CDM 2011). Mercury exceeded tissue-based toxicity reference values (TRVs) for perch in Iron Gate Reservoir and bullhead samples in all three reservoirs (CDM 2011). TRVs are not available for several chemicals detected in invertebrate and fish tissue (CDM 2011, see Section C.7.1.1 for more detail).

### **3.2.4 Environmental Consequences**

#### **3.2.4.1 Environmental Effects Determination Methods**

The Klamath Facilities Removal EIS/EIR water quality analysis includes consideration of the effects of the Proposed Action and alternatives on water temperature, suspended sediments, nutrients (TN, TP, nitrate, ammonium, ortho-phosphorus), dissolved oxygen, pH and alkalinity, chlorophyll-*a* and algal toxins, and inorganic and organic contaminants in water and reservoir sediments. For all water quality parameters, the analysis approach for water quality effects associated with facilities removal under Klamath Hydroelectric Settlement Agreement (KHSA) is conducted at the project-level and is presented by water quality parameter. Elements of Klamath Basin Restoration Agreement (KBRA) restoration projects that would affect water quality are identified and analyzed at a program-level.

For water quality, existing conditions is generally defined as physical, chemical, and biological characteristics of water in the area of analysis at the time of the Notice of Preparation (Water Year [WY] 2010). However, while some water quality parameters to be analyzed here are well-represented by data collected during WY2010, most are represented by data collected within the past 5 to 10 years (WY2000–WY2010). Further, the start of the analysis period for the hydrology, water temperature, and suspended sediment modeling conducted as part of Secretarial Determination studies corresponds to WY2012, or just following the expected date for the Secretarial Determination regarding dam removal. Despite several existing regulations or agreements that may be partially implemented between WY2010 and WY2012 and that would affect water quality, in general, conditions in the Klamath River are not expected to be substantially different in WY2012 than conditions during WY2000–WY2010. Therefore, for the water quality analysis existing conditions generally encompass the 10 to 12-year period prior to WY2012 (summarized in Section 3.2.3; additional detail provided in Appendix C).

The KHSA presents nine water-quality-related Interim Measures (IMs) (KHSA Section 1.2.4):

- IM 3, Iron Gate Turbine Venting
- IM 5, Iron Gate Flow Variability
- IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement
- IM 8, J.C. Boyle Bypass Barrier Removal
- IM 11, Interim Water Quality Improvements
- IM 13, Flow Releases and Ramp Rates
- IM 16, Water Diversions

As discussed in Chapter 2, IM 3 is already complete and included in existing conditions. IMs 5, 7, 8, and 13 are part of the No Action/No Project Alternative because they would be implemented as part of PacifiCorp's Habitat Conservation Plan<sup>2</sup>. IM 5, Iron Gate Flow Variability, would alter flow variability, but the flows would stay within the historic range of operations. One year of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement is included in the No Action/No Project Alternative because work is scheduled to begin in Fall 2011 before the Secretary makes a determination. IM 8, J.C. Boyle Barrier Removal, could have construction-related water quality effects. IM 13, Flow Releases and Ramp Rates stipulates no change in the current flows from J.C. Boyle, so no water quality effects are anticipated as part of existing conditions.

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<sup>2</sup> DOI has incorporated by reference pertinent information in this chapter from: NOAA Fisheries 2011. Draft Environmental Assessment for Authorization for Incidental Take and Implementation of the PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Coho Salmon Available at: <http://klamathrestoration.gov/>. DOI encourages readers to review this source document for more detailed information than is summarized in this EIS/R. Though not final this environmental analysis in NOAA Fisheries 2011 found no significant impact from IM implementation on Water Resources (Climate and Water Flow and Water Quality) or Biological Resources.

Remaining IMs are included in Alternatives 2 and 3. Seven years of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could affect water quality. Planning efforts under IM 11, Interim Water Quality Improvements are ongoing; however, pilot scale projects are still in the data collection or planning stage, so an assessment of water quality impacts is not yet practical. IM 16, the elimination of three screened diversions on Shovel and Negro Creeks and relocation of the points of diversion from the creeks to the Klamath River, could have construction-related water quality effects. Additionally, IM 15, Water Quality Monitoring, has produced some monitoring results (Watercourse Engineering, Inc. 2011) that are incorporated into the existing conditions summary.

Within the period of analysis (i.e., 50 years) reasonably foreseeable actions associated with water quality are anticipated to be the following:

- Ongoing restoration activities in the Klamath Basin (see Section 2.4.2).
- Implementation of TMDLs for Oregon and California (see Section 3.2.2.4)
- National Oceanic and Atmospheric Administration (NOAA) Fisheries Service 2010 Biological Opinion mandatory flows (see Section 2.3.1).
- California Department of Fish and Game (CDFG) Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River<sup>3</sup>
- Climate change (see Section 3.10.3.1).

Therefore, under the No Action/No Project Alternative, elements of ongoing restoration projects, TMDLs, and programs mandating stream flows that would affect future water quality are identified for a specific reach and/or water quality parameter and included as part of the analysis narrative in a qualitative or, if possible, a quantitative manner.

Under the Proposed Action and remaining alternatives, the analysis of water quality effects considers both short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities)<sup>4</sup>. While the timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects, some short-term effects are anticipated and, for water quality, would be heavily influenced by the release of fine sediment deposits currently stored behind the dams to the downstream river reaches, the estuary, and the marine nearshore environment. This is because mobilization of reservoir sediment deposits would be most intense during the first year or two following dam removal, when the majority of sediments would be eroded by river flows (Greimann et al. 2011, Stillwater Sciences 2008). Short-term effects would also occur as a result of construction activities related to fish passage structures and restoration activities associated with dam removal and KBRA implementation. Under the Proposed Action and other dam removal alternatives, long-term effects on water quality would be

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<sup>3</sup> This action is not included in the project description (Section 2) since it will occur only in tributaries to the middle and lower Klamath River. It may increase flows to the mainstem Klamath River, thus it is briefly discussed as part of the No Action/No Project Alternative analysis for water quality.

<sup>4</sup> Note that for the purposes of this analysis the use of “short-term” as <2 years is not the same as the use of “short-term (acute)” when applied to numeric water quality criteria for determining thresholds of aquatic life toxicity (i.e., 24-hr or 96-hr exposure periods).

primarily characterized by the shift from lacustrine to riverine environments in the Hydroelectric Reach and the concomitant changes in physical and chemical processes on water quality in this reach and downstream river reaches. Parameter-specific analysis methods are discussed below.

#### **3.2.4.1.1 Water Temperature**

Short-term (<2 years following dam removal/construction of fish passage facilities) effects of the alternatives on water temperature are assessed based on the existing conditions understanding of the seasonal effects of the KHP reservoirs on water temperature within the Hydroelectric Reach and downstream of the dam.

For long-term (2–50 years following dam removal/construction of fish passage facilities) effects of the alternatives, quantitative Klamath River water quality model (KRWQM) results for “current conditions” and dams-out conditions are available (PacifiCorp 2004a, Dunsmoor and Huntington 2006, FERC 2007; see Appendix D for more detail), but they do not include implementation of the Oregon and California TMDLs, which are considered as reasonably foreseeable actions under the No Action/No Project Alternative (see above list). The Klamath TMDL model includes a dams-in scenario (T4BSRN) assuming full attainment of the Oregon and California TMDLs with all Four Facilities in place (Tetra Tech 2009), similar to the conditions for the No Action/No Project Alternative. The Klamath TMDL model T1BSR natural conditions scenario is also useful for analyzing water temperature, since this parameter relies upon a comparison to background or natural levels for regulatory water quality compliance. The Klamath TMDL TOD2RN and TCD2RN scenarios assume the removal of the Four Facilities and full TMDL implementation (Tetra Tech 2009), which is similar to the Proposed Action; to place the Proposed Action analysis in the proper context, these scenarios are generally considered with respect to starting assumptions (i.e., model boundary conditions) about water temperature. These scenarios also represent Keno Dam as the historical natural Keno Reef, such that the Keno Reach is not a free-flowing reach (Tetra Tech 2009).

Since the TMDL model scenarios do not include climate change projections or changes in future hydrology included under KBRA, one additional set of water temperature modeling results is used for the Klamath Facilities Removal EIS/EIR analysis; the RBM10 model was developed as part of the Secretarial Determination studies and includes the effects of climate change and KBRA hydrology on future water temperatures. RBM10 model results use climate change predictions from five Global Circulation Models (GCMs) (see Appendix D for more detail).

Appendix D, Table D-1 shows the reaches where KRWQM, Klamath TMDL, and RBM10 model results are used for the water quality analysis under each alternative. Since no one existing model captures all of the elements analyzed for water temperature in this Klamath Facilities Removal EIS/EIR, where possible, model outputs are used in combination to assess similar spatial and temporal trends in predicted water temperature.

#### **3.2.4.1.2 Suspended Sediments**

The Proposed Action was optimally developed as an alternative, to allow reservoir drawdown to occur during winter months when precipitation, river flows, and turbidity are naturally highest. Results from the sediment mobility analysis conducted by the DOI are used to provide estimates of short-term (<2 years following dam removal) suspended sediment concentrations (SSCs) downstream of Iron Gate Dam under the Proposed Action and other dam removal alternatives. The sediment mobility analysis used existing suspended sediment data collected by the U. S. Geological Survey (USGS) at the Shasta River near Yreka (USGS gage no. 11517500), Klamath River near Orleans (USGS gage no. 11523000), and Klamath River near Klamath (USGS gage no. 11530500) gages to estimate daily total SSCs (mg/L) as a function of flow (cfs) using the SRH-1D sediment transport model (Sedimentation and River Hydraulics–One Dimension Version 2.4) (Huang and Greimann 2010, Greimann et al. 2011). Daily total SSCs were modeled for existing conditions representing WY 1961–2008 (“background”) and for conditions following dam removal (WY 2020–2021). SRH-1D model output representing total sediments, including both inorganic (i.e., mineral) and organic (i.e., algal-derived) sediments, is applied to the Klamath Facilities Removal EIS/EIR suspended sediment analysis. The SRH-1D model assumes a three-phase drawdown for Copco 1 Reservoir beginning on November 1, 2019, and a single-phase drawdown for J.C. Boyle and Iron Gate Reservoirs beginning on January 1, 2020 consistent with the Proposed Action. This would allow maximum SSCs to occur during winter months when flows are naturally high in the mainstem river (Stillwater Sciences 2008, Greimann et al. 2011). The analysis of short-term (<2 years following dam removal) effects also considers results from previous studies (e.g., Stillwater Sciences 2010) regarding anticipated sediment release from Klamath River Dam removal within the context of basin sediment delivery.

To inform long-term (2–50 years following dam removal/construction of fish passage facilities) effects determinations on suspended materials under all of the alternatives, existing data sources for TSS and turbidity sources to the Hydroelectric Reach and the lower Klamath River (e.g., PacifiCorp 2004a, 2004b; YTEP 2005) are used. Existing analyses of the potential effects of dam removal on long-term sediment supply (Stillwater Sciences 2010) are also considered.

#### **3.2.4.1.3 Nutrients**

Under the Proposed Action, short-term (<2 years following dam removal) nutrient loads associated with high SSCs are assessed in a qualitative manner, considering the likelihood of sediment deposition in the lower river, seasonal rates of primary productivity and microbially mediated nutrient cycling, and potential light limitation of primary producers given the high sediment concentrations in the river.

To determine general long-term spatial and temporal trends of nutrients in the Hydroelectric Reach and the lower Klamath River under all of the alternatives, the T4BSRN, TOD2RN and TCD2RN Klamath TMDL scenarios (Tetra Tech 2009) are presented. To place the Proposed Action analysis in the proper context, the TOD2RN and TCD2RN scenarios are generally considered with respect to starting assumptions (i.e., model boundary conditions) about nutrient concentrations. Reaches where

T4BSRN, TOD2RN and TCD2RN information is available include all reaches associated with the EIS/EIR nutrient analysis from J.C. Boyle Reservoir to the Klamath Estuary (see Appendix D, Table D-1).

Additionally, an existing analysis regarding potential nutrient dynamics under a “dams-out” scenario (i.e., Asarian et al. 2010) is used to inform the assessment of the long-term effects of the Proposed Action on nutrients. Using nutrient measurements and hydrologic data for the Klamath River, Asarian et al. (2010) constructed mass-balance nutrient budgets to evaluate nutrient dynamics in free-flowing reaches of the Klamath River, including longitudinal trends in absolute and relative retention of phosphorus and nitrogen. The analysis also compared nutrient retention rates between free-flowing river reaches and reservoir reaches and developed a range of estimates for how seasonal TP and TN concentrations downstream of Iron Gate Dam might be altered by dam removal. The analysis used hydrologic and nutrient data collected by a variety of tribal, federal, and state agencies, and PacifiCorp, during June-October of 2005–2008. The mass balance estimates for 2005–2008 improve upon estimates for the period 1998–2002 (Asarian and Kann 2006b) by using flow- and season-based multiple regression models for predicting daily nutrient concentrations and loads and quantification of uncertainty, relatively lower laboratory reporting limits, higher sampling frequency, and nutrient speciation (i.e., not just TN and TP). The effects of dam removal were quantified using calculated relative retention rates in river reaches and comparing them to results from a retention study of Copco 1 and Iron Gate Reservoirs by Asarian et al. (2009).

#### **3.2.4.1.4 Dissolved Oxygen**

Both short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2-50 years following dam removal/construction of fish passage facilities) dissolved oxygen effects due to the alternatives are analyzed. For short-term effects under the Proposed Action and dam removal alternatives, results of numerical modeling conducted by the Lead Agencies as part of the Klamath Dam Removal Secretarial Determination studies are used to describe predicted short-term dissolved oxygen levels in the Hydroelectric Reach and downstream of Iron Gate Dam due to mobilization of fine sediments following dam removal. In the 1-dimensional, steady-state model, the different short-term oxygen demand terms (i.e., BOD, immediate oxygen demand [IOD], and sediment oxygen demand [SOD]) are off-set by tributary dilution and re-aeration using an approach similar in concept to Streeter and Phelps (1925) dissolved oxygen-sag. This BOD/IOD spreadsheet model also includes chemical oxygen demand generated from the conversion of ammonium and other nitrogenous compounds in reservoir sediments to nitrate under oxic conditions. This is termed nitrogenous oxygen demand and is inherently included in the oxygen demand rate constants used in the BOD/IOD spreadsheet model (Stillwater Sciences 2011).

IOD and BOD are predicted in the spreadsheet model using empirically derived oxygen depletion rates for a particular SSC based on laboratory incubations conducted under the Secretarial Determination oxygen demand study (Stillwater Sciences 2011). Oxygen depletion rates are scaled to the level of suspended sediments expected under each of the three water year types considered for the DOI hydrology and sediment transport

modeling assessment (i.e., typical dry, median, and typical wet water years) (see Section 3.2.4.1).

The BOD/IOD spreadsheet model assumes a three-phase drawdown for Copco 1 Reservoir beginning on November 1, 2019, and a single-phase drawdown for J.C. Boyle and Iron Gate Reservoirs beginning on January 1, 2020 consistent with the Proposed Action (Greimann et al. 2011). This would allow maximum SSCs to occur during winter months when flows are naturally high in the mainstem river (Stillwater Sciences 2008, Greimann et al. 2011). While the KHP reservoirs exhibit varying degrees of thermal stratification and hypolimnetic anoxia during summer months (see Section 3.2.3.1), all of the reservoirs tend to experience fully-mixed conditions by November/December and remain mixed through April/May. Thus, drawdown beginning in December is expected to involve a well-oxygenated water column and, potentially, an oxic surficial sediment layer. This is important because the spreadsheet model is highly sensitive to background concentrations of dissolved oxygen (Stillwater Sciences 2011), which are generally highest in the KHP reservoirs during winter months (see Section 3.2.3.1). The BOD/IOD spreadsheet model results encompass a 6-month period following drawdown in order to estimate potential dissolved oxygen minimums corresponding to the period of greatest sediment transport in the river under the Proposed Action.

For long-term (2–50 years following dam removal/construction of fish passage facilities) effects, existing information on water quality dynamics and physical, chemical, and biological drivers for dissolved oxygen in the river are used to inform the effects determination for all of the alternatives. Dissolved oxygen model results from PacifiCorp relicensing efforts (FERC 2007) and the California Klamath River TMDL (NCRWQCB 2010a; see Section 3.2.2.7.4) are also used for the long-term effects analysis. Where possible, the Klamath TMDL model output is used in combination with KRWQM output to assess similar spatial and temporal trends in predicted dissolved oxygen. To place the Proposed Action analysis in the proper context, the TOD2RN and TCD2RN model predictions (Tetra Tech 2009) are considered with respect to starting assumptions (i.e., model boundary conditions) about dissolved oxygen (and nutrient) concentrations. Reaches where T4BSRN, TOD2RN and TCD2RN information is available include all reaches associated with the EIS/EIR dissolved oxygen analysis from J.C. Boyle Reservoir to the Klamath Estuary (see Appendix D, Table D-1).

#### **3.2.4.1.5 pH**

Short-term (<2 years following dam removal/construction of fish passage facilities) effects of the alternatives on pH are assessed based on the existing conditions understanding of the seasonal effects of the KHP reservoirs on pH within the Hydroelectric Reach and downstream of the dam.

For long-term (2–50 years following dam removal/construction of fish passage facilities) effects, existing data on pH in the Hydroelectric Reach and the Lower Klamath Basin are used to inform the effects determination for the Proposed Action. As for water temperature, nutrients, and dissolved oxygen, T4BSRN, TOD2RN and TCD2RN Klamath TMDL scenarios (Tetra Tech 2009) are available for pH. Reaches where

T4BSRN, TOD2RN and TCD2RN information is available include all reaches associated with the EIS/EIR pH analysis from J.C. Boyle Reservoir to the Klamath Estuary (see Appendix D, Table D-1).

#### **3.2.4.1.6 Chlorophyll-*a* and Algal Toxins**

Effects of the alternatives on the algal community (phytoplankton, aquatic macrophytes, riverine phytoplankton and periphyton) in the Klamath River are discussed in Section 3.4, Algae. Chlorophyll-*a* is analyzed as a separate water quality parameter in the Klamath Facilities Removal EIS/EIR because it is a surrogate measure of algal biomass and it is included as a numeric criterion associated with the Oregon nuisance algae growth water quality objective (see Table 3.2-3) and a target specific to the KHP reservoirs in the California Klamath River TMDLs (NCRWQCB 2010a). The Hoopa Valley Tribe water quality objective for chlorophyll-*a* is a measure of attached (benthic) algal growth (see Table 3.2-6) and is discussed further in Section 3.4, Algae.

Quantitative predictive tools for chlorophyll-*a* are not available for the alternatives. While the California Klamath TMDLs model includes a chlorophyll-*a* component, covering both periphyton and phytoplankton, the model appears to over predict chlorophyll-*a* under the “dams out” scenario (Tetra Tech 2008) and is therefore not used for the Klamath Facilities Removal EIS/EIR analysis. The chlorophyll-*a* target (10 ug/L) developed for the KHP reservoirs in the California Klamath TMDLs is based on a Nutrient Numeric Endpoints analysis, which appears to be a conservative estimate of mean summer chlorophyll-*a* concentrations required to move the system toward support of beneficial uses (Creager et al. 2006, Tetra Tech 2008).

The chlorophyll-*a* effects determinations are based on a qualitative assessment of whether the alternatives would result in exceedances of the Oregon 15 ug/L water quality objective or the California 10 ug/L target for the KHP reservoirs and adversely affect beneficial uses with respect to water column concentrations of chlorophyll-*a*. Growth conditions for suspended algae (i.e., nutrient availability, impounded water) are considered as part of the qualitative analysis, where predicted increases in nutrient availability, water temperatures, and the availability of lacustrine (lake or reservoir) conditions would correspondingly increase chlorophyll-*a* concentrations.

Since algal toxins are a water quality concern and have the potential to affect designated beneficial uses of water, an analysis of project effects on algal toxins as related to water quality standards and beneficial uses is included in the water quality effects determinations. There are no quantitative models predicting algal toxin trends under a dam removal scenario, thus the effects determinations are based upon trends in the density of *M. aeruginosa* (or other toxin-producing blue-green algae) to algal toxin concentrations (see Section 3.2.3.7) discerned from data collected in the Hydroelectric Reach and the Lower Klamath Basin. This information is considered along with the potential for changes in habitat availability for *M. aeruginosa* (or other toxin-producing blue-green algae) under the alternatives.

#### **3.2.4.1.7 Inorganic and Organic Contaminants**

The determination of potential toxicity and bioaccumulation with respect to aquatic species and humans under the alternatives is based on the evaluation of existing data on inorganic and organic contaminants associated with both reservoir water quality and sediment deposits, as well as new sediment contaminant data collected as part of the ongoing Secretarial Determination studies.

The Secretarial Determination sediment evaluation process has followed screening protocols of the Sediment Evaluation Framework (SEF) for the Pacific Northwest, issued in 2009 by the interagency Regional Sediment Evaluation Team (RSET). The SEF is a regional guidance document that provides a framework for the assessment and characterization of freshwater and marine sediments in Idaho, Oregon, and Washington (RSET 2009). The SEF involves a data screening assessment to compare reservoir sediment data to available and appropriate sediment maximum levels, screening levels, and bioaccumulation triggers. It also provides guidance for conducting elutriate chemistry, toxicity bioassays, and bioaccumulation tests, and special evaluations such as and risk assessments (the latter not utilized for this evaluation). The results of the SEF-based evaluation for the 2009–2010 Klamath River sediment samples are used primarily to inform the water quality effects determinations related to inorganic and organic contaminants under the Proposed Action.

To systematically consider potential impact pathways for each of the alternatives for the Secretarial Determination process, sediment data were compared to established sediment screening values in a step-wise manner. Elutriate (sediment pore water) data were also evaluated through comparison with a suite of regional, state and federal standards for water quality; the comparison is first carried out without consideration of dilution as a conservative approach (CDM 2011).

Biological testing was also conducted, using the SEF approach, and consisted of sediment and elutriate toxicity testing and tissue analyses, or other special evaluations designed to provide more empirical evidence regarding the potential for sediment contaminant loads to have adverse effects on receptors (RSET 2009). While whole sediment toxicity tests identify potential contamination that may affect bottom-dwelling (benthic) organisms, toxicity tests using suspension/elutriates of dredged material assess potential water column toxicity. Bioaccumulation evaluation is undertaken when bioaccumulative chemicals of concern exceed or may exceed sediment screening levels, and thus further evaluation is needed to determine whether they pose a potential risk to human health or ecological health in the aquatic environment (RSET 2009).

Results from elutriate and sediment toxicity bioassays and sediment bioaccumulation tests carried out for the Secretarial Determination studies are used to provide additional information beyond simple comparisons of sediment contaminant levels to individual-contaminant regional or national screening levels. The results of sediment and elutriate toxicity bioassays provide a direct assessment of potential toxicity that takes into account possible interactive effects of mixtures of multiple contaminants, and of potential contaminants that may be present but were not individually measured.

### **3.2.4.2 Significance Criteria**

Significance criteria to be used for the determination of impacts on beneficial uses of water and water quality are listed below. These criteria are excerpted from the list of ten significance criteria generally applicable to hydrology and water quality environmental factors for proposed projects in California (Appendix E in California Resources Agency [2010]). The criteria also encompass elements of Oregon and California water quality standards.

Effects on beneficial uses of water and water quality will be considered significant if the Proposed Action or alternatives would do any of the following:

- Result in regular exceedances of water quality standards or waste discharge requirements.
- Result in substantial adverse effects on beneficial uses of water.

For the purposes of this EIS/EIR, substantial is defined as “of considerable importance to water quality and the support of beneficial uses”. “Substantial adverse effects” are intended to correspond to water quality parameters that are included on the CWA Section 303(d) list (see Table 3.2-8) because if a parameter is listed, it has already been determined that beneficial uses are not supported due to regular exceedances of established numeric standards or water quality objectives. Substantial adverse effects can also apply to water quality parameters that would experience degradation within the EIS/EIR short-term time from of less than two years.

Additional criteria related to groundwater and hydrology (i.e., drainage, runoff, stormwater, flooding, and inundation) will be addressed in Section 3.6, Flood Hydrology or Section 3.7, Groundwater.

#### **3.2.4.2.1 Thresholds of Significance for Numeric Standards or Water Quality Objectives**

Thresholds of significance for established numeric standards and water quality objectives are the numeric values themselves. The numeric values for Oregon, California, Hoopa Valley Tribe, and the Ocean Plan are presented in Tables 3.2-3 through 3.2-7.

Numeric values presented in Tables 3.2-3 through 3.2-7 are used as thresholds of significance for water temperature, dissolved oxygen, and pH. Other numeric values presented in Tables 3.2-3 through 3.2-7, including Oregon and California turbidity standards, California nitrate and nitrite standards for the support of municipal beneficial uses, the Hoopa Valley Tribe criterion for chlorophyll-*a* as periphyton, and the Hoopa Valley Tribe ammonia and nitrate standards for the support of cold freshwater habitat and municipal beneficial uses, are not used as thresholds of significance. The reasons for not using these numeric standards in the water quality effects determinations are discussed below, by parameter.

### **3.2.4.2.2 Thresholds of Significance for Narrative Standards or Water Quality Objectives**

#### **3.2.4.2.2.1 Suspended Sediments**

Oregon has a numeric turbidity standard based upon increases relative to background levels (see Table 3.2-3), and California’s water quality objective for turbidity is based upon increases relative to natural conditions (see Table 3.2-4). Turbidity levels under natural conditions are not readily available in the Klamath River data record. While a relationship between turbidity and suspended sediment can be developed on a watershed-specific basis, seasonal coincident suspended sediment and turbidity data for the Klamath Basin are not currently sufficient, either temporally or spatially, to develop a robust relationship between these two parameters for either background levels or natural conditions levels (Stillwater Sciences 2009). For these reasons, the established numeric water quality objectives for turbidity in Oregon and California are not used for the water quality effects determination; instead, the narrative sediment water quality objectives are applied to the analysis.

California’s North Coast Basin Plan water quality objectives for suspended material, settleable material, and sediment are narrative and require that waters do not contain concentrations that cause nuisance or adversely affect beneficial uses (see Table 3.2-4). While the Klamath River has multiple designated beneficial uses (see Table 3.2-2), the use most sensitive to water quality is the cold freshwater habitat (COLD) associated with salmonids (NCRWQCB 2010a). In order to adequately protect this use from *short-term* (<2 years following dam removal) effects of the Proposed Action, the water quality effects determination methods focus on the suspended material water quality objective and rely upon the extensive sediment transport modeling effort undertaken for the Secretarial Determination process to quantify predicted SSCs for 1 to 2 years following dam removal (see Section 3.2.4.1). An alternative “dose-response” approach to developing a numeric suspended sediments threshold of significance for potential short-term effects has been adopted, as detailed in Appendix D, Section D.2. Based on this approach, the water quality effects determination uses a predicted suspended sediment value of 30 mg/L over a 4-week exposure period as a general threshold of significance for analyzing the *short-term* effects of the alternatives.

A more detailed analysis of suspended sediment effects on key fish species, including consideration of specific life history stages, SSCs, and exposure period, is required for a comprehensive assessment of the impacts of the alternatives on the cold water designated beneficial use. This level of analysis is presented in Section 3.3, Aquatic Resources and appendices to this section. Further discussion of particular effects of suspended sediment on shellfish and estuarine and marine organisms is also presented in Section 3.3.4.3, Aquatic Resources.

#### **3.2.4.2.2.2 Nutrients**

Oregon does not stipulate numeric nutrient water quality standards (see Table 3.2-3). California has a narrative water quality objective for biostimulatory substances and does not stipulate numeric nutrient water quality standards for the cold water habitat beneficial use (see Table 3.2-4). California does have numeric nitrate and nitrite standards for the

support of municipal beneficial uses (i.e., drinking water). However, these standards are much higher than concentrations that have been measured in the Klamath Basin, such that there is no indication that the municipal beneficial use is not being met. Hoopa Valley Tribe also has a nitrate standard for municipal beneficial uses, which is similarly high.

The California Klamath River TMDLs provide the numeric interpretation of the narrative biostimulatory substances objective for the Klamath River through numeric targets for nutrients, organic matter, chlorophyll-*a*, *M. aeruginosa* and microcystin. The numeric TMDL targets for nutrients (TP and TN) and organic matter (as carbonaceous biochemical oxygen demand [CBOD]) are established for the tailraces of Copco 2 and Iron Gate Dams. The numeric TP targets range 0.023–0.029 mg/L for May–October and 0.024–0.030 mg/L for November–April. The numeric TN targets range 0.252–0.372 mg/L for May–October and 0.304–0.395 mg/L for November–April (NCRWQCB 2010a). These targets are based on the T4BSRN scenario (Appendix D, Section D-1) and are established as the monthly mean concentrations that allow achievement of the in-reservoir chlorophyll-*a* summer mean target of 10 µg/L, the *M. aeruginosa* cell density target of 20,000 cells/mL, and the microcystin target of 4 µg/L (NCRWQCB 2010a).

For multiple locations in the Klamath River, the TMDL model results indicate large daily variability in TP and TN that exceeds the small range in the monthly TMDL targets, particularly during summer and early fall (i.e., generally June–October) (Tetra Tech 2009). Therefore, the nutrient effects analysis considers whether a general downward (or upward) trend in TP and TN toward (or away from) the numeric targets would occur and, qualitatively, whether such a trend would support or alleviate the growth of nuisance and/or noxious phytoplankton or nuisance periphyton.

#### **3.2.4.2.2.3 Chlorophyll-*a* and Algal Toxins**

Within the area of analysis, Oregon possesses a numeric criterion for chlorophyll-*a* that is associated with the nuisance algae growth water quality objective and applies to natural lakes that do not thermally stratify, reservoirs, rivers, and estuaries (see Table 3.2-3). The Klamath River TMDLs establish a chlorophyll-*a* target specific to the KHP of 10 µg/L during the growth season, based on a Nutrient Numeric Endpoint analysis (NCRWQCB 2010a). The Hoopa Valley Tribe has a chlorophyll-*a* criterion (150 mg/m<sup>2</sup>; see Table 3.2-6) for their periphyton density water quality objective, which is applicable to a short reach (≈RM 45–46) of the Klamath River upstream of the Trinity River. However, since effects of the Proposed Action on periphyton growth are addressed in Section 3.4, Algae, chlorophyll-*a* as a measure of periphyton density is not discussed further in the water quality effects analysis.

The Oregon criterion (15 µg/L) and the California TMDL target (10 µg/L) are used as chlorophyll-*a* thresholds of significance for J.C. Boyle Reservoir and Copco 1 and Iron Gate reservoirs, respectively. Anticipated regular exceedances of these thresholds would constitute a significant impact for this analysis.

For algal toxins, both Oregon and California have narrative water quality objectives for general toxicity (see Table 3.2-3 and 3.2-4). The Hoopa Valley Tribe has numeric

objectives for algal toxins (see Table 3.2-6). The WHO has set numeric thresholds for recreational exposures of microcystin toxin at 4 µg/L for a low probability of adverse health effects, and 20 µg/L for a moderate probability of adverse health effects (Falconer et al. 1999, Chorus and Cavalieri 2000). The WHO thresholds are general levels representing a variety of toxigenic cyanobacteria. Oregon has adopted public health guidelines for recreational exposures similar to the WHO values, and California uses the *Draft Voluntary Statewide Guidance for Blue-Green Algae Blooms* (SWRCB 2010) developed jointly by the California Department of Public Health, SWRCB and OEHHA. To avoid conditions that lead to water quality impairments, the California Klamath River TMDLs use the WHO low probability of adverse health effects thresholds as targets specific to the California reaches of the KHP for *M. aeruginosa* and microcystin toxin (see Table 3.2-10).

**Table 3.2-10. Summary of Water Quality Guidance, Criteria, or Targets for Toxigenic Blue-Green Algae and Algal Toxins in the Area of Analysis**

Source	Description
Oregon <sup>1</sup>	
Public health guidelines for recreational exposure	40,000 cells/mL <i>M. aeruginosa</i> , or 8 µg/L microcystin
California <sup>2</sup>	
Draft Voluntary Statewide Guidance for Blue-Green Algae Blooms	>100,000 cells/mL potentially toxigenic blue-green algae, or 40,000 cells/mL <i>M. aeruginosa</i> , or 8 µg/L microcystin
California Klamath River TMDL <sup>3</sup>	
Chl-a target for California KHP reservoirs (growth season)	< 20,000 cells/L <i>M. aeruginosa</i> , or < 4 ug/L microcystin
Hoopa Valley Tribe <sup>4</sup>	
<i>Microcystis aeruginosa</i> cell density	<5,000 cells/mL for drinking water <40,000 cells/mL for recreational water
Microcystin toxin Concentration	<1µg/L total microcystin for drinking water <8 µg/L total microcystin for recreational water
Total potentially toxigenic cyanobacteria species <sup>5</sup>	<100,000 cells/mL for recreational water

<sup>1</sup> Oregon DEQ (OAR 340-041): At these levels, water considered impaired.

<sup>2</sup> SWRCB (2010): At these levels, water considered impaired.

<sup>3</sup> NCRWQCB (2010a): These targets are set to avoid conditions that could lead to water quality impairments.

<sup>4</sup> HVTEPA (2008): At these levels, water considered impaired.

<sup>5</sup> Includes: Anabaena, Microcystis, Planktothrix, Nostoc, Coelosphaerium, Anabaenopsis, Aphanizomenon, Gloeotrichia, and Oscillatoria.

Since it is common to Oregon, California, and the Hoopa Valley Tribe (see Table 3.2-10), the < 8 ug/L criterion for microcystin in recreational water is used as the threshold of significance for this Klamath Facilities Removal EIS/EIR. As is the case with chlorophyll-*a*, quantitative predictive tools for algal toxins are not available for the Proposed Action. Therefore, the algal toxin effects determinations are based on a qualitative assessment of whether the Proposed Action would result in exceedances of the criterion and adversely affect the human health recreational beneficial uses (REC-1, REC-2; Table 3.2-2). Growth conditions for toxigenic suspended algae (i.e., nutrient availability, impounded water) are considered as part of the qualitative analysis, where predicted increases in nutrient availability, water temperatures, and the availability of lacustrine (lake or reservoir) conditions would correspondingly increase algal toxin concentrations.

#### **3.2.4.2.4 Inorganic and Organic Contaminants**

Both Oregon and California have water quality objectives related to inorganic and organic contaminants. Oregon's toxicity objective has both a narrative and a numeric component (see Table 3.2-3); the numeric component has chemical-specific water-column criteria for freshwater and marine aquatic life and human health (CDM 2011). Oregon's numeric marine aquatic life criteria are not considered further because the Proposed Action would not affect the marine environment in Oregon. California's chemical constituents objective is numeric (listed in the Basin Plan [NCRWQCB 2006a], as noted in Table 3.2-4 and has chemical-specific water-column criteria for freshwater and marine aquatic life and human health, including bioaccumulative chemicals such as PCBs, methylmercury, dioxins, and furans (CDM 2011). California's toxicity and pesticides objectives are narrative (see Table 3.2-4). Hoopa Valley also has an ammonia toxicity objective based on pH and temperature (see Table 3.2-6). However, since available data collected to date suggests no actual ammonia toxicity events associated with the operation of the Four Facilities (NCRWQCB 2010a), this objective is not considered further.

Thresholds of significance for the Oregon and California narrative water quality objectives focus on designated beneficial uses and are applicable for contaminants in either the water column or the sediments. For this Klamath Facilities Removal EIS/EIR, establishment of toxicity and/or bioaccumulative potential for sediment contaminants relies upon thresholds developed through regional and state efforts such as the SEF for the Pacific Northwest (Appendix D, Section D.3). The SEF includes bulk sediment screening levels for standard chemicals of concern and chemicals of special occurrence in marine and freshwater sediments for Idaho, Oregon, and Washington (RSET 2009). Additionally, Oregon has developed bioaccumulation screening level values that are used for this Klamath Facilities Removal EIS/EIR analysis. Similar numeric chemical guidelines for the assessment and characterization of freshwater and marine sediments do not exist for California. Additional information regarding applicable sediment screening levels used for the Secretarial Determination sediment evaluation process is presented in CDM (2011).

Impacts on water quality would be considered significant if results of sediment and elutriate chemical analyses and biological testing indicate that at least one chemical is detected at a level with potential for significant adverse effects based on multiple lines of evidence (CDM 2011). This evaluation is not intended to be equivalent to the SEF process.

### **3.2.4.3 Effects Determinations**

#### **3.2.4.3.1 Alternative 1: No Action/No Project Alternative**

Under this Alternative, the Klamath Hydroelectric Project would continue current operations under the terms of an annual license until a long-term license is finalized. Some restoration actions have already been initiated and would continue under the No Action. These include the Williamson River Delta Project, the Agency Lake and Barnes Ranch Project, fish habitat restoration work, and ongoing climate change assessments. The TMDLs would still be implemented under this and all other alternatives as they are an unrelated regulatory action. Hydroelectric operations would continue as they have been, providing peaking power generation during the summer as demand requires and conditions allow. The No Action/No Project Alternative would leave the Four Facilities in place. In the Upper Klamath Basin, this would only affect water quality in the Hydroelectric Reach; however, resource management actions elsewhere in the Upper Klamath Basin (i.e., Upper Klamath Lake and tributaries) are also analyzed under this alternative because they would potentially affect water quality further downstream.

#### **3.2.4.3.1.1 Water Temperature**

##### **Upper Klamath Basin**

*Continued impoundment of water at the Four Facilities could result in short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable ODEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the Hydroelectric Reach.* Under existing conditions, water temperatures (measured as 7-day-average maximum values) in much of the reach from Upper Klamath Lake to the Oregon-California state line exceed 20°C (68°F) in June through August and result in non-attainment of the fish and aquatic life beneficial use for spawning and rearing of salmon, steelhead, and trout, as well as core coldwater habitat (see Table 3.2-3). The exception to this occurs in the J.C. Boyle Bypass Reach where cold groundwater springs enter the river at a relatively constant 11-12°C (Kirk et al. 2010). Due to the constant groundwater input, there is also little daily fluctuation in water temperatures in this reach. Just downstream, in the J.C. Boyle Peaking Reach, water temperatures fluctuate on a daily basis due to powerhouse peaking flows. When peaking flows are not occurring, water in the Peaking Reach is dominated by cooler water from the upstream groundwater springs. When peaking flows from J.C. Boyle Reservoir enter the reach, water temperatures can increase by several degrees (PacifiCorp 2006b). Further downstream in the California portions of the Klamath River, summer MWMTs throughout the Hydroelectric Reach regularly exceed the range of chronic effects temperature thresholds (13–20°C [55.4–68°F]) for full salmonid support in California (NCRWQCB 2010a) and result in non-attainment of designated COLD and WARM beneficial uses (see Table 3.2-4)

Under the No Action/No Project Alternative, several ongoing resource management actions in the Upper Klamath Basin represent reasonably foreseeable actions related to water temperature within the period of analysis (50 years). Underway since 2007, the Williamson River Delta Project is intended to restore wetlands for endangered fish species and improve water quality in Upper Klamath Lake (see Section 2.3.1). Thus far, the project has involved breaching over two miles of agricultural levees along the Williamson River where it flows into Upper Klamath Lake, restoring approximately 3,500 acres of wetlands in 2007 and an additional 1,400 acres in 2008. One of the project goals is to create wetlands with warmer spring water temperatures for rearing fish in the wetlands (as compared to cooler temperatures in the Williamson River or Upper Klamath Lake). The Agency Lake and Barnes Ranches Project would use historically diked and drained portions of the Barnes Ranches as interim pumped water storage areas, ultimately reconnecting them to Agency Lake (see Section 2.3.1). Breaching the dikes would convert the current 63,770 acre feet pumped storage to passive storage in Upper Klamath Lake. Specific options still need to be developed and studied as part of a separate project-level National Environmental Policy Act (NEPA) evaluation and Endangered Species Act (ESA) consultation. At a programmatic level, these activities may improve springtime water temperatures for spawning and rearing of fish in Upper Klamath Lake and tributaries to the lake. Additional resource management actions related to spring, summer, and fall water temperatures that are ongoing in tributaries to Upper Klamath Lake (see Section 2.3.1) include the following:

- Floodplain rehabilitation
- Large woody debris replacement
- Riparian vegetation planting
- Purchase of conservation easements and/or land

Although these resource management actions would improve water temperatures in the Upper Klamath Basin under the No Action/No Project Alternative, the effects would only be local and would not measurably improve water temperatures in the Hydroelectric Reach. These resource management actions are discussed again with respect to water quality effects under the KBRA (see Section 3.2.4.3, Full Facilities Removal of Four Dams - KBRA).

In Oregon, implementation measures focused on water temperature in the Upper Klamath Lake Drainage TMDL and those in the Upper Klamath River and Lost River Sub-basins TMDLs would improve water temperatures in the Hydroelectric Reach. The Oregon TMDLs include heat load allocations for anthropogenic and background nonpoint sources, where effective shade and channel morphology targets are used as surrogate measures for controlling nonpoint source temperature loading (see Section 3.2.2.4).

To support beneficial uses in California, the North Coast Basin Plan stipulates that water temperature can not be increased by more than 2.8°C (5°F) above natural receiving temperatures (see Table 3.2-4). The NCRWQCB has determined that natural receiving water temperatures in the Klamath River are already too warm to support designated beneficial uses. Therefore, the Klamath TMDL allocates a daily average (and daily

maximum) increase in water temperatures of 0.5°C [0.9°F] for Copco 1 and 2 reservoir tailraces and 0.1°C [0.18°F] for the Iron Gate Reservoir tailrace. This allocation is designed to alleviate the late summer/fall 2–10°C (3.6–18°F) warming caused by the reservoirs immediately downstream of Iron Gate Dam under existing conditions (see Section 3.2.3.2). Additionally, a compliance lens in Copco 1 and Iron Gate Reservoirs must be maintained, such that water temperature and dissolved oxygen conditions would be suitable for cold water fish in the reservoirs during the critical summer period (see Section 3.2.2.4). To date, no proposed action has been identified by PacifiCorp to achieve the temperature allocations assigned to Copco 1 and Iron Gate reservoirs.

The Klamath TMDL model (see Appendix D) indicates that under the No Action/No Project Alternative (similar to the TMDL T4BSRN scenario) water temperatures in the reach from Link River Dam to just upstream of J.C. Boyle Reservoir (including Keno Impoundment and Lake Ewauna) and in the Hydroelectric Reach would be very similar to modeled natural conditions temperatures (TMDL T1BSR scenario) (NCRWQCB 2010a). While the Klamath TMDL model output also indicates that natural conditions would exceed the 16°C (60.8°F) numeric water quality objective for the support of core coldwater habitat in Oregon during June–October (see Table 3.2-3), the narrative Oregon standard stipulates that the natural conditions criterion would supersede the numeric criterion. Thus, assuming eventual full attainment of the Oregon and California TMDLs, water temperature objectives in the Klamath Hydropower Reach can be met; however, the timeframes for achieving water temperature allocations required under the TMDLs will depend on the measures taken to improve water quality conditions. Full attainment could require decades to achieve.

The TMDL models do not address the potential effects of global climate change on water temperatures in the Klamath Basin (Appendix D). Within the period of analysis (i.e., 50 years), climate change models for the region suggest that as the western United States warms, air temperatures will increase, there will be a slight increase in overall precipitation, winter snowfall will likely shift to higher elevations, and snowpack will be diminished as more precipitation falls as rain (Oregon Climate Change Research Institute [OCCRI] 2010; see also Section 3.10.3.1). For the Sprague River watershed, increased flooding earlier in the spring and decreased summer baseflow would occur as a consequence of increased and decreased proportions of rainfall and snowfall, respectively, given climate change projections (Risley 2010). In the Klamath Basin as a whole, increasing air temperatures and decreasing flows in the summer months would be expected to cause general increases in summer and fall water temperatures on the order of 2–3°C (3.6–5.4°F) (Bartholow 2005) (see also discussion under Lower Klamath Basin).

As part of the Klamath Dam Removal Secretarial Determination studies, the effects of climate change were included in model projections for future water temperatures under the No Action/No Project Alternative and the Proposed Action. RBM10 model results using climate change predictions from five GCMs indicate that future water temperatures under the No Action/No Project Alternative (where simulated flows are subject to the 2010 Biological Opinion mandatory flow regime [NOAA Fisheries Service 2010]) would be 1–2.3 °C (1.8–4.1 °F) warmer than historical temperatures in the Klamath Basin (Perry

et al. 2011). While this temperature range is slightly lower than that suggested using the Bartholow (2005) historical estimates, within the general uncertainty of climate change projections, the two modeling efforts correspond reasonably well and indicate that water temperatures in the Upper Klamath Basin are expected to increase with the period of analysis on the order of 1–3°C (1.8–5.4°F).

The anticipated increases in water temperatures due to climate change would also occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Upper Klamath Basin. The magnitude of the opposition would be slightly less than, but within the general range of, late summer/fall improvements (2–10°C [3.6–18°F]) expected by the TMDLs immediately downstream of Iron Gate Dam (see discussion under Lower Klamath Basin), such that climate change would partially offset the anticipated TMDL-related improvements.

**Existing late summer/fall water temperatures in the Hydroelectric Reach are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanisms and timing unknown) would significantly improve conditions in the Hydroelectric Reach, but climate change would partially offset TMDL-related improvements in the late summer/fall. Continued impoundment of water in the reservoirs at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### Lower Klamath Basin

*Continued impoundment of water at the Four Facilities could result in short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable California North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the Klamath River downstream of Iron Gate Dam.* Under existing conditions, the Four Facilities alter the natural thermal regime of the river by cooling springtime water temperatures 1–2.5°C (1.8–4.5°F) and warming late summer/fall water temperatures 2–10°C (3.6–18°F) in the lower Klamath River, with the largest effects occurring just downstream of Iron Gate Dam (RM 190.1) (PacifiCorp 2004a, Duns Moor and Huntington 2006, NCRWQCB 2010a, Perry et al. 2011). Effects diminish with distance downstream such that they are not discernable by the Salmon River (RM 66) (see Section 3.2.3.2 and Appendix C for more detail). Summer MWMTs in the Klamath River downstream of Iron Gate Dam to the Salmon River regularly exceed the range of chronic effects temperature thresholds (13–20°C [55.4–68°F]) for full salmonid support in California (NCRWQCB 2010a) and result in non-attainment of designated COLD and WARM beneficial uses (see Table 3.2-4). Although not an effect of the reservoirs at the Four Facilities, MWMTs in the mainstem from the Salmon River to the Klamath Estuary also regularly exceed these thresholds and result in non-attainment of these beneficial uses (see Section 3.2.3.2 and Appendix C for more detail).

Within the period of analysis (i.e., 50 years), implementation of NOAA Fisheries Service 2010 Biological Opinion mandatory flows and CDFG Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River (see Section 2.3.1 and Section 3.2.4.1, *No Action/No Project Alternative*) would increase seasonal stream flow and

would be expected to moderately decrease water temperatures in the Klamath River downstream of Iron Gate Dam, particularly during summer and fall months. The California Klamath River TMDLs were developed based on compliance with water quality objectives at the Oregon-California state line, meaning that successful implementation of water quality improvement measures under the Oregon TMDLs will improve water temperatures in the Lower Klamath Basin as well. General implementation measures under the California Klamath TMDLs associated with water temperature improvements are described in the prior section for the Upper Klamath Basin and in Section 3.2.2.4. Additionally, the Shasta, Scott, and Salmon Rivers, tributaries to the lower Klamath River, have TMDLs addressing temperature (see Section 3.2.2.4).

The Klamath TMDL model indicates that under the No Action/No Project Alternative (similar to TMDL T4BSRN scenario), water temperatures from Iron Gate Dam (RM 190.1) to the Klamath Estuary (RM 0-2) would improve towards modeled natural conditions (similar to the TMDL T1BSR scenario) (NCRWQCB 2010a). Some delayed warming of springtime water temperatures (February-March) and delayed cooling of late summer/fall (August-November) water temperatures would still occur under the No Action/No Project Alternative due to the large thermal mass of Copco 1 and Iron Gate reservoirs. This temporal shift may continue to occur under the No Action/No Project Alternative from downstream of Iron Gate Dam to approximately Seiad Valley (RM 129.4) because while full attainment of the California Klamath TMDLs would improve water temperature, the model is unable to demonstrate full temperature compliance in the spring and fall downstream of Iron Gate Dam to Seiad Valley with the Four Facilities in place. Based on TMDL model results, water temperature from Seiad Valley (RM 129.4) to the Salmon River (RM 66.0) (the approximate location at which the reservoir temperature signal no longer persists under existing conditions), would meet water quality objectives. The model-predicted lack of compliance from Iron Gate Dam to Seiad Valley underlies the TMDL requirement for PacifiCorp to develop a Reservoir Management Plan that specifically addresses water temperature and dissolved oxygen improvements that would allow the Four Facilities to meet water quality objectives (NCRWQCB 2010a). The timeframes for achieving water temperature allocations required under these TMDLs will depend on the measures taken to improve water quality conditions. It is anticipated that full attainment of the TMDLs would require decades to achieve.

General climate change effects are discussed in Section 3.10.3.1. With respect to water temperatures in the Lower Klamath Basin, the historical data record indicates that mainstem water temperatures have increased approximately 0.05°C (0.09°F) per year between 1962 and 2001 (Bartholow 2005) such that climate change may already be affecting Klamath River water temperatures. Projecting the Bartholow (2005) estimate of an average annual temperature increase 50 years into the future, water temperatures would increase 2–3°C (3.6–5.4°F) by the end of the analysis period. As part of the Klamath Dam Removal Secretarial Determination studies, the effects of climate change were included in model projections for future water temperatures under the No Action/No Project Alternative and the Proposed Action. RBM10 model results using climate change predictions from five GCMs indicate that future water temperatures under the No

Action/No Project Alternative (where simulated flows are subject to the 2010 Biological Opinion mandatory flow regime [NOAA Fisheries Service 2010]) would be 1–2.3 °C (1.8–4.1 °F) warmer than historical temperatures (Perry et al. 2011). While this temperature range is slightly lower than that suggested using the Bartholow (2005) historical estimates, within the general uncertainty of climate change projections, the two projections correspond reasonably well and indicate that water temperatures in the Lower Klamath Basin are expected to increase with the period of analysis on the order of 1–3°C (1.8–5.4°F).

The anticipated increases in water temperatures due to climate change would also occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Lower Klamath Basin. Within the range of late summer/fall improvements expected by the TMDLs (2–10°C [3.6–18°F] immediately downstream of Iron Gate Dam and 2–5°C [3.6–9°F] just upstream of the Scott River), climate change would partially offset the anticipated TMDL-related improvements. Climate change would also completely offset the existing 1–2°C springtime cooling effect of the reservoirs; the cooling effect in spring is potentially beneficial to rearing salmonids by reducing stress and disease for late outmigrants.

**Existing late summer/fall water temperatures in the Klamath River from immediately downstream of Iron Gate Dam to the Salmon River (RM 66) are adverse<sup>5</sup>. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly improve conditions but water temperatures from Iron Gate Dam to approximately Seiad Valley (RM 129.4) would remain adverse. Climate change would partially offset TMDL-related improvements in the late summer/fall. Continued impoundment of water in the reservoirs at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### **3.2.4.3.1.2 Suspended Sediments**

##### Upper Klamath Basin

*Continued impoundment of water at the Four Facilities could result in short-term and long-term interception and retention of mineral (inorganic) suspended material by the KHP dams.* Under existing conditions, peak concentrations of this suspended material occur during winter and spring (November through April) due to runoff and tributary flows to the Hydroelectric Reach associated with high-flow events. The KHP dams intercept and trap suspended materials such that water column concentrations generally decrease with distance downstream in the Hydroelectric Reach (see Section 3.2.3.3). While this may be potentially beneficial for downstream reaches by decreasing TSS concentrations and turbidity, the trapping of fine sediments and suspended materials does not appear to be a critical function with respect to the overall sediment delivery for the Klamath Basin (see also Section 3.11.3.3 for a discussion of basin sediment supply and transport). A relatively small (3.4 percent) fraction of total sediment supplied to the

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<sup>5</sup> Water temperatures from the Salmon River to the Klamath Estuary are also adverse but this condition is not a result of the impoundment of water in the reservoirs at the Four Facilities.

Klamath River on an annual basis originates from the upper and middle Klamath River (i.e., from Keno Dam to the Shasta River) (see Section 3.2.3.3) and beneficial uses in the upper Klamath River are currently not impaired due to mineral (inorganic) suspended material (see Table 3.2-8).

Under the No Action/No Project Alternative, the ongoing Williamson River Delta Project and Agency Lake and Barnes Ranches Project would contribute to reduced mineral (inorganic) fine sediment inputs to Upper Klamath Lake. In the tributaries to Upper Klamath Lake, additional resource management actions for fish habitat restoration (see Section 2.4.2) related to mineral (inorganic) sediment are ongoing, including the following:

- Floodplain rehabilitation
- Large woody debris replacement
- Cattle exclusion [fencing]
- Riparian vegetation planting
- Mechanical thinning of upland areas and fire treatment
- Purchase of conservation easements/land
- Road decommissioning
- Reduction of fine sediment sources

These resource management actions are also discussed with respect to water quality effects under the KBRA (see Section 3.2.4.3, Full Facilities Removal of Four Dams - KBRA).

Anticipated climate change effects within the period of analysis (i.e., 50 years) include increased fine sediment delivery to streams due to more intense and frequent precipitation events and elevated stormwater runoff (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections). The anticipated increases would occur over a timescale of decades and may reduce anticipated improvements expected from successful implementation of the aforementioned resource management actions; however, the magnitude of the increased sediment delivery relative to the currently low levels of fine sediment production has not been assessed.

**Existing interception and retention of mineral (inorganic) suspended material in the reservoirs in the Hydroelectric Reach is potentially beneficial. Continued impoundment of water at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

*Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term (one year) increases in mineral (inorganic) suspended material in the Hydroelectric Reach.* Under this IM, suitable spawning gravel would be placed in the J.C. Boyle Bypass and Peaking reaches in the fall of 2011 using a passive approach before high flow periods, or to provide for other habitat enhancement in the Klamath River upstream of Copco 1 Reservoir. These actions would provide improvements in habitat quality for resident fish prior to dam removal, and for resident and anadromous

species following dam removal. Work on IM 7 began in fall 2010 with the contracting, planning, and permitting phase. Passive gravel placement is specified by IM 7, which would avoid in-stream placement of gravel and would limit turbidity increases to periods of high river flow when turbidity is naturally elevated. The potential for sediments to enter the water during gravel placement along the river banks can be minimized or eliminated downstream of the enhancement sites through the implementation of BMPs for construction activities (Appendix B) (BLM 2011). Any disturbed sediments would be trapped by Iron Gate Reservoir and not transferred downstream to the Klamath River, particularly given implementation of BMPs. **Under the No Action/No Project Alternative, the effect of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, on SSCs in the Hydroelectric Reach would be a less-than-significant impact.**

*Implementation of IM 8, J.C. Boyle Bypass Barrier Removal, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach due to deconstruction activities.* Under this IM, the sidecast rock barrier located approximately three miles upstream of the J.C. Boyle Powerhouse in the J.C. Boyle Bypass Reach would be removed. The objective of IM 8 is to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead, Pacific lamprey, and redband trout. The potential for sediments to enter the water during in-stream work associated with barrier removal and from construction site runoff could be minimized or eliminated through the implementation of BMPs for construction activities (Appendix B). Any disturbed sediments would be trapped by Copco 1 Reservoir and not transferred downstream to the Klamath River, particularly given implementation of BMPs. **Under the No Action/No Project Alternative, the effect of IM 8, J.C. Boyle Bypass Barrier Removal, on SSCs in the Hydroelectric Reach in the J.C. Boyle bypass reach would be a less-than-significant impact.**

*Continued impoundment of water at the Four Facilities could result in short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the Hydroelectric Reach due to in-situ algal blooms.* Under existing conditions, episodic increases in suspended material occur in the KHP reservoirs during summer months as a result of *in-situ* algal productivity. These concentrations typically range 10–20 mg/L, but can be greater than 200 mg/L (see Section 3.2.3.3) and cause nuisance or adversely affect beneficial uses during intense blooms. While some settling of algal-derived (organic) suspended materials from Upper Klamath Lake may occur in the reservoirs at the Four Facilities, the majority of removal occurs further upstream in the Keno Impoundment, with some additional decreases in concentration due to mechanical breakdown of algal remains in the turbulent river reaches between Keno Dam and Copco 1 Reservoir, and dilution from the springs downstream of J.C. Boyle Dam (see Appendix C for more detail). The high levels of seasonal suspended material caused by algal blooms in the reservoirs in the Hydroelectric Reach would continue to occur under the No Action/No Project Alternative.

Also under this alternative, the ongoing Williamson River Delta Project and Agency Lake and Barnes Ranches Project would contribute to reduced fine sediment inputs to

Upper Klamath Lake. At a programmatic level, the fine sediment reductions may decrease overall sediment-associated phosphorus inputs to the lake and downstream reaches. The effects would be mostly local, but may indirectly reduce nutrient concentrations in the Hydroelectric Reach by decreasing concentrations in upstream Upper Klamath Lake. In the tributaries to Upper Klamath Lake, additional resource management actions for fish habitat restoration (see Section 2.4.2) related to sediment-associated phosphorus are ongoing, including the following:

- Floodplain rehabilitation
- Cattle exclusion [fencing]
- Riparian vegetation planting
- Mechanical thinning of upland areas and fire treatment
- Purchase of conservation easements/land
- Road decommissioning

These resource management actions are also discussed with respect to water quality effects under the KBRA (see Section 3.2.4.3, Full Facilities Removal of Four Dams - KBRA).

Full attainment of the measures in Oregon's Upper Klamath River and Lost River TMDLs may indirectly decrease algal-derived suspended material in the Link River and Klamath River upstream of the Oregon-California state line within the period of analysis (i.e., 50 years). The Oregon draft TMDLs require reductions in phosphorus and nitrogen loading from both point sources and nonpoint sources in the Upper Klamath River to address chlorophyll-*a* impairments (see Section 3.2.2.4, Upper Klamath River and Lost River TMDLs). Decreases in nutrient inputs to the upper Klamath River would decrease algal blooms and decrease algal-derived suspended material in this reach. Full attainment of the California Lower Lost River for pH and nutrients and the Klamath River TMDLs for organic enrichment/low dissolved oxygen, nutrients, and microcystin water quality impairments would decrease algal-derived suspended material in the Klamath River downstream of the Oregon-California state line to Iron Gate Reservoir and would, in the long-term, be beneficial to water quality. It is anticipated that full attainment of the Oregon and California TMDLs would require decades to achieve.

Anticipated climate change effects within the period of analysis (i.e., 50 years) include longer and more intense algal blooms due to increased air temperatures (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections) and higher overall rates of photosynthesis during summer months. This may increase levels of algal-derived (organic) suspended material. The anticipated increases in suspended material due to climate change would also occur over a timescale of decades and may reduce anticipated improvements expected from successful TMDL implementation throughout the Upper Klamath Basin; however, the magnitude of the increased algal productivity with increasing temperature has not been assessed.

**Existing seasonal increases in algal-derived (organic) suspended material in the reservoirs in the Hydroelectric Reach are adverse. Full attainment of the Oregon**

**and California TMDLs (implementation mechanism and timing unknown) would significantly decrease algal blooms and associated suspended material in the reservoirs in this reach. Continued impoundment of water in the reservoirs at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### Lower Klamath Basin

*Continued impoundment of water at the Four Facilities could result in short-term and long-term interception and retention of mineral (inorganic) sediments by the dams and correspondingly low levels of suspended material immediately downstream of Iron Gate Dam.* Under existing conditions, during November–April, mineral (inorganic) suspended sediments tend to be <100 mg/L in the Klamath River immediately downstream of Iron Gate Dam, increasing to levels greater than 150 mg/L in the mainstem downstream of the confluence with the Trinity River during storm events (see Section 3.2.3.3). While the interception and retention of mineral (inorganic) suspended sediments may be moderately beneficial for the Klamath River immediately downstream of Iron Gate Dam, this represents a very minor portion of the load with respect to overall sediment delivery for the Klamath Basin. A relatively small (3.4 percent) fraction of total sediment supplied to the Klamath River on an annual basis, originates from the upper and middle Klamath River (i.e., from Keno Dam to the Shasta River) (see Section 3.2.3.3) and beneficial uses in the Klamath River immediately downstream of Iron Gate Dam are currently not impaired due to mineral (inorganic) suspended material (see Table 3.2-8).

The Klamath River from the Trinity River (RM 42.5) to the mouth (RM 0) is listed as sediment impaired (see Table 3.2-8), and while the California Klamath River TMDLs do not explicitly address sediment impairments, they do identify allocations to address temperature impairments caused by excessive (primarily inorganic) sedimentation (see Section 3.2.2.4, Klamath River TMDLs). Additionally, the Trinity River and South Fork Trinity River TMDLs, which are outside of the area of analysis for the Proposed Action and alternatives, are expected to affect water quality in the lower Klamath River. These TMDLs include a specific focus on sediment improvements. Further, the Scott River TMDL addresses sediment. General measures under the Trinity, South Fork Trinity, and Scott Rivers' TMDLs that can be associated with (primarily mineral) suspended sediment loads are described briefly in Section 3.2.2.4.

Full attainment of the measures in the Trinity River, South Fork Trinity River, and Scott River TMDLs would decrease (primarily mineral) suspended sediment loads in the sediment impaired reach of the lower Klamath River from the Trinity River (RM 40) to the mouth (RM 0) and would, in the long-term, be beneficial to water quality. Full attainment could require decades to achieve. These implementation measures would occur downstream of the Four Facilities and are not related to the KHP reservoirs under the *No Action/No Project Alternative*.

Anticipated climate change effects within the period of analysis (i.e., 50 years) include increased fine sediment delivery to streams due to more intense and frequent precipitation events and elevated stormwater runoff (Barr et al. 2010) (see Section 3.10.3.1, Existing

Conditions – Climate Change Projections). The anticipated increases would occur over a timescale of decades and may reduce improvements expected from successful implementation of the aforementioned TMDL implementation actions; however, the magnitude of the increased sediment delivery relative to the currently low levels of fine sediment production has not been assessed.

**Existing interception and retention of mineral (inorganic) sediments by the dams is potentially beneficial. Continued impoundment of water in the reservoirs at the Four Facilities under the No Action/No Project Alternative would result in no change from existing conditions.**

*Continued impoundment of water at the Four Facilities could result in short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the reservoirs in the Hydroelectric Reach and transport into the Klamath River downstream of Iron Gate Dam.* Under existing conditions, concentrations of summer and fall (June–October) algal-derived (organic) suspended material in the Klamath immediately downstream of Iron Gate Dam tend to be less than 5–8 mg/L, reflecting the dams’ capacity to intercept and retain suspended material. Much of the algal-derived (organic) suspended material retained behind the Project dams is a result of in-reservoir algal production, as the majority (although not all) of the algal material transported downstream from Upper Klamath Lake appears to be intercepted in the Keno Impoundment (see Appendix C for more detail). However, some of the seasonal algal production that occurs in Copco 1 and Iron Gate Reservoirs is transported downstream to the Klamath River, as evidenced by chlorophyll-*a* patterns, and to a lesser degree TSS patterns, in the river from Iron Gate Dam to the Klamath Estuary (see Appendix C for more detail). While the transport occurs, TSS levels are still relatively low. This pattern would continue to occur under the No Action/No Project Alternative.

Full attainment of the measures in Oregon’s Upper Klamath River and Lost River TMDLs would decrease algal blooms and decrease algal-derived suspended material in the KHP reservoirs due to decreasing nutrient availability. Full attainment of the measures in California’s Lower Lost River TMDLs and Klamath River TMDLs for organic enrichment/low dissolved oxygen, nutrients, and microcystin water quality impairments, would also decrease algal-derived suspended material KHP reservoirs and would, in the long-term, be beneficial to water quality. It is anticipated that full attainment of the Oregon and California TMDLs would require decades to achieve.

Anticipated climate change effects within the period of analysis (i.e., 50 years) include increased fine sediment delivery to streams and earlier, longer, and more intense algal blooms (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections), which may increase levels of both mineral (inorganic) and algal-derived (organic) suspended material, the latter due to higher overall rates of photosynthesis during summer months. The anticipated increases in suspended sediments due to climate change would also occur over a timescale of decades and may reduce improvements expected from successful TMDL implementation throughout the Lower Klamath Basin; however, the magnitude of the opposition is unknown.

**Existing transport of seasonally high algal-derived (organic) suspended material from the reservoirs to the Klamath River downstream of Iron Gate Dam is adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly improve conditions. Continued impoundment of water in the reservoirs at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

### **3.2.4.3.1.3 Nutrients**

#### Upper Klamath Basin

*Continued impoundment of water at the Four Facilities could result in long-term interception and retention of TN and TP in the Hydroelectric Reach on an annual basis but release (export) of TP and TN from reservoir sediments on a seasonal basis.* Under existing conditions, TN and TP decrease longitudinally through the Hydroelectric Reach on an annual basis due to dilution from the springs downstream of J.C. Boyle Dam and the settling of algal-derived (organic) material and associated nutrients in Copco 1 and Iron Gate reservoirs. On a seasonal basis, reservoir sediments can release bioavailable TP (as ortho-phosphorus), and to a lesser degree, bioavailable TN (as ammonium), to the water column during periods of seasonal hypolimnetic anoxia (see Section 3.2.3.4). While much of the TP released from anoxic reservoir sediments appears to remain within the hypolimnion until the reservoirs begin to turn over in the fall, some release does occur during late summer and fall months when it could stimulate in-reservoir algal blooms. Nutrients infrequently meet narrative Oregon water quality objectives for nuisance algae growth (Oregon Administrative Rule [OAR] 340-041-0019), or the narrative California North Coast Basin Plan water quality objective for biostimulatory substances (see Table 3.2-4) in the Hydroelectric Reach.

Under the No Action/No Project Alternative, the ongoing Williamson River Delta Project and Agency Lake and Barnes Ranches Project (see above water temperature and suspended sediment discussions) would provide long-term reductions in nutrients transported from the Agency Lake subbasin to Upper Klamath Lake. While short-term releases of nutrients are possible during the establishment of project equilibrium, at a programmatic level, these activities may decrease overall nutrient inputs to Upper Klamath Lake by inundating wetland (peat) soils and creating anaerobic conditions that support nutrient retention, particularly in the case of phosphorus (Snyder and Morace 1997). The effects would be mostly local, but may indirectly reduce nutrient concentrations in the Hydroelectric Reach by decreasing upstream nutrient concentrations in Upper Klamath Lake. These resource management actions are discussed again with respect to water quality effects under the KBRA (see Section 3.2.4.3.2, Full Facilities Removal of Four Dams - KBRA).

In Oregon, implementation of water quality improvement measures addressing nutrients in the Upper Klamath Lake Drainage TMDL and Water Quality Management Plan (WQMP) and the Upper Klamath River and Lost River Sub-basins TMDL and WQMP (see Section 3.2.2.4), include the following:

- Achievement of TMDL targets for TP loading as the primary method of improving dissolved oxygen (and pH) conditions in Upper Klamath and Agency lakes
- Reductions in phosphorus, nitrogen, and BOD loading from both point and nonpoint (e.g., agricultural returns) sources in the Upper Klamath River

In addition to the Oregon upstream improvements, California possesses load allocations for the Lower Lost River TMDLs for pH and nutrients and specific TMDL load allocations for TN and TP assigned to the KHP facilities for the Klamath River TMDLs. The California Klamath River TMDL also indicates that “alternative pollutant load reductions and/or management measures or offsets that achieve the in-reservoir targets” are possible (NCRWQCB 2010a).

The Oregon and California TMDLs in the Upper Klamath Basin are designed to meet water quality objectives; however, the timeframes for achieving nutrient allocations required under these TMDLs will depend on the measures taken to improve water quality conditions. Klamath TMDL model results for nutrient species (i.e., ortho-phosphorus, nitrate, and ammonium) are highly variable depending on location and season, likely due to rapid uptake and release of these chemical species during and following seasonal algal blooms (see Section 3.2.3.1) and potentially due to peaking operations at the J.C. Boyle Powerhouse. Nonetheless, TMDL modeling results tend to suggest that concentrations under the No Action/No Project Alternative would be similar to modeled natural conditions in the Hydroelectric Reach in spring and summer assuming full attainment of the TMDLs. Full attainment could require decades to achieve and is highly dependent on nutrient loads exiting Upper Klamath Lake and on agricultural return flows along the Keno Reach.

In summary, despite beneficial annual decreases in TP and TN through the Hydroelectric Reach, on a seasonal basis, internal release and export of TP, and to a lesser degree TN, from anoxic reservoir sediments during the summer and late fall may contribute to large blooms of toxigenic algae in the reservoirs.

**Existing interception and retention of nutrients in the reservoirs on an annual basis is beneficial, but the release (export) of nutrients (particularly TP) from reservoir sediments on a seasonal basis is adverse for the Hydroelectric Reach. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly decrease nutrients. Continued impoundment of water in the reservoirs at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### Lower Klamath Basin

*Continued impoundment of water at the Four Facilities could result in long-term interception and retention of TP and TN in the KHP reservoirs on an annual basis and release (export) of TP and TN to the Klamath River downstream of Iron Gate Dam on a seasonal basis. On an annual basis, nutrients in the Klamath River downstream of Iron Gate Dam currently tend to be lower than those in upstream reaches, due to dilution from*

the natural springs downstream of J.C. Boyle Dam and settling of particulate matter and associated nutrients in the larger KHP reservoirs (see Section 3.2.3.4). Further decreases in nutrient levels occur with distance downstream of Iron Gate Dam due to a combination of tributary dilution and in-river nutrient removal processes (see Section 3.2.3.4).

Although interception and retention of nutrients in the KHP reservoirs on an annual basis may be beneficial to the Klamath River downstream of Iron Gate Dam, under existing conditions TP and TN concentrations from the dam to the Klamath Estuary during late summer/early fall do not meet the narrative California Basin Plan water quality objective for biostimulatory substances due to the promotion of algal growth at levels that cause nuisance effects or adversely affect beneficial uses (see Table 3.2-4), nor do they meet the Hoopa Valley Tribe numeric criteria for TP (0.035 mg/L) and TN (0.2 mg/L) (see Table 3.2-6). Further, in late-summer and fall (i.e., August-November), TP and TN concentrations can increase downstream of the KHP reservoirs due to release of TP (as ortho-phosphorus) and, to a lesser degree, TN (as ammonium), which are formed during periods of seasonal hypolimnetic anoxia in Copco 1 and Iron Gate reservoirs. This seasonal release occurs during periods that may stimulate periphyton growth in the Klamath River downstream of Iron Gate Dam (see Appendix C, Sections C.3.1.4 C.3.2.1). This pattern would continue under the No Action/No Project Alternative.

In the Lower Klamath Basin, the California Klamath TMDLs include a specific focus on nutrient (TN and TP) improvements through specific load allocations assigned to the KHP facilities in California – Copco and Iron Gate reservoirs (see Section 3.2.2.4). Although specific nutrient allocations are only assigned to the KHP, the California Klamath TMDLs were developed based on compliance with water quality objectives at the Oregon-California state line, meaning that successful implementation of water quality improvement measures under the Oregon TMDLs will improve nutrients in the Lower Klamath Basin as well. General measures under the California Klamath River TMDLs that are associated with nutrients include the following:

- Developing a conditional waiver by 2012 to control discharges from agricultural activities (e.g., grazing, irrigated agriculture)
- Prohibiting the unauthorized discharge of waste that is in violation of water quality standards

The Shasta River TMDLs also address nutrients (see Section 3.2.2.4).

Full attainment of the measures in the Oregon and California TMDLs would result in waters meeting water quality standards; however, the timeframes for achieving nutrient allocations required under these TMDLs will depend on the measures taken to improve water quality conditions. Modeling conducted for development of the California Klamath River TMDLs indicates that under the No Action/No Project Alternative (similar to the T4BSRN scenario) TN and TP in the Klamath River downstream of Iron Gate Dam would meet or be lower than modeled natural conditions due to the trapping efficiency of sediment- and algal-associated nutrients behind the dams. Nutrient levels would also meet Hoopa Valley Tribe criteria for TP (0.035 mg/L) and TN (0.2 mg/L) (NCRWQCB 2010a). Given full attainment of the measures in the Oregon and California

TMDLs, actual TN concentrations under the No Action/No Project Alternative and natural conditions might be slightly lower than the model predicted concentrations, because denitrification is not included as a possible nitrogen removal term in the riverine segments of the Klamath TMDL model (Tetra Tech 2009). Nutrient species (i.e., ortho-phosphorus, nitrate, ammonium) concentrations are variable depending on location and season, with particularly high daily variation during summer months, but Klamath TMDL model results tend to suggest that concentrations under the No Action/No Project Alternative would be somewhat higher than modeled natural conditions in the Lower Klamath Basin. Use of adaptive management will be employed to refine efforts toward achieving water quality standards and TMDL targets. It is anticipated that full attainment of the TMDLs would require decades to achieve.

**Existing interception and retention of nutrients in the reservoirs on an annual basis is beneficial, but the release (export) of nutrients (particularly TP) on a seasonal basis is adverse for the Klamath River downstream of Iron Gate Dam. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly decrease nutrients. Continued impoundment of water in the reservoirs at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### **3.2.4.3.1.4 Dissolved Oxygen**

##### Upper Klamath Basin

*Continued impoundment of water at the Four Facilities could result in long-term seasonal and daily variability in dissolved oxygen concentrations in the Hydroelectric Reach, such that levels do not meet ODEQ and California North Coast Basin Plan water quality objectives and adversely affect beneficial uses.* Under existing conditions, dissolved oxygen levels exhibit summer and fall levels substantially below water quality objectives and infrequently support designated beneficial uses in Oregon for coldwater aquatic life, cool water aquatic life, warm water aquatic life, and spawning (including bull trout spawning and juvenile rearing, core cold-water habitat, redband trout, and cool water species [no salmonid use]; see Table 3.2-3), and in California for COLD, WARM, and SPWN beneficial uses (see Table 3.2-4). Dissolved oxygen levels are particularly low during the summer in the reach from Link River Dam to upstream of J.C. Boyle Reservoir (including Keno Impoundment and Lake Ewauna), with typical levels ranging from <1 mg/L to 5 mg/L. The primary cause of low summertime dissolved oxygen in the Keno Impoundment (including Lake Ewauna) is settling and decomposition of algae exported from Upper Klamath Lake (see Section 3.2.2.5). In the Hydroelectric Reach, the seasonal variability in dissolved oxygen concentrations in J.C. Boyle Reservoir is highly influenced by the adverse dissolved oxygen conditions in the upstream Keno Impoundment. Dissolved oxygen in hypolimnetic waters of Copco 1 and Iron Gate reservoirs reach minimum values near 0 mg/L during the summer (see Section 3.2.2.5).

Under the No Action/No Project Alternative, the ongoing Williamson River Delta Project and Agency Lake and Barnes Ranches Project may contribute to long-term improvements in seasonally low dissolved oxygen in Upper Klamath Lake. These resource management actions may decrease overall suspended sediment and nutrient inputs to

Upper Klamath Lake and downstream reaches. These resource management actions are discussed again with respect to water quality effects under the KBRA (see Section 3.2.4.3, Full Facilities Removal of Four Dams - KBRA).

In Oregon, implementation of TMDL water quality improvement measures focus on dissolved oxygen through reductions in water temperature and nutrient concentrations. The Upper Klamath Lake Drainage TMDL (see Section 3.2.2.4) include the following recommended measures for working toward achievement of TMDL targets for TP loading as the primary method of improving dissolved oxygen (and pH) conditions in Upper Klamath River along with Upper Klamath Lake and Agency lakes:

- Implementation of BMPs for improving dissolved oxygen in the Sprague River
- Reductions in phosphorus, nitrogen, and BOD loading from both point and nonpoint sources in the Upper Klamath River

Additionally, the Upper Klamath River and Lost River Sub-basins TMDLs require dissolved oxygen augmentation to J.C. Boyle Reservoir and several impoundments on the Lost River (the latter is not included in the area of analysis). The Lower Lost River pH and nutrient TMDLs were designed to ensure that California's numeric dissolved oxygen water quality standard would be attained. In California, one of the three TMDL load allocations assigned to the KHP is to create sufficient dissolved oxygen in Copco 1 and Iron Gate Reservoirs through a compliance lens, such that water temperature and dissolved oxygen conditions would be suitable for cold water fish during the critical summer period (see Section 3.2.2.4).

Full attainment of the measures in the Oregon and California TMDLs would result in waters meeting water quality standards; however, the timeframes for achieving dissolved oxygen (DO) allocations required under these TMDLs will depend on the measures taken to improve water quality conditions, especially reductions in nutrients. Based on Oregon numeric water quality standards, dissolved oxygen levels in the Upper Klamath Basin would need to meet natural conditions or attain 5.5 mg/L (year-round minimum for warm water aquatic life), 6.5 mg/L (year-round minimum for cool water aquatic life), 8.0 mg/L (year-round minimum for coldwater aquatic life), or 11.0 mg/L (January 1–April 15 minimum for spawning) (see Table 3.2-3). As with water temperature, the narrative Oregon standard stipulates that the natural conditions criterion supersedes the numeric criterion and is the standard for that water body (see Table 3.2-3). For California, dissolved oxygen would need to achieve 90 percent saturation based on natural receiving water temperatures during October–March and 85 percent saturation during April–September (see Table 3.2-4). The Klamath TMDL model (see Appendix D) indicates that under the No Action/No Project Alternative with full attainment of the TMDLs (similar to the T4BSRN scenario) dissolved oxygen in the riverine portions of the reach from Link River Dam to the Oregon-California state line would meet Oregon's 6.5 mg/L numeric objective for supporting the cool water aquatic life beneficial use (see Figure 3.2-16). Dissolved oxygen predicted levels would be similar to the modeled natural conditions baseline (TMDL T1BSR scenario) (NCRWQCB 2010a).

Klamath TMDL model results for riverine conditions at the Oregon-California state line indicate a similar pattern, whereby predicted dissolved oxygen concentrations meet the 6.5 mg/L objective year round and achieve the modeled natural conditions baseline during the warm summer and fall months (Figure 3.2-17). Under full TMDL compliant conditions, the California 85 percent saturation objective (based on natural receiving water temperatures) is met at state line under the No Action/No Project Alternative (Figure 3.2-17). Thus, full attainment of the Oregon and California TMDLs would eventually be beneficial for dissolved oxygen in the Hydroelectric Reach. Full attainment could require decades to achieve and it is highly dependent on improvements in dissolved oxygen in Upper Klamath Lake and the upstream reach from Link River Dam to J.C. Boyle Dam (particularly Keno Impoundment and Lake Ewauna).

Climate change is expected to cause a small anticipated decrease in dissolved oxygen due to general increases in water temperature in the Klamath Basin on the order of 2–3°C (3.6–5.4°F) over the period of analysis (i.e., 50 years) (Bartholow 2005; see also Section 3.2.4.3, Alternative 1: No Action/No Project Alternative: Water Temperature: Upper Klamath Basin). This would decrease the 100 percent saturation level for dissolved oxygen by an estimated 0.3–0.4 mg/L, using general assumptions for water temperature (20–24°C [68–75.2°F]), salinity (0 ppt) and elevation (1,433 m [4,700 ft]), where the elevation of Upper Klamath Lake is used as a simplifying assumption for the calculation. Climate change would also occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Upper Klamath Basin. Alternately, increased levels of algal growth and photosynthesis anticipated under climate change (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections) may increase daytime dissolved oxygen concentrations during summer months. The magnitude of this increase is unknown.

**Existing seasonal dissolved oxygen levels in the Hydroelectric Reach are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly increase dissolved oxygen. Continued impoundment of water at the Four Facilities under the No Action/No Project Alternative would result in no change from existing conditions.**

#### Lower Klamath Basin

*Continued impoundment of water at the Four Facilities could result in long-term seasonal and daily variability in dissolved oxygen concentrations in the Klamath River downstream of Iron Gate Dam, such that levels do not meet California North Coast Basin Plan and Hoopa Valley Tribe water quality objectives and adversely affect beneficial uses.* Under existing conditions, dissolved oxygen in the Klamath River exhibits seasonal and daily variability immediately downstream of Iron Gate Reservoir with frequent violations of the California water quality objective (expressed as percent saturation, see Table 3.2-5) during late summer/early fall (July–September) (see Section 3.2.3.5). Dissolved oxygen levels generally recover with distance downstream, but they still exhibit occasional minimum values below objectives during late summer/early fall downstream of the confluence with the Trinity River (RM 40). The Hoopa Valley Tribe (8 mg/L) water quality objective for dissolved oxygen, which applies at ≈RM 45–46, is

also infrequently met during late summer/early fall months (see Section 3.2.3.5). Thus, dissolved oxygen conditions currently do not fully support designated beneficial uses COLD and WARM beneficial uses (see Table 3.2-4) in the Klamath River downstream of Iron Gate Dam.

Under the No Action/No Project Alternative, IM 3, Iron Gate Turbine Venting, as part of ongoing KHSa IM studies (see also Section 3.2.4.1), may be used to augment dissolved oxygen in the river for a short distance (approximately one-quarter mile) downstream of the dam prior to 2020 (see Section 3.2.3.1, Upper Klamath Basin – Dissolved Oxygen – Hydroelectric Reach). However, pilot studies to date have not indicated that turbine venting efforts would be a viable long-term solution for dissolved oxygen impairment from the reservoirs.

In the Lower Klamath Basin, the California Klamath River TMDLs include a specific focus on dissolved oxygen improvements. Full attainment of water quality improvement measures under the Oregon TMDLs would improve dissolved oxygen in the California portions of the Klamath River as well, particularly since California Klamath River TMDLs were developed based on compliance with water quality objectives at the Oregon-California state line. Specific dissolved oxygen allocations are assigned to the KHP and TN, TP, and CBOD allocations are assigned to the mainstem river and tributaries to support improvement toward dissolved oxygen targets (i.e., water quality objectives for dissolved oxygen). Specific monthly dissolved oxygen numeric targets are also assigned to the Copco and Iron Gate tailraces, based on percent saturation (see Section 3.2.2.4). General measures under the California Klamath River TMDLs associated with dissolved oxygen in the Klamath River include the following:

- A conditional waiver (developed by 2012) for discharges from agricultural activities (e.g., grazing, irrigated agriculture)
- Prohibiting the unauthorized discharge of waste that is in violation of water quality standards

The Shasta River TMDLs also address dissolved oxygen. Dissolved oxygen improvements in the Shasta River would be expected to improve concentrations in the Klamath River mainstem at or downstream of the confluence with the Shasta River (RM 176.7). Multiple water quality improvement measures in the Shasta River TMDL focus on dissolved oxygen (see Section 3.2.2.4).

Full attainment of the measures in the Oregon and California TMDLs would result in waters meeting water quality standards; however, the timeframes for achieving dissolved oxygen allocations and targets required under these TMDLs will depend on the measures taken to improve water quality conditions, especially reductions in nutrients in upstream reaches. The Oregon and California with-dam TMDL scenario (T4BSRN - see Appendix D) was run in order to quantify the impacts of the dams on water quality and to determine appropriate allocations and targets. The Klamath with-dam TMDL modeling scenario indicates that under the No Action/No Project Alternative (similar to the TMDL T4BSRN scenario), dissolved oxygen concentrations downstream of Iron Gate Dam to the Shasta

River (RM 176.7), without additional mitigation, would not meet the North Coast Basin Plan water quality objective of 85 percent saturation (see Tables 3.2-4 and 3.2-5) during July–September and from the Shasta River to approximately the Scott River (RM 143) from September–November (see Figures 3.2-19 and 3.2-20). The inability to achieve the water quality objective of 85% saturation under TMDL compliance conditions from Iron Gate Dam to the Shasta River is due to the release of low dissolved oxygen water from the hypolimnion of the reservoir. This result indicates that while full attainment of the California Klamath TMDLs would result in dramatic improvements in dissolved oxygen both upstream and downstream of Iron Gate Dam, release of low dissolved oxygen water from the hypolimnion (i.e., the bottom layer within stratified reservoir) inhibits compliance from the Iron Gate tailrace to the Scott River with the dams in place. The TMDL does include dissolved oxygen targets for the tailrace that meet water quality objectives. It is possible that there are management practices that PacifiCorp could use to meet the TMDL dissolved oxygen targets. However, these practices have not been demonstrated to date and the NCRWQCB could not make presumptions regarding what these practices might be. Therefore, these enhancements were not included in the with-dams TMDL modeling scenario. Therefore, the TMDL Action Plan includes a requirement for PacifiCorp to develop a Reservoir Management Plan that specifically addresses water temperature and dissolved oxygen improvements that would allow the KHP facilities and downstream reaches to meet water quality objectives (NCRWQCB 2010a).

Farther downstream with full attainment of TMDL allocations, predicted dissolved oxygen concentrations would remain at or above 85 percent saturation, meeting the North Coast Region Basin Plan water quality objective from Seiad Valley (RM 129.4) to the Klamath Estuary. Despite this, predicted dissolved oxygen would infrequently meet the Hoopa Valley Tribe numeric dissolved oxygen objective of 8 mg/L (see Table 3.2-6), which applies at  $\approx$ RM45–46, because warm water temperatures during July–October would decrease the saturation level of oxygen in the water column to less than 8 mg/L (see Figure 3.2-20 and 3.2-21). However, Hoopa Valley Tribe has a natural conditions clause requiring dissolved oxygen to achieve 90% saturation if numeric values are not met; predicted dissolved oxygen concentrations would meet this natural condition clause. Throughout the lower Klamath River, daily fluctuations in dissolved oxygen during July–October would occur due to colonization of periphyton mats in the river and the associated photosynthetic swings in oxygen production.

As described for the Upper Klamath Basin, climate change would decrease the 100 percent saturation level for dissolved oxygen in the lower basin by increasing water temperatures. In the lower basin, this would result in an estimated 0.3–0.5 mg/L decrease in dissolved oxygen, using general assumptions for water temperature (20–24°C [68–75.2°F]), salinity (0 ppt) and elevation at sea level as a simplifying assumption for the calculation. The small anticipated decreases in dissolved oxygen due to climate change would also occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Lower Klamath Basin. As with the upper basin, increased levels of algal growth and photosynthesis anticipated under climate change (Barr et al. 2010) (see Section 3.10.3.1,

Existing Conditions – Climate Change Projections) may increase daytime dissolved oxygen concentrations during summer months. The magnitude of this increase is unknown.

**Existing seasonal dissolved oxygen levels immediately downstream of Iron Gate Dam are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly increase dissolved oxygen, although seasonal concentrations from Iron Gate Dam to the Shasta River would remain adverse. Continued impoundment of water at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

### **3.2.4.3.1.5 pH**

#### Upper Klamath Basin

*Continued impoundment of water at the Four Facilities could result in long-term seasonal and daily variability in pH in the Hydroelectric Reach.* Under existing conditions, pH values in the Hydroelectric Reach range from just above neutral to greater than 9, with large (0.5–1.5 pH units) daily fluctuations occurring in reservoir surface waters during periods of intense algal blooms. During these periods, pH levels infrequently meet applicable ODEQ and California North Coast Basin Plan water quality objectives (see Table 3.2-3 and Table 3.2-4), and adversely affect beneficial uses.

Several ongoing resource management actions represent reasonably foreseeable actions within the period of analysis that may affect pH. Although initially resulting in increased nutrient release, the ongoing Williamson River Delta Project and Wood River Wetland Restoration are expected to eventually reduce nutrient inputs to Upper Klamath Lake which may decrease algal bloom populations and rates of photosynthesis, correspondingly decreasing observed pH maximums in the lake and its tributaries. Additional resource management actions such as floodplain rehabilitation, riparian vegetation planting, and purchase of conservation easements/land related to nutrients are currently ongoing in the Upper Klamath Basin (see Section 2.3.1) and are expected to continue to improve long-term pH in the Upper Klamath Lake. This may indirectly decrease pH maximums in the Hydroelectric Reach. These resource management actions are discussed again with respect to water quality effects under the KBRA (see Section 3.2.4.3, Full Facilities Removal of Four Dams - KBRA).

In Oregon, implementation of TMDL measures focused on pH in the Upper Klamath Lake Drainage TMDL and WQMP and those in the draft Upper Klamath River and Lost River Sub-basins TMDL and WQMP (see Section 3.2.2.4) include decreased loading of total phosphorous as the primary method for decreasing pH in Upper Klamath and Agency lakes and in the Sprague River. While the California Klamath River TMDLs do not include specific allocations or targets for pH, load allocations and targets for TN and TP assigned to the KHP are designed to limit algal photosynthesis, which will decrease maximum pH levels and daily variability in the Hydroelectric Reach. The California Lower Lost River TMDLs also include pH allocations.

The Oregon and California TMDLs in the Upper Klamath Basin are designed to achieve water quality objectives; however, the timeframes for achieving pH objectives will depend on the measures taken to improve water quality conditions, especially reductions in nutrients. To consistently support beneficial uses, pH cannot be below 6.5 units or above 9.0 units in Oregon (see Table 3.2-3) and cannot be depressed below 7.0 units nor raised above 8.5 units in California upstream or downstream of Iron Gate Dam (see Table 3.2-4). The pH in the reach from Link River Dam to just upstream of J.C. Boyle Reservoir, and to the Oregon-California state line in the Hydroelectric Reach, would meet water quality objectives for Oregon. Similarly, in California from the state line to Iron Gate Dam, pH is expected to trend toward achievement of water quality objectives given full attainment of the TMDLs within the period of analysis (NCRWQCB 2010a). Full attainment could require decades to achieve.

Anticipated climate change effects on pH include earlier, longer, and more intense algal blooms (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections), which may increase pH maximums due to higher overall rates of photosynthesis during summer months. The anticipated increases in pH due to climate change would also occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Upper Klamath Basin; however, the magnitude of the opposition is unknown.

**Existing seasonal fluctuations in pH occurring during periods of intense algal blooms in the Hydroelectric Reach are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly improve pH. Continued impoundment of water at the Four Facilities under the No Action/No Project Alternative would result in no change from existing conditions.**

#### Lower Klamath Basin

*Continued impoundment of water at the Four Facilities could result in long-term seasonal and daily variability in pH in the Klamath River downstream of Iron Gate Dam.* Under existing conditions, pH during late-summer and early-fall months (August–September) in the Klamath River downstream of Iron Gate Dam ranges from just above neutral to greater than 9, with large (0.5–1.5 pH units) daily fluctuations occurring in the lower river during periods of high photosynthesis (see Section 3.2.3.6). In California, to consistently support beneficial uses in the Klamath, pH cannot be depressed below 7.0 units nor raised above 8.5 units (see Table 3.2-4).

While the California Klamath River TMDLs do not include specific allocations or targets for pH, load allocations and targets for TN and TP assigned to the KHP are designed to limit algal photosynthesis, which will decrease maximum pH levels and daily variability in the Klamath River downstream of Iron Gate Dam.

The timeframes for achieving pH objectives will depend on the measures taken to improve water quality conditions, especially reductions in nutrients. The Klamath TMDL model (see Appendix D) indicates that under the No Action/No Project

Alternative (similar to TMDL T4BSRN scenario) pH in the reach from Seiad Valley (RM 129.4) to downstream of the mainstem confluence with Indian Creek (RM 108) would meet water quality objectives. While model results indicate that daily maximum values in some stretches of the Klamath River downstream of Iron Gate Dam may not meet the Basin Plan water quality objective of 8.5 pH units (see Table 3.2-4), within the resolution of the Klamath TMDL model these potentially occasional exceedances of the pH objective would not be expected to substantially adversely affect beneficial uses. The Hoopa Valley Tribe water quality objective for pH (7.0–8.5) (see Table 3.2-6) is met at the location that it is applicable ( $\approx$ RM 45–6) (NCRWQCB 2010a). Therefore, pH under the No Action/No Project Alternative would meet pH water quality objectives for California within the period of analysis due to full attainment of the California TMDLs (NCRWQCB 2010a). It is anticipated that full attainment of the TMDLs would require decades to achieve.

Anticipated climate change effects on pH include earlier, longer, and more intense algal blooms (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections), which may increase pH maximums due to higher overall rates of photosynthesis during summer months. The anticipated increases in pH due to climate change would also occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Lower Klamath Basin; however, the magnitude of the opposition is unknown.

**Existing seasonal fluctuations in pH downstream of Iron Gate Dam, which occur during periods of intense algal blooms in the upstream reservoirs, are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly improve pH. Continued impoundment of water at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### **3.2.4.3.1.6 Chlorophyll-a and Algal Toxins**

##### Upper Klamath Basin

*Continued impoundment of water at the Four Facilities could support long-term growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa*, resulting in high seasonal concentrations of chlorophyll-a and algal toxins in the Hydroelectric Reach.* Under existing conditions, chlorophyll-a samples during summer and fall in Upper Klamath Lake and the reservoirs at the Four Facilities exhibit annual mean values  $>10$   $\mu\text{g/L}$  (measured May through October) with the highest values ( $> 100$   $\text{mg/L}$ ) occurring in surface waters during late summer periods of intense algal blooms (see Section 3.2.3.1). High ( $>8$   $\mu\text{g/L}$ ) seasonal levels of algal toxins (microcystin) are linked to intense blue-green algae blooms and exceed applicable ODEQ water quality objectives for toxic substances (see Table 3.2-3) and the North Coast Basin Plan water quality objectives for toxicity (see Table 3.2-4). This adversely affects beneficial uses, particularly the human health water contact recreational use (REC-1) and the cultural use (CUL).

As with other water quality parameters analyzed in this EIS/EIR (i.e., water temperature, sediment, nutrients, dissolved oxygen, pH), several ongoing resource management actions represent reasonably foreseeable actions within the period of analysis that may affect algal toxins and chlorophyll-*a* concentrations in the Upper Klamath Basin. The ongoing Williamson River Delta Project and Wood River Wetland Restoration are intended to eventually reduce nutrient inputs to Upper Klamath Lake, which may help decrease the incidence of toxic cyanobacterial algal blooms and high chlorophyll-*a* levels and algal toxins in Upper Klamath Lake and reduce those transported downstream to the Hydroelectric Reach. Additional resource management actions such as floodplain rehabilitation, riparian vegetation planting, and purchase of conservation easements/land related to nutrients are ongoing in the Upper Klamath Basin (see Section 2.3.1) and are expected to continue to decrease long-term levels of algal toxins and chlorophyll-*a* in Upper Klamath Lake. This may slightly decrease concentrations in the Hydroelectric Reach. These resource management actions are discussed again with respect to water quality effects under the KBRA (see Section 3.2.4.3, Full Facilities Removal of Four Dams - KBRA).

In Oregon, implementation of measures related to chlorophyll-*a* and algal toxins in the Upper Klamath Lake Drainage TMDL and WQMP and those in the Upper Klamath River and Lost River Sub-basins TMDL and WQMP (see Section 3.2.2.4) include decreased loading of TP as the primary method for decreasing the magnitude of algal productivity (blooms) affecting the high rates of photosynthesis and the related water quality problems (e.g., pH, dissolved oxygen) in the Sprague River, Upper Klamath and Agency lakes, and the Keno Reach. Decreases in upstream algal blooms would result in corresponding decreases in chlorophyll-*a* concentrations and, for toxin-producing algal species, levels of microcystin in the Hydroelectric Reach.

Additionally, the Oregon and California TMDLs include specific load allocations for TN and TP upstream of the Klamath Hydropower Facilities (see Section 3.2.2.4), which are intended to eventually limit the extensive algal blooms in Copco 1 and Iron Gate Reservoirs and thus decrease chlorophyll-*a* and algal toxin levels toward the TMDL targets of 10 µg/L chlorophyll-*a* (growing season average), *M. aeruginosa* cell density ≤20,000 cells/L, and microcystin toxin <4 µg/L (see Table 3.2-10). Full attainment of the measures in the Oregon and California TMDLs would result in waters meeting water quality standards; however, the timeframes for achieving water quality objectives with respect to algal toxins and chlorophyll-*a* will depend on the measures taken to improve water quality conditions. This would require decades to achieve and it is highly dependent on improvements in nutrients in the upstream reach from Link River Dam to J.C. Boyle Dam (particularly Keno Impoundment including Lake Ewauna).

Anticipated climate change effects include earlier, longer, and more intense algal blooms (Barr et al. 2010) (see Section 3.10.3.1, Existing Conditions – Climate Change Projections), which may increase algal toxin and chlorophyll-*a* concentrations due to higher overall rates of photosynthesis during summer months. The anticipated effects of climate change would also occur over a timescale of decades and may slightly offset

improvements expected from successful TMDL implementation throughout the Upper Klamath Basin.

**Existing seasonal blooms of toxin-producing nuisance algal species and corresponding levels of chlorophyll-*a* and algal toxins in the Hydroelectric Reach are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly decrease chlorophyll-*a* and algal toxins. Continued impoundment of water at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### Lower Klamath Basin

*Continued impoundment of water at the Four Facilities could support long-term growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa*, resulting in high seasonal concentrations of chlorophyll-*a* and algal toxins (e.g., microcystin) transported into the Klamath River from downstream of Iron Gate Dam to the Klamath Estuary, and potentially the marine nearshore environment.* Under existing conditions, chlorophyll-*a* concentrations during summer through fall in the Klamath River downstream of Iron Gate Dam are lower than those in Upper Klamath Lake and the KHP reservoirs due to interception of algae by the KHP dams. However, concentrations are variable by location and increase as a result of periodic seasonal (i.e., summer, fall) in-reservoir algal blooms that are transported into the lower river (see Section 3.2.3.7). These algal blooms can be toxic and can exceed numeric thresholds for microcystin (8 µg/L) posing a human health risk and substantially adversely affecting recreational beneficial uses, particularly water contact (REC-1) and CUL uses. Although the CUL beneficial use has only been approved for the Hoopa Valley Tribe thus far (see Table 3.2-2), known or perceived risks of exposure to degraded water quality conditions due to algal toxins during ceremonial bathing and traditional cultural activities have resulted in impairment of this beneficial use for the Karuk Tribe as well (see also Section 3.12.3.3). Additionally, Hoopa Valley Tribe water quality objectives for toxigenic cyanobacteria species and cyanobacterial scums are not consistently met during summer months (see Section 3.2.3.7 and Appendix C for more detail). Microcystin can also bioaccumulate in aquatic biota, including filter feeders and fish. A discussion of algal toxins as related to fish health is presented in Section 3.3.3.2, Physical Habitat Descriptions - Water Quality - Algal Toxins. Lastly, there is emerging evidence that cyanotoxins flushing from coastal rivers into Monterey Bay, California were responsible for numerous sea otter deaths in 2007 (Miller et al. 2010). While it is not known if conditions in Monterey Bay are similar to those in the Klamath River marine nearshore environment, there may be potential for microcystin to adversely impact marine organisms under the No Action/No Project Alternative.

The California Klamath River TMDLs include specific load allocations for TN and TP upstream of the Four Facilities to offset the reduced nutrient assimilative capacity in the reservoirs (see Section 3.2.2.4, Klamath River TMDLs); the decreased nutrient loads would limit algal growth and decrease chlorophyll-*a* and algal toxin levels in the KHP reservoirs toward the TMDL targets of 10 µg/L chlorophyll-*a* (growing season average), *M. aeruginosa* cell density 20,000 cells/L, and microcystin toxin <4 µg/L (NCRWQCB

2010a). This would subsequently decrease levels of chlorophyll-*a* and algal toxins transported into the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment. This would require decades to achieve and it is highly dependent on upstream nutrient improvements.

As with the Upper Klamath Basin, anticipated effects of climate change on chlorophyll-*a* and algal toxins would occur over a timescale of decades and would act in opposition to improvements expected from successful TMDL implementation throughout the Lower Klamath Basin; however, the magnitude of the opposition is unknown.

**Existing transport of seasonal blooms of toxin-producing nuisance algal species, chlorophyll-*a*, and algal toxins into the Klamath River from downstream of Iron Gate Dam to the Klamath Estuary are adverse. Transport to the marine nearshore environment is potentially adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly decrease chlorophyll-*a* and algal toxins. Continued impoundment of water at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

#### **3.2.4.3.1.7 Inorganic and Organic Contaminants**

##### Upper Klamath Basin

##### *Freshwater Aquatic Life Toxicity and/or Bioaccumulation*

Effects of the No Action/No Project Alternative on potential inorganic and organic contaminants in Upper Klamath Lake and its major tributaries cannot be assessed directly due to a lack of information for these parameters (see Section 3.2.3.8, Upper Klamath Lake – Inorganic and Organic Contaminants). However, under the No Action/No Project Alternative, ongoing resource management actions (i.e., Williamson River Delta Project, Agency Lake and Barnes Ranches Project) may reduce transport of inorganic and organic contaminants into Upper Klamath Lake and downstream reaches. While Oregon and California TMDLs do not address inorganic and organic contaminants, under the No Action/No Project Alternative TMDL implementation may indirectly limit transport of inorganic and organic contaminants through mechanisms expected to reduce suspended sediments and nutrients.

Low levels of organic and inorganic contaminants have been identified in the sediment deposits trapped behind the dams in the Hydroelectric Reach (see Section 3.2.3.8). Benthic uptake and subsequent transfer through the food web is one potential pathway of contaminant exposure for aquatic organisms in the Hydroelectric Reach; exposure to water column contaminants is also a possible pathway. Sediment contaminants influenced by pH or dissolved oxygen, such as methylmercury, may flux into the water column via the low redox conditions supported by reservoir stratification and seasonal anoxia. Human exposure to methylmercury, inorganic contaminants (e.g., arsenic), and organic contaminants (e.g., pesticides, PCBs, PAHs) associated with reservoir sediments may occur through consumption of contaminated reservoir fish or shellfish. Potential effects of the No Action/No Project Alternative are further discussed below using available water column, sediment, and aquatic biota contaminant data.

*Continued impoundment of water at the Four Facilities and associated interception and retention of sediments behind the dams could result in long-term low-level exposure to inorganic and organic contaminants for freshwater aquatic species in the Hydroelectric Reach.*

Water Column Contaminants. Water quality data collected during in Copco 1 and Iron Gate reservoirs during 2001–2005 under the SWAMP indicate that concentrations of numerous inorganic compounds (i.e., arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) and organic compounds (i.e., pesticides, PCBs, phenols) were in compliance with water quality objectives (NCRWQCB 2008; see Section 3.2.3.1 and Appendix C, Section C.7.1.1 for more detail).

Sediment Contaminants. Two studies provide data for the evaluation of sediment toxicity and bioaccumulation potential under the No Action/No Project Alternative:

- Sediment chemistry data collected during 2004–2005 from 26 cores in J.C. Boyle, Copco 1, and Iron Gate Reservoirs (Shannon & Wilson, Inc. 2006). The 2004–2005 sediment chemistry data indicate generally low levels of metals, pesticides, chlorinated acid herbicides, PCBs, VOCs, SVOCs, cyanide, and dioxins (Shannon & Wilson, Inc. 2006; see Section 3.2.3.1).
- Sediment chemistry and toxicity data collected during 2009–2010 as part of the Secretarial Determination process, including samples from J.C. Boyle, Copco 1, and Iron Gate Reservoirs, and the Klamath Estuary (Department of the Interior 2010a and exposure “Scenario 1” in CDM [2011]). Based on comparison to appropriate freshwater sediment screening levels (see Section 3.2.3.8 and Appendix C for more detail), no exceedances of detected chemicals were found in sediment samples, indicating a low risk of toxicity to freshwater sediment-dwelling organisms in the Hydroelectric Reach under the No Action/No Project Alternative. Based on additional lines of evidence (i.e., toxicity tests, calculation of TEQs), there does not appear to be a substantial sediment toxicity concern for national benchmark benthic indicator species from Copco 1 and Iron Gate Reservoir under the No Action/No Project Alternative. The exception to this occurred in a single sample from J.C. Boyle Reservoir, where survival of the benthic amphipod *Hyalella azteca* indicated a moderate potential for toxicity. TEQs for dioxin, furan, and dioxin-like PCBs in reservoir and estuary sediment samples were within the range of local background values and suggest a limited potential for adverse effects for fish exposed to reservoir sediments under the No Action/No Project Alternative (CDM 2011). Lastly, sediment samples were also evaluated for levels of known bioaccumulative compounds; ODEQ bioaccumulation sediment screening values were not exceeded in J.C. Boyle Reservoir sediments, with the exception of a small number of samples for DDTs (i.e., 4,4'-DDT, 4,4'-DDD, 4,4'-DDE) (CDM 2011).

Contaminants in Aquatic Biota. The potential for bioaccumulation under the No Action/No Project Alternative can also be evaluated using fish tissue concentrations. Two studies provide data for the evaluation of bioaccumulation potential in freshwater fish:

- PacifiCorp (2004c) conducted a screening-level analysis looking at metals (i.e., arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc), organochlorine pesticides, and PCBs in the Hydroelectric Reach and Upper Klamath Lake. The PacifiCorp data suggest that, with two exceptions, fish in the KHP reservoirs do not appear to be exposed to levels of contaminants that may adversely affect beneficial uses or that are toxic or detrimental to aquatic life. The exceptions include exceedances of the total mercury wildlife screening level (0.00227 ug/g) for all tissue samples in Keno, J.C. Boyle, Copco 1, and Iron Gate Reservoirs (see Appendix C for more detail), suggesting that localized mercury methylation may be occurring during periods of stratification and anoxia in the reservoirs (see Table 3.2-5). Another exception is that exceedances of recommended wildlife screening levels for total DDTs based on p,p'-DDE found in fish tissue samples from Upper Klamath Lake, the Keno Impoundment, J.C. Boyle Reservoir, and Copco 1 Reservoir (see Section 3.2.3.1, Inorganic and Organic Contaminants – Hydroelectric Reach), may suggest a possible broader-scale bioaccumulation effect (see Appendix C, Table C-7).
- Results from the 2009-2010 Secretarial Determination fish tissue sampling (exposure “Scenario 1” in CDM [2011]) indicate that mercury is present in fish tissue at levels with potential to cause minor or limited adverse effects to fish; multiple other chemicals are not present at such levels, or they are present but do not possess tissue-based TRVs for comparison (see Section 3.2.3.8 and Appendix C for more detail). Fish tissue results were also below dioxin, furan, and dioxin-like PCB TEQs, indicating no adverse effect (CDM 2011). Combined with the sediment contaminant data (see above), inorganic and organic contaminants are present in reservoir sediments at levels that have the potential to cause minor or limited adverse effects (i.e., toxicity or bioaccumulation) to freshwater aquatic species (Figure 3.2-2).

Exposure Scenario		Freshwater biota	Marine biota	Terrestrial biota	Humans
Scenario 1 (No Action Alternative)	Long-term exposure to reservoir sediments	●			●
Scenario 2 (Proposed Action)	Short-term exposure to sediments flushed downstream	●	●		
Scenario 3 (Proposed Action)	Long-term exposure to exposed reservoir terrace and or river bank deposits			● <sup>(1)</sup>	● <sup>(1)</sup>
Scenario 4 (Proposed Action)	Long-term exposure to river bed deposits	●			●
Scenario 5 (Proposed Action)	Long-term exposure to marine / near shore deposits		●		

●	No adverse effects based on lines of evidence
●	One or more chemicals present, but at levels unlikely to cause adverse effects based on the lines of evidence
●	One or more chemicals present at levels with potential to cause minor or limited adverse effects based on the lines of evidence
●	At least one chemical detected at a level with potential for significant adverse effects based on the lines of evidence
	This exposure pathway is incomplete or unimportant for this receptor group

**Figure 3.2-2. Summary of Anticipated Effects of Inorganic and Organic Contaminants in Klamath Reservoir and Estuary Sediments Under the No Action/No Project Alternative and the Proposed Action. This does not include an evaluation of the physical effects (e.g., dissolved oxygen, suspended sediment). (1): Qualitative evaluation conducted for this exposure scenario. Source: CDM 2011.**

**Existing inorganic and organic contaminant data characterizing reservoir sediments at the Four Facilities indicate that a relatively small number of chemicals (i.e., mercury, DDTs, and possibly dioxin-like chemicals) are present in reservoir sediments at levels that have the potential to cause minor or limited adverse effects (i.e., toxicity or bioaccumulation) to freshwater aquatic species in the Hydroelectric Reach. Continued impoundment of water at the Four Facilities under the No Action/No Project Alternative would result in no change from existing conditions.**

*Continued impoundment of water at the Four Facilities and associated interception and retention of sediments behind the dams could result in long-term low-level exposure to inorganic and organic contaminants in the Hydroelectric Reach for humans through the consumption of resident fish tissue. Human health exposure to inorganic or organic chemicals in reservoir sediments under the No Action/No Project Alternative is through consumption of resident fish. Under the No Action/No Project Alternative, direct human exposure to sediments is not considered a reasonable exposure pathway. Three studies provide data for the evaluation of human health exposure through consumption of resident fish:*

- Results from California SWAMP fish tissue sampling in Copco 1 and Iron Gate Reservoirs indicate mercury tissue concentrations of 0.31 and 0.33 ng/g wet weight, respectively (Davis et al. 2010). These data are greater than the advisory tissue levels for 3 and 2 servings per week (70 and 150 ng/g wet weight, respectively) and the fish contaminant goal (220 ng/g wet weight) (see Section 3.2.3.1), suggesting low-level bioaccumulation potential in the two largest KHP reservoirs.
- PacifiCorp (2004c) reported that, in general, fish in the reservoirs at the Four Facilities are not exposed to levels of contaminants that may adversely affect human health via fish consumption. Exceptions to this include arsenic and total PCBs, which may equal or exceed the toxicity screening level for subsistence fishers (see Section 3.2.3.1; PacifiCorp 2004c). Additionally, a subsequent review of the PacifiCorp data and conversion to wet weight values found that mercury levels exceeded the screening level for subsistence fishers (0.049 ug/g) for samples from Keno, J.C. Boyle, Copco 1, and Iron Gate Reservoirs, and exceeded the screening level for recreational fishers (0.4 ug/g) for samples from Copco 1 and Iron Gate Reservoirs (see Appendix C for more detail).
- Results from the 2010 Secretarial Determination fish tissue sampling indicate that a relatively small number of chemicals are present in fish tissue at levels with potential to cause minor or limited adverse effects to humans through fish consumption (Figure 3.2-2). These include arsenic, total PCBs, and dioxins in yellow perch at J.C. Boyle, Copco 1, and Iron Gate reservoirs (CDM 2011). In bullhead, the same chemicals are present, with the addition of mercury for Copco 1 Reservoir (see Section 3.2.3.8 and Appendix C for more details).

In summary, existing fish tissue, bioassay, and sediment chemistry data indicate that continued retention of sediments behind the KHP dams under the No Action/No Project Alternative may result in concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses or are toxic to humans in the Hydroelectric Reach. This includes possible exposure to low-level bioaccumulation of arsenic (which may be naturally elevated in the Upper Klamath Basin [see Section 3.2.2.8, Inorganic and Organic Contaminants]) and mercury in fish residing in the lacustrine environment of the Keno Impoundment (including Lake Ewauna) and J.C. Boyle, Iron Gate, and Copco 1 Reservoirs.

**Existing inorganic and organic contaminant data characterizing fish tissue in the reservoirs at the Four Facilities indicate that a relatively small number of chemicals (i.e., mercury, arsenic, total PCBs, and dioxins) are present at levels that have the potential to cause minor or limited adverse effects to humans through fish consumption in the Hydroelectric Reach. Continued impoundment of water at the Four Facilities under the *No Action/No Project Alternative* would result in no change from existing conditions.**

### Lower Klamath Basin

With the possible exception of compounds (i.e., mercury) that can be released (exported) from reservoir bottom waters under seasonally anoxic conditions, continued impoundment of water at the Four Facilities is not anticipated to result in increased exposure to inorganic and organic contaminants for freshwater aquatic species in the Klamath River downstream of Iron Gate Dam. This is because contaminants that may be present in reservoir sediments at the Four Facilities would remain in place under the No Action/No Project Alternative. There is currently insufficient information to assess whether the No Action/No Project Alternative would expose downstream aquatic biota to methylmercury released from bottom waters. Bioaccumulation of algal toxins (i.e., microcystin) has been documented in fish and mussel tissue in the Klamath River downstream of Iron Gate Dam (Kann et al. 2010) and is discussed further in Section 3.3, Aquatic Resources. Potential for the Proposed Action and alternatives to affect production and toxicity of algal toxins is discussed in Section 3.4, Algae.

#### **3.2.4.3.2 Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

The Full Facilities Removal of Four Dams (Proposed Action) is the removal of four major dams in the Klamath Hydroelectric Project (J.C. Boyle, Copco 1, Copco 2, and Iron Gate) along with the ancillary facilities of each installation in a 20-month period which includes an 8-month period of site preparation and partial drawdown at Copco 1 and a 12-month period for full drawdown and removal of facilities. This includes the entire dam, the powerhouses, spillways, and other infrastructure associated with the power generating facilities, as well as the transfer of the Keno Dam facilities to the DOI and the implementation of the KBRA. Removal of the Four Facilities would not affect water quality in the following reaches in the Upper Klamath Basin: Wood, Williamson, and Sprague Rivers, Upper Klamath Lake, and Link River to the upstream end of J.C. Boyle Reservoir. In the Hydroelectric Reach of the Upper Klamath Basin, removal of the Four Facilities would result in the release of sediments currently trapped behind the dams. This release would have short-term (<2 years following dam removal) effects on suspended sediments, dissolved oxygen, nutrients, and inorganic and organic contaminant concentrations in the Klamath River. Under the Proposed Action, interception and retention of sediments behind the dams at the Four Facilities would no longer occur; this would have long-term (2–50 years following dam removal) effects on suspended sediments. Additionally, elimination of the lacustrine environment of the reservoirs under the Proposed Action would have long-term effects on water temperature, dissolved oxygen, nutrients, pH, algal toxins and chlorophyll-*a* in the river. The following sections provide detail regarding the anticipated effects. KBRA under the Proposed Action is addressed at a programmatic level in the last subsection of the Proposed Action.

#### **3.2.4.3.2.1 Water Temperature**

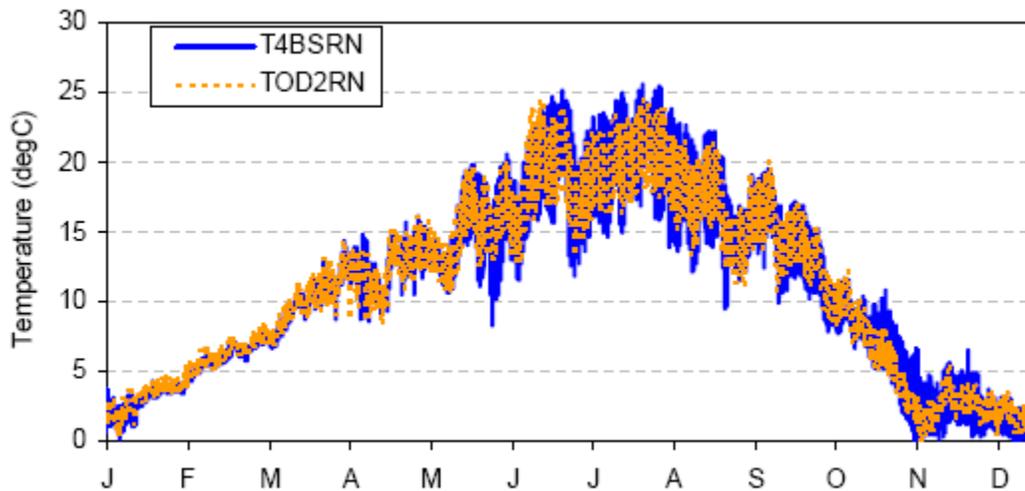
##### Upper Klamath Basin

*Removal of the Four Facilities under the Proposed Action and elimination of hydropower peaking operations at J.C. Boyle Powerhouse could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) alterations in daily water temperatures and fluctuations in the J.C. Boyle bypass and peaking reaches. Klamath TMDL model (see Appendix D) results indicate that under the*

Proposed Action (similar to the TMDL TOD2RN scenario, which includes Oregon TMDL allocations), water temperatures in the Hydroelectric Reach immediately downstream of J.C. Boyle Dam would be similar to those under the No Action/No Project Alternative, but there would be relatively *higher* daily fluctuations during June through September (similar to the TMDL T4BSRN scenario) due to the absence of the thermal mass in J.C. Boyle Reservoir, which tends to moderate daily temperature fluctuations immediately downstream of the dam under existing conditions (NCRWQCB 2010a). Higher daily fluctuations would also occur in the J.C. Boyle bypass reach because it would no longer be dominated by cold groundwater inputs at a relatively constant temperature of 11–12°C (Kirk et al. 2010, Asarian and Kann 2006a). Water temperatures in this short river reach would increase during summer months, moving it away from support of core coldwater habitat; however, areas adjacent to the coldwater springs in the bypass reach would continue to serve as thermal refugia for aquatic species because the springs themselves would not be affected by the Proposed Action. In the J.C. Boyle peaking reach model results indicate that water temperatures under the Proposed Action would be slightly lower (0.5–1°C [0.9–1.8°F]) than those predicted under the No Action/No Project and would exhibit *lower* daily fluctuation during June through September (NCRWQCB 2010a, Asarian and Kann 2006a). At these locations the relative difference in daily water temperature fluctuations between the Proposed Action and the No Action/No Project Alternative is due to the elimination of peaking operations and the associated large daily temperature swings.

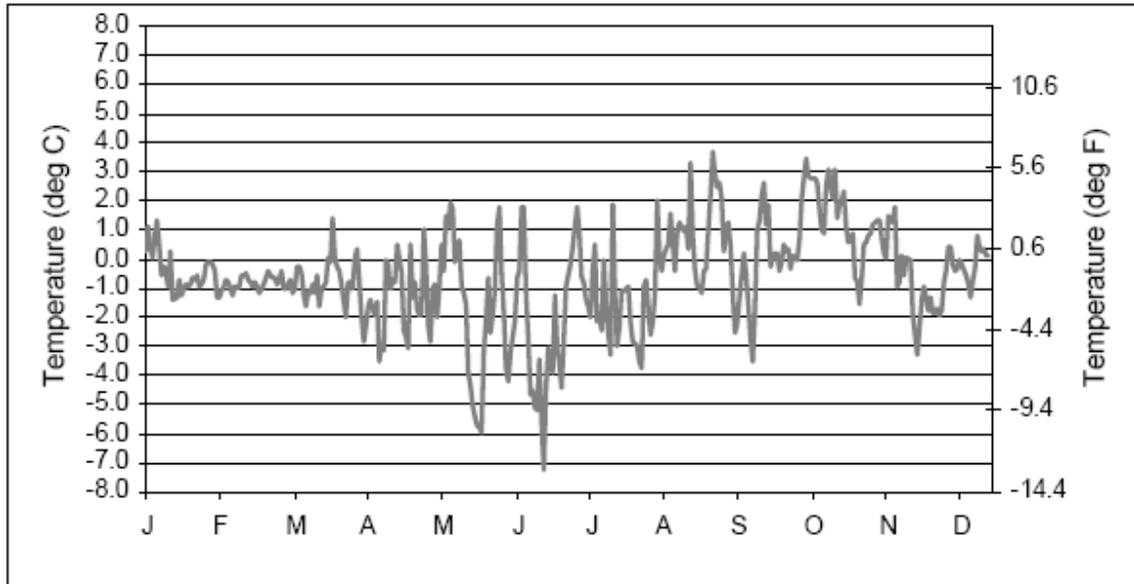
**Under the *Proposed Action*, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in summer/fall water temperatures and daily fluctuations in the J.C. Boyle bypass reach due to the elimination of hydropower peaking operations would be a significant impact. Slight decreases in long-term summer/fall water temperatures and less daily fluctuation in the J.C. Boyle peaking reach would be beneficial.**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in spring water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir. In the Klamath River downstream of the J.C. Boyle bypass and peaking reaches, TMDL model results indicate that water temperatures under the Proposed Action would be slightly lower (0.5–1°C [0.9–1.8°F]) than those predicted under the No Action/No Project and would exhibit *lower* daily fluctuation during June through September (NCRWQCB 2010a, Asarian and Kann 2006a; Figure 3.2-3). Overall, the TMDL model results indicate that June through October riverine water temperatures from J.C. Boyle Reservoir to the Oregon-California state line would meet the Oregon narrative natural conditions criterion that supersedes the numeric objective (i.e., 16°C [60.8°F], see Table 3.2-3) for support of core coldwater habitat.*



**Figure 3.2-3. Predicted Water Temperature at the California-Oregon State Line (RM 208.5) for the Klamath TMDL Scenarios Similar to the Proposed Action (TOD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**

In the California portion of the Hydroelectric Reach, the TMDL model indicates that removal of the Four Facilities under the Proposed Action would eliminate the seasonal temperature shift caused by the Four Facilities in the Hydroelectric Reach such that spring water temperatures would increase and late summer/fall temperatures would decrease. Just downstream of Copco 1 and Copco 2 Reservoirs ( $\approx$ RM 198), this would increase daily maximum temperatures that are currently up to  $7^{\circ}\text{C}$  ( $13^{\circ}\text{F}$ ) lower than modeled natural conditions in spring (May and June) and decrease temperatures that are up to roughly  $4^{\circ}\text{C}$  ( $7^{\circ}\text{F}$ ) greater than modeled natural conditions in late summer/fall (August through October), due to the presence of the reservoirs (Figure 3.2-4) (NCRWQCB 2010a). Water temperature modeling conducted for the Klamath Dam Removal Secretarial Determination Studies provides generally similar results, with RBM10 model results showing a projected shift in the annual temperature cycle that would slightly increase river temperatures in the spring, and decrease temperatures in the late summer/fall in the Hydroelectric Reach under the Proposed Action (Perry et al. 2011). Further discussion of RBM10 results is presented below for the Lower Klamath Basin.



**Figure 3.2-4. Estimated Changes in Daily Maximum Klamath River Water Temperatures at ≈RM 198 due to the Presence of Copco 1 and 2 Reservoirs for the 2000 Calendar Year. Positive Values Represent an Increase above Modeled Natural Conditions. Source: NCRWQCB 2010a.**

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects. Because drawdown of the reservoirs would begin in winter and would be largely complete by March/April of 2020 (i.e., prior to thermal stratification in the reservoirs), the aforementioned water temperature effects of the Proposed Action in the Hydroelectric Reach would occur, either partially or fully, within the first 1 to 2 years following dam removal and would, therefore, also be short-term effects.

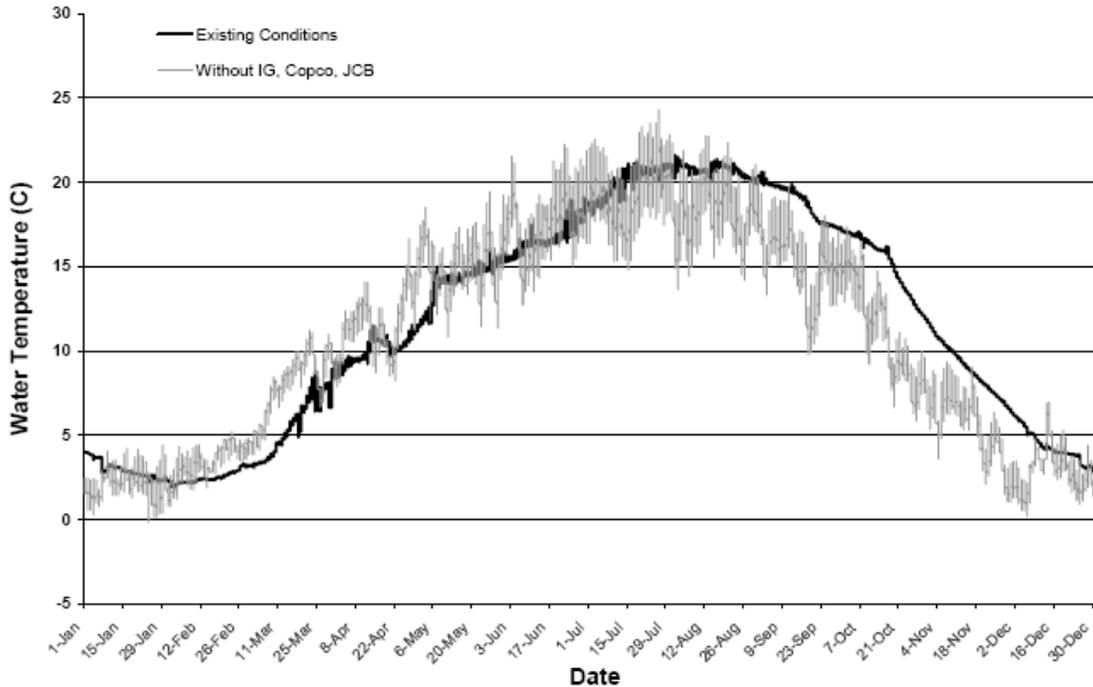
The Klamath TMDL model does not address the potential long-term effects of global climate change on water temperatures in the Klamath Basin (Appendix D). As described for the No Action/No Project Alternative, climate change is expected to increase summer and fall water temperatures in the Klamath Basin on the order of 1–3°C (1.8–5.4°F) (Bartholow 2005, Perry et al. 2011). The Proposed Action would decrease long-term late summer/fall water temperatures and would therefore increase the likelihood that beneficial uses would be supported under climate change.

**Under the *Proposed Action*, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in springtime water temperatures would be potentially significant while decreases in late summer/fall water temperatures would be beneficial.**

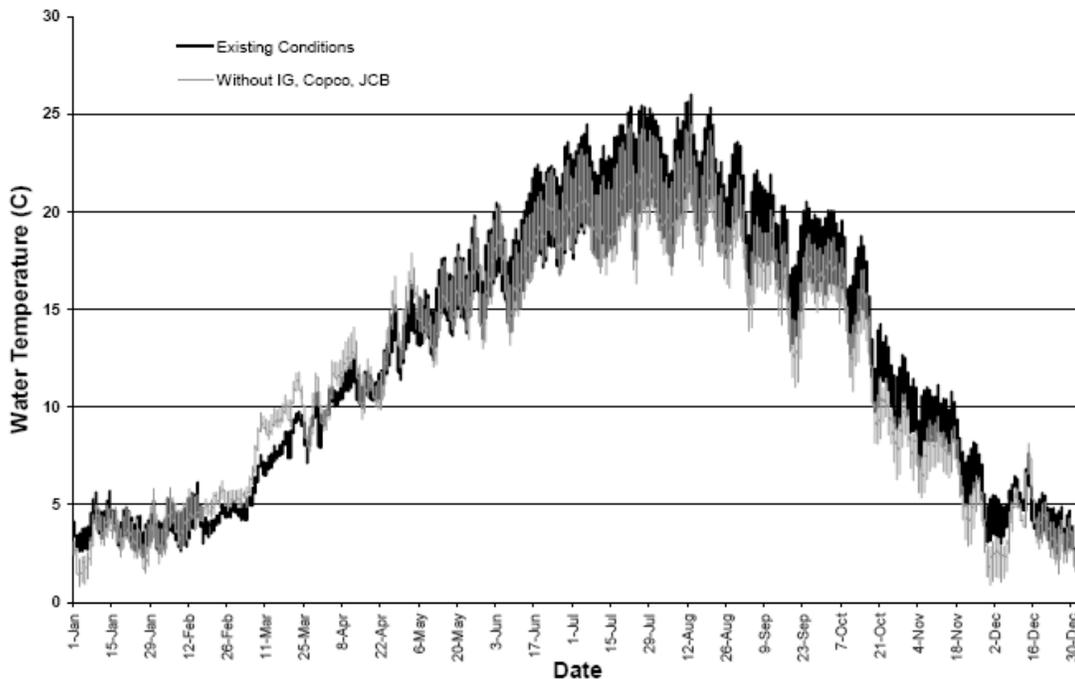
### Lower Klamath Basin

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River.* Water temperature modeling results are available for the Lower Klamath Basin from three separate modeling efforts: the PacifiCorp relicensing efforts (KRWQM; see Appendix D); development of the California Klamath River TMDLs (see Appendix D); and, water temperature modeling conducted for the Secretarial Determination studies (RBM10; see Appendix D). KRWQM results comparing the current condition (all KHP dams in place) to four without-project scenarios (i.e., no KHP dams; without Iron Gate Dam; without Copco 1, Copco 2, and Iron Gate; and without J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams) for 2001–2004 indicate that the reservoirs create a temporal shift by releasing generally cooler water from mid-January to April, variably cooler or warmer water from April through early August, and warmer water from August through November (PacifiCorp 2004a, Dunsmoor and Huntington 2006). Just downstream of Iron Gate Dam (RM 190.1), this translates to a 1–2.5°C (1.8–4.5°F) cooling during spring and a 2–10°C (3.6–18°F) warming during summer and fall (Figure 3.2-5). Immediately upstream of the confluence with the Scott River (RM 143.9), the difference between existing conditions and without-project scenarios indicates a lesser, albeit still measurable, warming of 2–5°C (3.6–9°F) for most of October and November (Figure 3.2-6). Because patterns in reservoir thermal structure for Iron Gate and Copco 1 indicate that stratification generally commences in April and ends in November, the effect of reservoir thermal regime on downstream water temperatures appears to be cooling during non-stratified periods and warming during stratified periods. The cooling effect in spring is potentially beneficial to rearing salmonids by reducing stress and disease for late outmigrants. The warming effect, which can be stressful to rearing salmonids, lasts for the majority of late summer and fall months and is of larger magnitude (PacifiCorp 2004a).

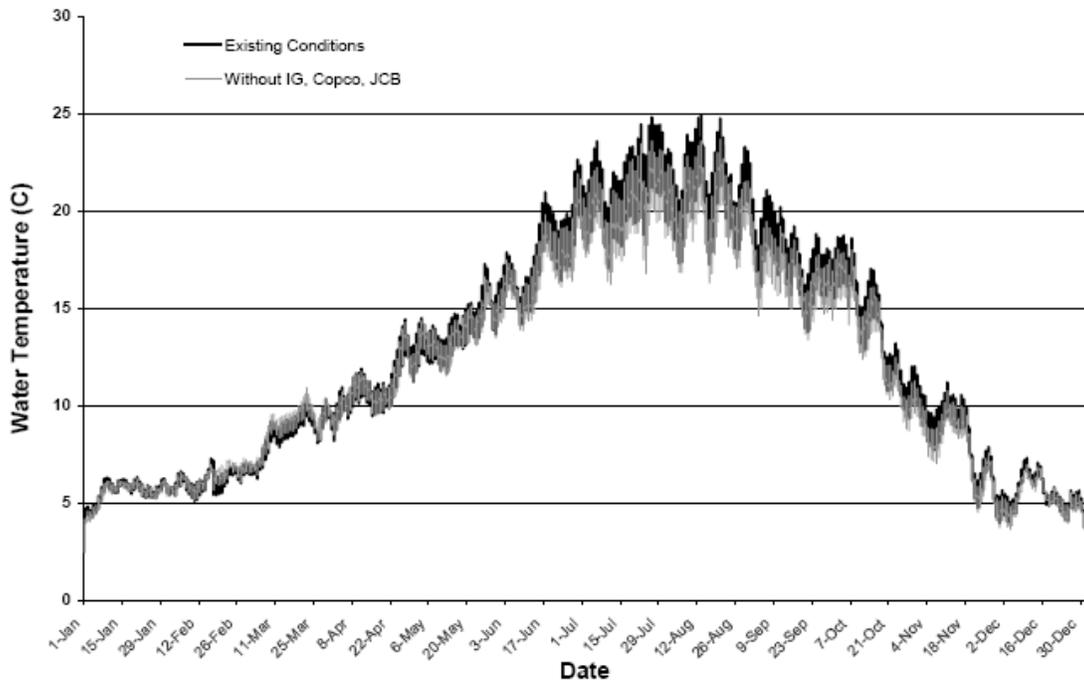
Reservoir thermal regimes also act to reduce the magnitude of daily temperature fluctuations in the reservoir reaches and the riverine reaches immediately downstream of Iron Gate Reservoir (RM 190.1; see Figure 3.2-5) (Deas and Orlob 1999, PacifiCorp 2004b). As with the seasonal temperature effect, the influence on daily temperature fluctuations is generally absent farther downstream, at the confluence with the Scott River (RM 143.9; see Figure 3.2-6). The KRWQM indicates that the temperature influence of the Hydroelectric Reach is mostly ameliorated by RM 66 at the confluence with the Salmon River (see Figure 3.2-7).



**Figure 3.2-5. Simulated Hourly Water Temperature Downstream of Iron Gate Dam (RM 190.1) Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle (JCB), Copco 1, Copco 2, and Iron Gate (IG) Dams. Source: PacifiCorp 2004a.**



**Figure 3.2-6. Simulated Hourly Water Temperature Immediately Upstream of the Scott River Confluence (RM 143.9) Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle (JCB), Copco 1, Copco 2, and Iron Gate (IG) Dams. Source: PacifiCorp 2004a.**



**Figure 3.2-7. Simulated Hourly Water Temperature Downstream of the Salmon River Confluence ( $\approx$ RM 66) Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle (JCB), Copco 1, Copco 2, and Iron Gate (IG) Dams. Source: PacifiCorp 2004a.**

In agreement with KRWQM results, Klamath TMDL model (see Appendix D) results also indicate that under the Proposed Action (similar to the TMDL TCD2RN scenario), water temperature in the Klamath River downstream of Iron Gate Dam (RM 190.1) would be 2–10°C (3.6–18°F) lower during August through November and 2–5°C (3.6–9°F) higher during January through March than those under the No Action/No Project (similar to the TMDL T4BSRN scenario), due to removal of the large thermal mass created by the reservoirs (NCRWQCB 2010a). The Klamath TMDL model also predicts that daily fluctuations in water temperature at this location during this same period would be greater under the Proposed Action (TCD2RN) than the No Action/No Project Alternative (T4BSRN) as water temperatures would be in equilibrium with (and would reflect) daily fluctuations in ambient air temperatures. As with KRWQM, these impacts would decrease in magnitude with distance downstream of Iron Gate Dam, and they would not be evident by the Salmon River confluence ( $\approx$ RM 66). Therefore, under the Proposed Action, water temperatures would not be directly affected in the lower river downstream of the confluence with the Salmon River, including the Klamath Estuary and the marine nearshore environment.

As part of the Klamath Dam Removal Secretarial Determination studies, the effects of climate change were included in model projections for future water temperatures under the No Action/No Project Alternative and the Proposed Action. RBM10 model results using climate change predictions from five GCMs indicate that future water temperatures

under the Proposed Action (where simulated flows are subject to KBRA flows) would be 1–2.3°C (1.8–4.1°F) warmer than historical temperatures (Perry et al. 2011). This temperature range is slightly lower than that suggested by projecting Bartholow (2005) historical (1962–2001) estimates of 0.05°C (0.09°F) per year, or 2–3°C (3.6–5.4°F) over 50 years. However, within the general uncertainty of climate change projections, results from the two models correspond reasonably well and indicate that water temperatures in the Upper Klamath Basin are expected to increase with the period of analysis on the order of 1–3°C (1.8–5.4°F).

RBM10 results also indicate that, despite warming of water temperatures under climate change, the primary effect of dam removal is still anticipated be the return of approximately 160 miles of the Klamath River, from J.C. Boyle Reservoir (RM 224.7) to the Salmon River (RM 66), to a natural thermal regime (Perry et al. 2011). Model results indicate that the annual temperature cycle downstream of Iron Gate Dam would shift forward in time by approximately 18 days under the Proposed Action, with warmer temperatures in spring and early summer and cooler temperatures in late summer and fall immediately downstream of the dam. Just downstream of Iron Gate Dam, water temperatures under the Proposed Action including climate change would average 2°C greater in May than those under the No Action/No Project Alternative, while during October water temperatures would average 4°C cooler. At the confluence with the Scott River, the differences would be diminished, but there would still be a slight warming (<1 °C) in the spring and cooling (1–2 °C) in the late summer and fall (Perry et al. 2011). Thus, despite the anticipated warming under climate change, water temperature improvements under the Proposed Action would still help to achieve the Oregon and California temperature TMDLs for the mainstem Klamath River.

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects. Because drawdown of the reservoirs would begin in winter and would be largely complete by March/April of 2020 (i.e., prior to reservoir thermal stratification), water temperature effects of the Proposed Action in the Klamath River downstream of Iron Gate Dam would occur, either partially or fully, within the first 1 to 2 years following dam removal and would be a short-term effect as well as a long-term effect.

**Under the Proposed Action, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in spring water temperatures for the reach from Iron Gate Dam to the confluence with the Salmon River would be potentially significant. Decreases in late summer/fall water temperatures would be beneficial. There would be no change from existing conditions on water temperatures for Klamath River downstream of the Salmon River, the Klamath Estuary, and the marine nearshore environment.**

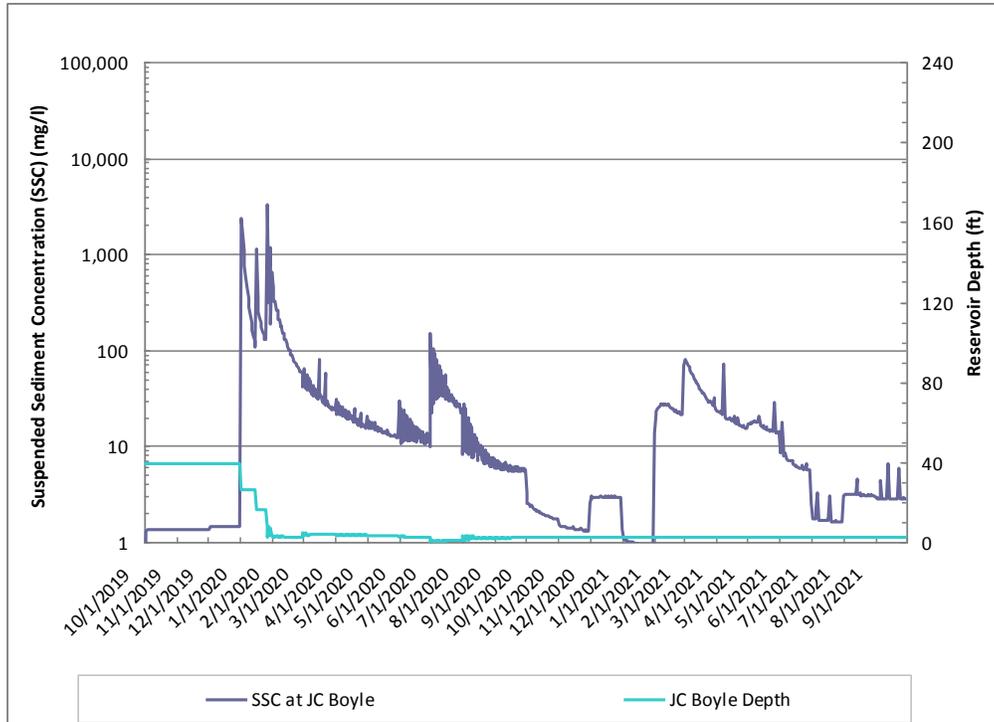
*Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) and/or long-term (2-50 years following dam removal) increases in sediment deposition in the Klamath River or Estuary that could alter morphological characteristics and indirectly affect*

*seasonal water temperatures.* Increased sediment deposition in the estuary under the Proposed Action may decrease the size of the salt wedge, either by increasing the frequency of mouth closure, or by elevating the bottom of the estuary above portions of the tidal range when the mouth is open. Alternately, scouring of current estuarine sediment deposits may occur during the short-term high sediment transport predicted to occur following dam removal, which may sufficiently change morphology as to effect mouth closure, salt wedge formation, and associated seasonal water temperatures. However, because little short-term settling, sedimentation, or scouring is expected to occur in the Klamath River or the estuary as a result of the Proposed Action (see Section 3.11.4.3), and estimates of baseline sediment delivery for the Klamath Basin indicate that long-term sediment delivery rates will not change substantially under the Proposed Action (Stillwater Sciences 2010), **there would be no indirect effect on water temperatures in the Klamath Estuary under the Proposed Action.**

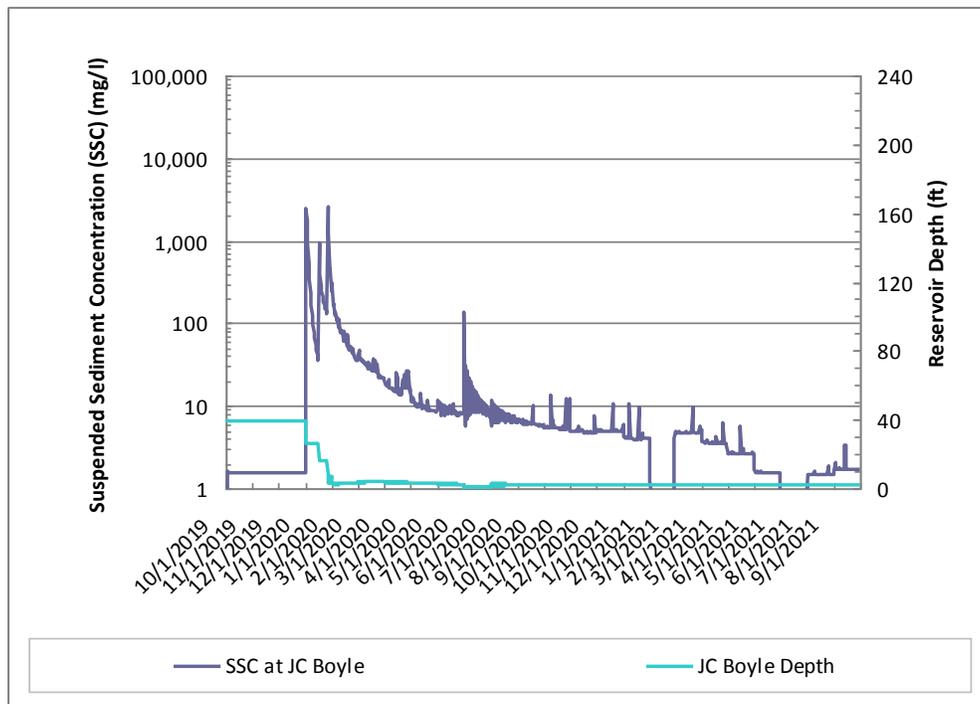
#### **3.2.4.3.2.2 Suspended Sediments**

##### Upper Klamath Basin

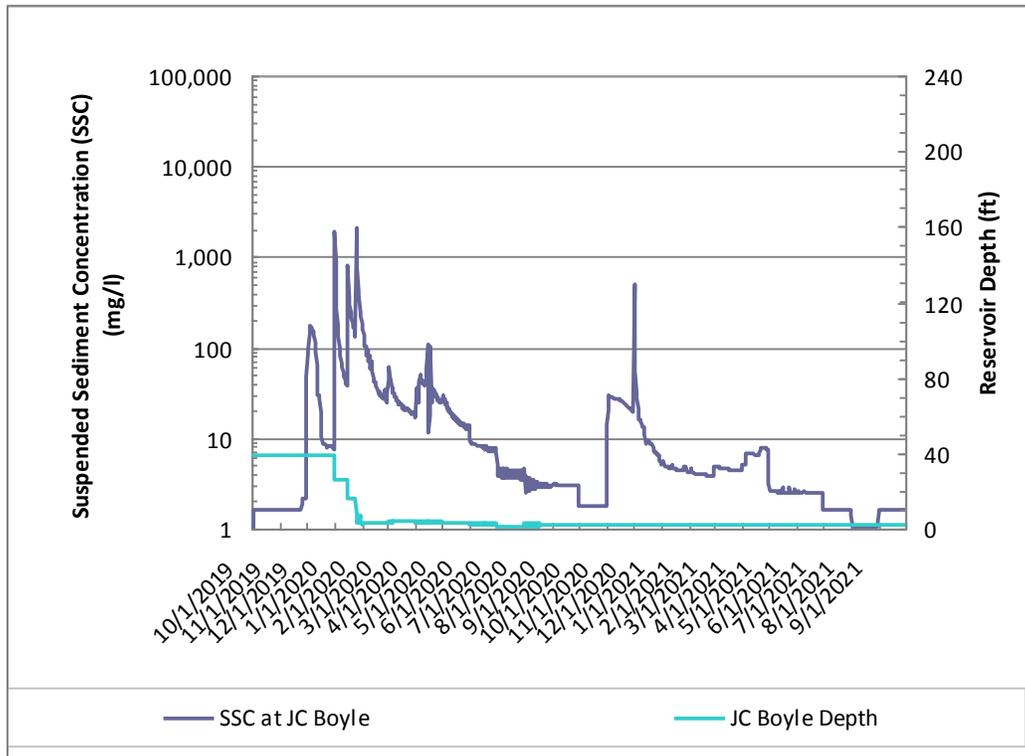
*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam due to the release of sediments currently trapped behind the dams at the Four Facilities.* Results of sediment transport modeling of the impacts of dam removal on suspended sediment in the lower Klamath River indicate high short-term loads immediately downstream of Iron Gate Dam under the Proposed Action (Greimann et al. 2011, Stillwater Sciences 2008). Modeled SSCs downstream of J.C. Boyle Reservoir are similarly high in the short-term, although due to the relatively small volume of the sediment deposits behind J.C. Boyle Dam (i.e., 15 percent of total volume for the Four Facilities), concentrations would be considerably less than those anticipated to occur downstream of Iron Gate Reservoir. Overall, and within the general uncertainty of the model predictions, SSCs at J.C. Boyle Reservoir across the three water year types would have peak values of 2,000–3,000 mg/L and occurring within 1–2 months of reservoir drawdown. Predicted SSCs quickly decrease to less than 100 mg/L for 5–7 months following drawdown, and concentrations less than 10 mg/L for 6–10 months following drawdown (Figures 3.2-8 through 3.2-10). **Under the Proposed Action, the short-term (<2 years following dam removal) increases in SSCs in the Hydroelectric Reach downstream of J.C. Boyle Dam would be a significant impact.**



**Figure 3.2-8. Suspended Sediment Concentrations Modeled at J.C. Boyle Reservoir Under the Proposed Action Assuming Typical Dry Hydrology (WY2001).**



**Figure 3.2-9. Suspended Sediment Concentrations Modeled at J.C. Boyle Reservoir Under the Proposed Action Assuming Median Hydrology (WY1976).**



**Figure 3.2-10. Suspended Sediment Concentrations Modeled at J.C. Boyle Reservoir Under the Proposed Action Assuming Typical Wet Hydrology (WY1984).**

*Stormwater runoff from deconstruction activities under the Proposed Action could cause short-term increases in suspended material in the Hydroelectric Reach during the deconstruction period.* Deconstruction activities under the Proposed Action would include demolition of the dams and their associated structures, power generation facilities, transmission lines, installation of temporary cofferdams, road upgrading, hauling, reservoir restoration, and other activities (as described in Section 2.4.3.1). Deconstruction activities are scheduled to occur between January 10 and June 26, with cofferdam installation scheduled to occur between 2 January 2020 and 6 February 2020. Therefore, cofferdam installation would occur during the first month of reservoir drawdown and the period of peak SSCs associated with mobilization of reservoir sediment deposits during drawdown. While the magnitude of short-term effects on SSCs due to erosion of the large volume of reservoir sediment deposits trapped behind the dams would be substantially greater than those due to dam deconstruction activities, this does not alleviate the requirement to reduce impacts from deconstruction-related activities. The potential for sediments to enter the Hydroelectric Reach from deconstruction site runoff, cofferdam installation, or in-water deconstruction work can be minimized or eliminated through the implementation of BMPs for deconstruction activities that would occur in or adjacent to the Klamath River (Appendix B). **Under the Proposed Action, the effect of stormwater runoff from deconstruction activities on**

**SSCs in the Hydroelectric Reach downstream of J.C. Boyle Dam would be a less-than-significant impact.**

*Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach.* The Proposed Action includes seven years of gravel placement (after an Affirmative Determination until 2019). Under this IM, suitable spawning gravel would be placed in the J.C. Boyle Bypass and Peaking reaches. The spawning gravel would be placed using a passive approach before high flow periods, or to provide for other habitat enhancement in the Klamath River upstream of Copco 1 Reservoir. These actions would provide improvements in habitat quality for resident fish prior to dam removal, and for resident and anadromous species following dam removal. Passive gravel placement is specified by IM 7, which would avoid in-stream placement of gravel and would limit turbidity increases to periods of high river flow when turbidity is naturally elevated. The potential for sediments to enter the water during gravel placement along the river banks could be minimized or eliminated downstream of the enhancement sites through the implementation of BMPs for construction activities (Appendix B) (BLM 2011). Any disturbed sediments would be trapped by Iron Gate Reservoir and not transferred downstream to the Klamath River, particularly given implementation of BMPs. **Under the Proposed Action, the effect of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, on SSCs in the Hydroelectric Reach would be a less-than-significant impact.**

*Implementation of IM 16, Water Diversions, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach due to diversion screening deconstruction and construction activities.* Under IM 16, PacifiCorp would seek to eliminate three screened diversions (the Lower Shovel Creek Diversion [7.5 cfs], Upper Shovel Creek Diversion [2.5 cfs], and Negro Creek Diversion [5 cfs]) from Shovel and Negro Creeks and would seek to modify its water rights to move the points of diversion from Shovel and Negro creeks to the mainstem Klamath River. If this were successful the screened diversions would be removed prior to dam removal in 2020. The intent of this measure is to provide additional water to Shovel and Negro creeks, thus increasing the quality and amount of suitable habitat for aquatic species within these tributaries, while not diminishing PacifiCorp's water rights. The potential for sediments to enter the water during screen removal activities is minimal if the diversions are individual pump intakes. If the diversions are larger concrete structures, the impacts would be of greater magnitude and longer duration, albeit still short-term and due to construction/deconstruction activities. In this case, impacts to SSCs can be minimized or eliminated through the implementation of BMPs for construction activities (Appendix B) stipulated during permitting of IM 16. Since IM 16 would be undertaken prior to dam removal, any disturbed sediments would be trapped by Copco 1 Reservoir and not transferred downstream to the Klamath River, particularly given implementation of BMPs. The diversions would not be likely to affect other aspects of short-term or long-term water quality in the mainstem Klamath River since the water rights are relatively small (7.5 cfs, 2.5 cfs, and 5 cfs) compared to seasonal low flows in the mainstem upstream of Copco 1 Reservoir (typically >800 cfs). **Under the Proposed Action, the**

**effect of IM 16, Water Diversions, on SSCs in the Hydroelectric Reach in the J.C. Boyle Bypass Reach would be a less-than-significant impact.**

*Construction of the Yreka Pipeline under the Proposed Action could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period.* For construction of the Yreka Pipeline, Dam Removal Entity (DRE) would construct a new, elevated pipeline and steel pipeline bridge to support the pipe above the river at the upstream end of Iron Gate Reservoir (see Section 2.4.3). The pipeline bridge would require in-water work in 2019 to build three concrete piers to support the bridge. Additional construction would occur along the Iron Gate Reservoir banks at each end of the new bridge where the new pipeline would be connected to the existing buried pipeline. The potential for sediments to enter the water during in-water pier construction and from construction site runoff can be minimized or eliminated in Iron Gate Reservoir through the implementation of BMPs for construction activities (Appendix B). Since the construction work will be undertaken in 2019, prior to dam removal, any disturbed sediments would be trapped by Iron Gate Reservoir and not transferred downstream to the Klamath River, particularly given implementation of BMPs. **Under the Proposed Action, the effect of Yreka Pipeline construction activities on SSCs in the Hydroelectric Reach at the upstream end of Iron Gate Reservoir would be a less-than-significant impact.**

*Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs will be removed following drawdown, and could release suspended sediment into the Klamath River.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities will be removed. The potential for sediments to enter the water during the facilities removal will be minimized or eliminated through the implementation of BMPs for construction activities (Appendix B). Implementation of BMPs would ensure that impacts are constrained to the individual sites and their immediate area, and not transferred downstream in the Klamath River. **Under the Proposed Action, the short-term impacts on SSCs from the deconstruction of the recreational facilities would be less-than-significant.**

*Under the Proposed Action, revegetation associated with management of the reservoir footprint area could decrease the erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach.* Based on the reservoir area management planning currently underway, establishment of herbaceous vegetation in drained reservoir areas will be undertaken to stabilize the surface of the sediment and minimize erosion from exposed terrace surfaces following drawdown (O'Meara et al. 2010). Hydroseeding of herbaceous vegetation (i.e., grass) would be used, which typically entails applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion to exposed slopes. Hydroseeding would be undertaken using a barge in spring 2020 while reservoir levels are high enough to operate and access the barge. Later in spring and summer 2020, aerial application would be necessary for precision applications of material near the newly established river channel, as well as in the remaining areas (see Section 2.3.4.5). Some

aerial fall seeding in 2020 might be necessary to supplement areas where spring hydroseeding was unsuccessful.

Hydroseeding would be undertaken using standard BMPs for reducing water quality impacts during deconstruction and/or construction activities and restoration projects (Appendix B). Additional BMPs specific to hydroseeding, such as avoiding over-spray onto roads, trails, existing vegetation, and the stream channel, would also be implemented so that the hydroseed mixture itself would not easily runoff or be directly sprayed into the Klamath River. **Under the Proposed Action, hydroseeding would decrease the short-term (<2 years following dam removal) erosion of fine sediments from exposed reservoir terraces into the river channel in the Hydroelectric Reach and would be beneficial.**

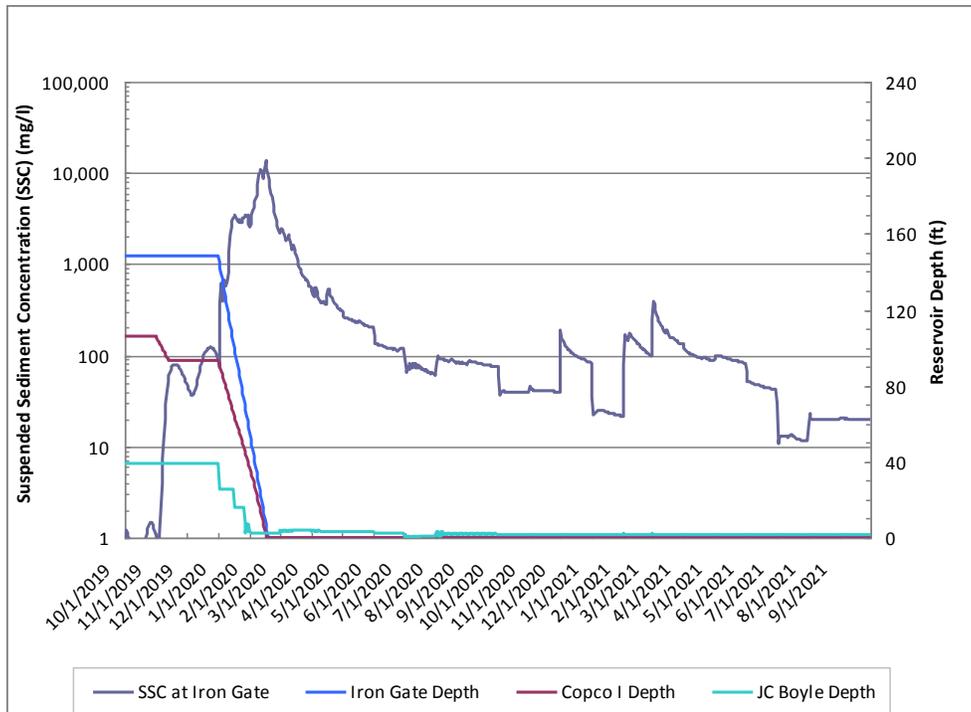
*Under the Proposed Action, the lack of continued interception and retention of mineral (inorganic) suspended material by the dams at the Four Facilities could result in long-term (2–50 years following dam removal) increases in suspended material in the Hydroelectric Reach.* Peak concentrations of mineral (inorganic) suspended material in the Hydroelectric Reach during the winter/early spring (November through April) would likely remain associated with high-flow events and any increases due to the lack of interception by the dams would not be large; estimates of baseline sediment delivery for the Klamath Basin indicate that a relatively small fraction of total sediment (199,300 tons per year or 3.4 percent of the cumulative average annual delivery from the basin) is supplied to the Klamath River on an annual basis from the upper and middle Klamath River (i.e., from Keno Dam to the Shasta River) due to the generally lower rates of precipitation and runoff, more resistant and permeable geologic terrain, and relatively low topographic relief and drainage density of the Upper Klamath Basin as compared with the lower basin. (Stillwater Sciences 2010). **Under the Proposed Action, the long-term (2–50 years following dam removal) increase in mineral (inorganic) suspended material in the Hydroelectric Reach would be a less-than-significant impact.**

*Under the Proposed Action, the lack of continued interception and retention of algal-derived (organic) suspended material by the dams at the Four Facilities could result in slight long-term (2–50 years following dam removal) increases in suspended material in the Hydroelectric Reach.* Episodic increases (10–20 mg/L) in algal-derived (organic) suspended material resulting from in-reservoir algal productivity are not expected to occur in the Hydroelectric Reach following dam removal. SSCs in the Hydroelectric Reach may attain levels similar to those observed upstream of J.C. Boyle Dam under existing conditions during May through October (>15 mg/L; see Appendix C), as algal-dominated suspended material is transported downstream from Upper Klamath Lake. However, similar to the No Action/No Project Alternative, interception and retention of suspended material from upstream sources would still occur to a large degree in the Keno Impoundment (including Lake Ewauna), as would additional decreases in concentration due to mechanical breakdown of algal remains in the turbulent river reaches between Keno Dam and Copco 1 Reservoir, and dilution from the springs downstream of J.C. Boyle Dam. If slight long-term increases in suspended materials did occur, they would likely be offset by the loss of algal-derived suspended material previously produced in

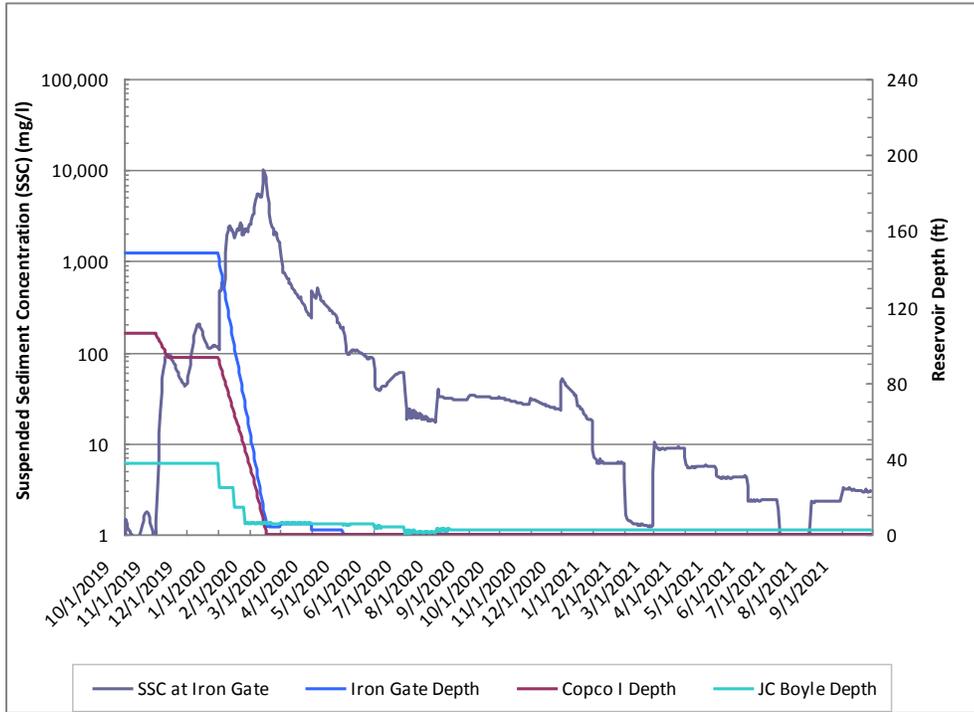
Copco 1 and Iron Gate Reservoirs and would not exceed levels that would substantially adversely affect the cold freshwater habitat (COLDF) beneficial use (see discussion under Alternative 2 – Suspended Sediments – Lower Klamath Basin). **Under the Proposed Action, the long-term (2–50 years following dam removal) changes in algal-derived (organic) suspended material in the Hydroelectric Reach would be a less-than-significant impact.**

Lower Klamath Basin

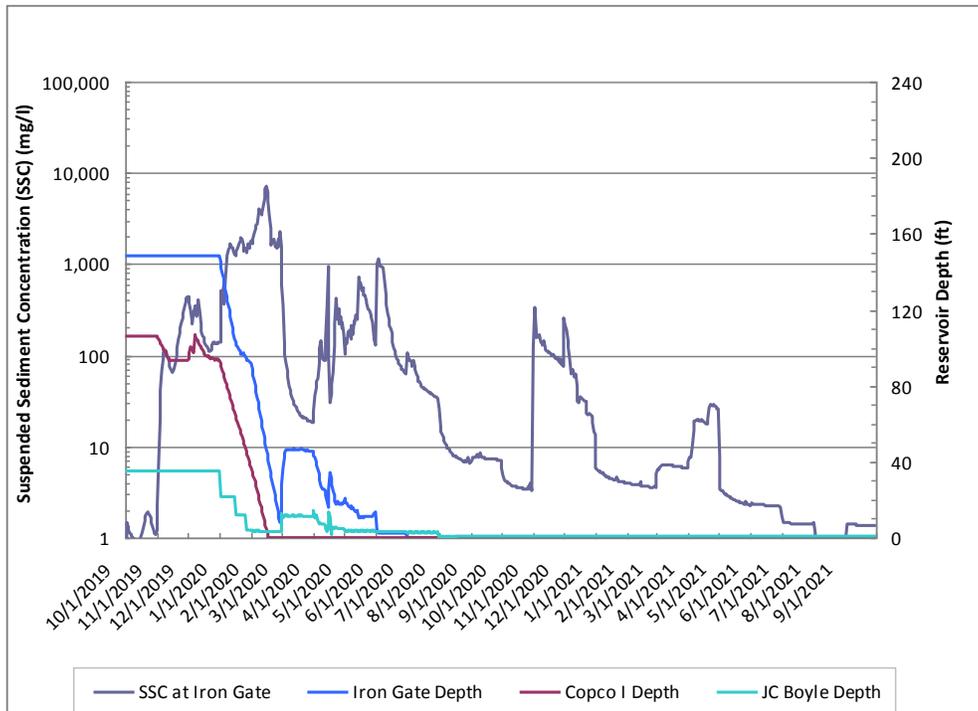
*Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) increases in suspended material in the lower Klamath River and the Klamath Estuary.* Sediment transport modeling of the impacts of dam removal on suspended sediment in the lower Klamath River indicates high short-term loads immediately downstream of Iron Gate Dam under the Proposed Action (Greimann et al. 2011, Stillwater Sciences 2008). The Proposed Action involves a three-phase drawdown for Copco 1 Reservoir beginning on November 1, 2019, and a single-phase drawdown for J.C. Boyle and Iron Gate Reservoirs beginning on January 1, 2020 (Greimann et al. 2011), which allows maximum SSCs to occur during winter months when flows are naturally high in the mainstem river. Suspended sediment model predictions for the Proposed Action are presented in Figure 3.2-11 through 3.2-13 for the three water year types (dry, median, wet) considered as part of the Secretarial Determination process. Model predictions are discussed below and summarized in Table 3.2-11.



**Figure 3.2-11. SSCs Modeled Downstream of Iron Gate Dam Under the Proposed Action Assuming Typical Dry Hydrology (WY2001).**



**Figure 3.2-12. SSCs Modeled Downstream of Iron Gate Dam Under the Proposed Action Assuming Median Hydrology (WY1976).**



**Figure 3.2-13. SSCs Modeled Downstream of Iron Gate Dam Under the Proposed Action Assuming Typical Wet Hydrology (WY1984).**

**Table 3.2-11. Summary of Model Predictions for SSCs in the Klamath River Downstream of Iron Gate Dam for the Proposed Action.**

Water Year Type	Peak SSC (mg/L)	SSC≥1,000 mg/L		SSC≥100 mg/L		SSC≥30 mg/L	
		Duration (Months)	Time Period	Duration (Months)	Time Period	Duration (Months)	Time Period
Dry (WY2001)	13,600	3	January–March 2020	6	January–June 2020	10	January–October 2020
Median (WY1976)	9,900	2	January–February 2020	5	January–May 2020	6	January–June 2020
Wet (WY1984)	7,100	2	January–February 2020	7	November 2019–February 2020 and April–June 2020	9	November 2019–July 2020

For typical dry year (WY2001) hydrologic conditions, predicted SSCs in the Klamath River immediately downstream of Iron Gate Dam (RM 190.1) experience a relatively small increase to near 100 mg/L in mid-November 2019 as Copco 1 undergoes the first phase of drawdown, and a large increase (>1,000 mg/L) in early January 2020 when Iron Gate and J.C. Boyle begin drawdown and Copco 1 enters phase 2 of drawdown. Concentrations remain very high (>1,000 mg/L) for approximately 3 months from January through April 2020 (see Figure 3.2-11), with peak values exceeding 10,000 mg/L to reach approximately 13,600 mg/L for a short period (4–5 days) in mid-February 2020. SSCs generally return to less than 100 mg/L by July 2020, and to concentrations near 30 mg/L by October 2020. Predicted SSCs increase again to levels between 200–400 mg/L during winter and spring of 2021 due to flushing of sediments that were not removed during the first year following drawdown.

Model predictions for median year (WY1976) hydrologic conditions follow a pattern similar to that of a typical dry year (WY2001), with a relatively small increase in SSCs (i.e., to near 200 mg/L) in mid-December 2019, and a large (>1,000 mg/L) increase again in early January 2020. Peak SSCs downstream of Iron Gate Dam are predicted to be lower for the median year condition, reaching levels just under 10,000 mg/L. Relative to the typical dry year, the lower median year peak SSCs are a result of greater flows flushing the same volume of sediment out of the reservoir and downstream. Peak concentrations also occur in mid-February 2020 for the median year hydrologic condition (see Figure 3.2-12). Predicted SSCs downstream of Iron Gate Dam (RM 190.1) remain very high (>1,000 mg/L) for approximately 2 months following the inception of drawdown in Iron Gate and Copco 1 Reservoirs, from January through February 2020. There is a slightly earlier return to SSCs less than 100 mg/L for the median year (WY1976), with concentrations decreasing by May 2020. SSCs decrease to less than 30 mg/L by June 2020, and fluctuate between 10 mg/L and 100 mg/L through the remainder

of 2020. The increases above 100 mg/L are not predicted for the typical median water year condition in the year following dam removal (2021), but fluctuating SSCs may occur in the second year following dam removal due to erosion of sediment deposits remaining in the reservoir footprint area.

Model predictions for typical wet year (WY1984) hydrologic conditions indicate a higher initial pulse of fine sediments following the first phase of Copco 1 drawdown in early to mid-December 2019, with concentrations at or near 400 mg/L. Model predictions indicate that for typical wet year conditions, the outlet capacity at Copco 1 Dam is exceeded during the same timeframe and the reservoir fills slightly (see Figure 3.2-13). Very high (>1,000 mg/L) SSCs are experienced for approximately 2 months following the inception of drawdown in the reservoirs, from January through February 2020 (see Figure 3.2-13). SSCs reach approximately 7,100 mg/L, with peak values occurring in mid-February 2020. Secondary peaks ( $\approx$ 1,000 mg/L) in SSCs occur in mid-April and June 2020 for wet year (WY1984) hydrologic conditions. SSCs generally return to less than 100 mg/L during the month of March 2020 and then again by July 2020. Concentrations return to less than 30 mg/L by July 2020.

For all three water year types, predicted SSCs in the lower Klamath River decrease to 60–70 percent of their value at Iron Gate Dam by Seiad Valley (RM 129.4) and to 40 percent of their initial value downstream of Orleans ( $\approx$ RM 59) (Greimann et al. 2011).

Overall, and within the general uncertainty of the model predictions, SSCs across the three water year types would have peak values of 7,000–14,000 mg/L and occurring within 2–3 months of reservoir drawdown. Predicted SSCs would remain greater than or equal to 100 mg/L for 5–7 months following drawdown, and concentrations would remain greater than or equal to 30 mg/L for 6–10 months following drawdown (Table 3.2-11). Model results also indicate that while dilution in the lower river would decrease SSCs to 60–70 percent of their initial value downstream of Seiad Valley (RM 129.4) and to 40 percent of their initial value downstream of Orleans ( $\approx$ RM 59), within a factor of 2 uncertainty for the model results it can be conservatively assumed that SSCs in the lower Klamath River would be sufficient ( $\geq$ 30 mg/L) to substantially adversely affect beneficial uses throughout the lower River and the Klamath Estuary for 6–10 months following drawdown (Greimann et al. 2011). A more detailed analysis of the anticipated suspended sediment effects on key fish species in the lower river is presented in Section 3.3.4.3.

Overall, sediment release associated with the Proposed Action would cause short-term increases in suspended material ( $\geq$ 30 mg/L for 6–10 months following drawdown) that would result in non-attainment of applicable North Coast Basin Plan water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary and would substantially adversely affect the cold freshwater habitat (COLD) beneficial use. **Under the Proposed Action, the short-term (<2 years following dam removal) increases in SSCs in the lower Klamath River and the Klamath Estuary would be a significant impact.**

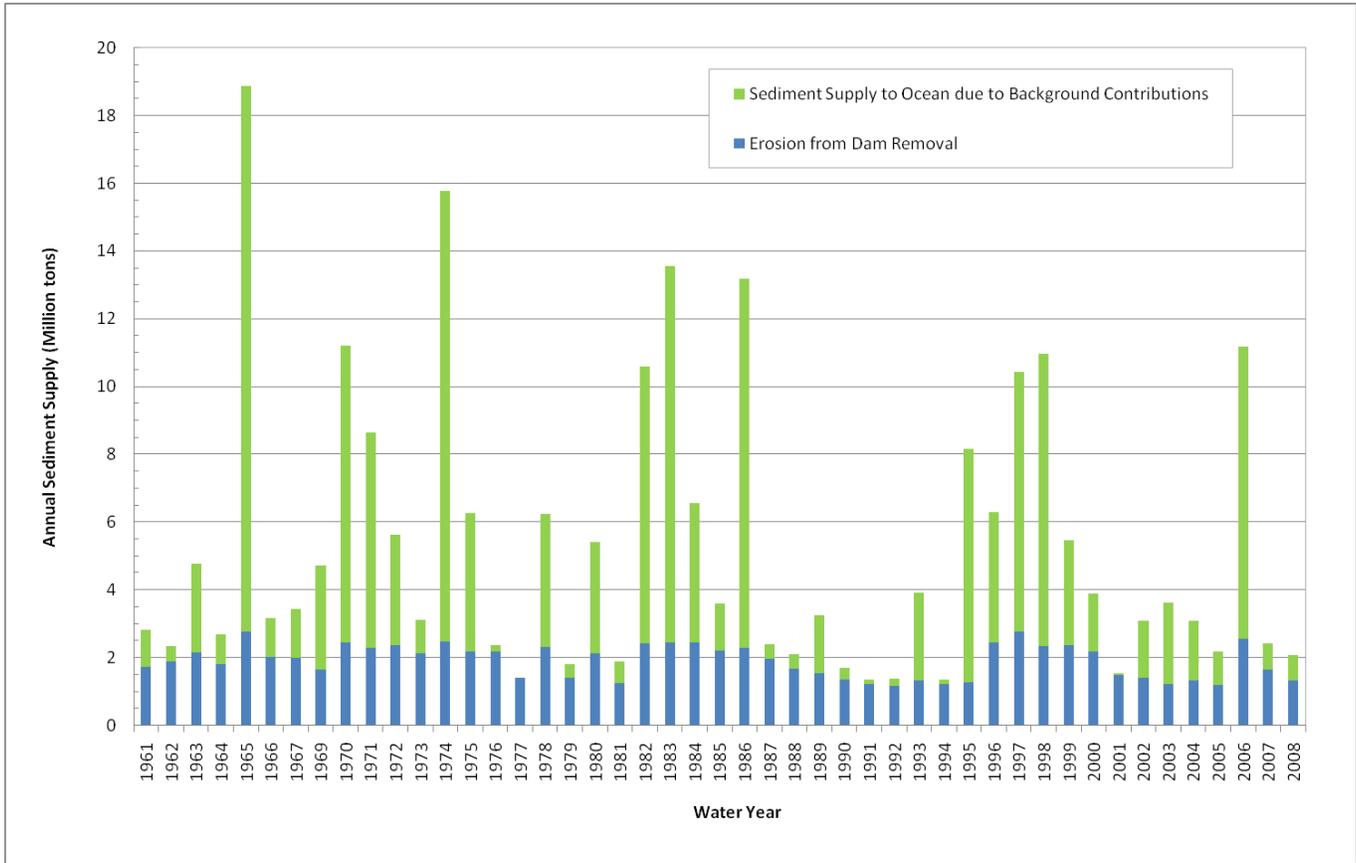
*Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material and rates of deposition in the marine nearshore environment.* The results of model predictions for sediment transport following dam removal under the Proposed Action indicate that dam removal would cause a release of less than 3 million tons of fine sediment to the Klamath River downstream of Iron Gate Dam (see Figure 3.2-14). While estimates of long-term average annual sediment discharge to the Klamath Estuary vary considerably, they are generally well above the projected 3 million tons. For example, annual sediment supply from Trinity River alone is calculated to be 8.5 million tons based on data provided in USEPA (2001). Additionally, Stillwater Sciences (2010) estimated that Klamath River annual sediment discharge to the estuary is approximately 5.8 million tons<sup>6</sup>. The predicted sediment release due to dam removal under the Proposed Action ranges from 1.5 to 2.6 million tons depending on water year type (see Figure 3.2-14) and is only about one eighth of the cumulative sediment transport in the Klamath River at Hoopa in a four-day period during the December 1964 flood event. Lastly, the predicted sediment release due to dam removal is approximately the same as the cumulative sediment transport over a single day at the Salmon River confluence during a very large flood event (i.e., the January 1974 flood) (Stillwater Sciences 2010).

After exiting the river mouth, the high SSCs (>1,000 mg/L) transported by the lower Klamath River would form a surface plume of less dense, turbid, surface water floating on more dense, salty ocean water (Mulder and Syvitski 1995). No detailed investigations of the likely size and dynamics of the Klamath River plume have been conducted. Thus, it is not possible to predict accurately the sediment deposition pattern and location in the nearshore environment. However, the general dynamics and transport mechanisms of fine sediment can be surmised based upon regional oceanographic and sediment plume studies.

The California Marine Life Protection Act (MLPA) 2008 Draft Master Plan identifies freshwater plumes as one of three prominent habitats with demonstrated importance to coastal species (California Marine Life Protection Act 2008). The California MLPA Master Plan Science Advisory Team (2011) Methods Report designates river plumes as a key habitat to be included in marine protected areas because they harbor a particular set of species or life stages, have special physical characteristics, or are used in ways that differ from other habitats.

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<sup>6</sup> The estimated Klamath River sediment supply to the estuary by Farnsworth and Warrick (2007) is 1.2 million tons per year, but this estimate is likely low because their estimated upper bound of 1.7 million tons is much lower than observations. The calculated sediment transport based on field data for the period of 22 through 26 December 1964, for example, is more than 25 million tons (Stillwater Sciences 2010). As a result, the Farnsworth and Warrick (2007) estimate of Klamath River sediment delivery is not used for direct comparisons here.



**Figure 3.2-14. Annual predicted sediment delivery to the Pacific Ocean under the Proposed Action and the No Action (background conditions) by Water Year. Note: model results are only valid for the year of dam removal. No significant increase in sediment loads is predicted in years following dam removal (Source: Greimann et al. 2011).**

A recent USGS overview report on the sources, dispersal, and fate of fine sediment delivered to California’s coastal waters (Farnsworth and Warrick 2007) found the following:

- Rivers dominate the supply of fine sediment to the California coastal waters, with an average annual flux of 34 million metric tons.
- All California coastal rivers discharge episodically, with large proportions of their annual sediment loads delivered over the course of only a few winter days.
- After heavy loading of fine sediment onto the continental shelf during river floods, there is increasing evidence that fluid-mud gravity flows occur within a layer 10 to 50 cm above the seabed and efficiently transport fine sediment offshore.
- Although fine sediment dominates the mid-shelf mud belts offshore of California river mouths, these mud belts are not the dominant sink of fine sediment, much of

which is deposited across the inner shelf and deeper water off the continental shelf.

- Accumulation rates of fine sediment, which can exceed several millimeters per year, are generally highest near river sources of sediment and along the inner shelf and midshelf.

Farnsworth and Warrick (2007) conclude that fine sediment is a natural and dynamic element of the California coastal system because of large, natural sediment sources and dynamic transport processes.

In northern California, plume zones are primarily north of river mouths because alongshore currents and prevailing winds are northward during periods of strong runoff (Geyer et al. 2000, Pullen and Allen 2000, Farnsworth and Warrick 2007, California MLPA Master Plan Science Advisory Team 2011). Surface plumes occurring during periods of northerly (upwelling favorable) winds will thin and stretch offshore, while in the presence of southern downwelling-favorable winds, the plume may hug the coastline and mix extensively (Geyer et al. 2000, Pullen and Allen 2000, Borgeld et al. 2008). River plume area, location, and dynamics are also affected by the magnitude of river discharge, SSCs, tides, the magnitude of winter storms, and regional climatic and oceanographic conditions such as El Niño-Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) climate cycles (Curran et al. 2002).

During several large flood events on the geographically proximal Eel River in the winter of 1997 and 1998, Geyer et al. (2000) found the following: flood conditions were usually accompanied by strong winds from the southern quadrant. The structure of the river plume was strongly influenced by the wind-forcing conditions. During periods of strong southerly (i.e., downwelling favorable) winds, the plume was confined inside the 50-m isobath (i.e., sea floor contour at 50-m below the water surface), within about 7 km of shore. Occasional northerly (upwelling favorable) winds arrested the northward motion of the plume and caused it to spread across the shelf. Transport of the sediment plume was confined to the inner shelf (water depths less than 50 m), during both southerly and northerly wind conditions. During southerly wind periods, fine, un-aggregated sediment was rapidly transported northward to at least 30 km from the river mouth, but flocculated sediment was deposited within 1–10 km of the river mouth. During northerly (upwelling-favorable) winds, most of the sediment fell out within 5 km of the mouth, and negligible sediment was carried offshore. The Eel River mouth is 120 km (75 miles) to the south of the Klamath River mouth and thus serves as a reasonable system for comparison.

Based upon Eel River plume studies and current knowledge of northern California oceanographic patterns, the fine sediment discharged to the marine nearshore environment under the Proposed Action would likely be delivered to the ocean in a buoyant river plume that hugs the shoreline as it is transported northward. However, since the flushing of sediments from behind the dams will occur over a number of weeks to months (and perhaps to some degree over 1-2 years), the plume carrying reservoir sediments would likely be influenced by a range of meteorological and ocean conditions (e.g., storm and non-storm periods, differing storm directions). Therefore, some of the

time the plume would likely be constrained to shallower nearshore waters, while at other times it would likely extend further offshore and spread more widely. While elevated SSCs (i.e., 10–100 mg/L) created in the nearshore plume would affect physical water quality characteristics specified in the Ocean Plan (i.e., visible floating particulates, natural light attenuation, the deposition rate of inert solids [Table 3.2-7]), the effects are likely to be within the range caused by historical storm events.

A 1995 Eel River flood with a 30-yr return period delivered an estimated  $25 \pm 3$  million metric tons of fine-grained ( $<62 \mu\text{m}$ ) sediment to the ocean (Wheatcroft et al. 1997). Transported sediments formed a distinct layer on the sea bed that was centered on the 70-m isobath, extended for 30 km along shelf and 8 km across shelf, and was as thick as 8.5 cm. Wheatcroft et al. (1997), estimated that 75% of the flood-derived sediment did not form a recognizable sea-floor deposit, but was instead rapidly and widely dispersed over the continental margin.

A considerable amount of fine sediment in the plume is anticipated to initially deposit on the seafloor shoreward of the 60-m isobath along the coast, with greater quantities depositing in close proximity to the mouth of the Klamath River. After this initial deposition, as described by Farnsworth and Warrick (2007), resuspension during the typical winter storms would likely occur before final deposition and burial. Much of this sediment will eventually be transported further offshore to the mid-shelf and into deeper water depths off-shelf through progressive resuspension and fluid-mud gravity flows.

Because of the complexities of the transport processes, the area and depth of the deposition of fine sediment from the Proposed Action cannot be precisely predicted. However, the short-term ( $< 2$  years following dam removal) plume effects and long-term (2-50 years following dam removal) sediment deposit effects would be less-than-significant given the relatively small amount of total sediment input, in comparison to the total annual sediment inputs to the nearshore environment, and the fact that river plume sediment inputs are a naturally occurring process. As a result, net deposition of reservoir sediments to the marine nearshore bottom substrates should be relatively less concentrated (i.e., thinner deposits in any one spot) and more widespread.

In summary, due to the relatively small magnitude of SSCs released to the nearshore environment, the anticipated rapid dilution of the sediment plume as it expands in the ocean, and the relatively low rate of deposition of sediments to the marine nearshore bottom substrates, **the short-term ( $< 2$  years following dam removal) increases in SSCs and fine sediment deposition in the marine nearshore environment under the Proposed Action would be a less-than-significant impact.**

*Stormwater runoff from deconstruction activities under the Proposed Action could cause increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment during the deconstruction period. Deconstruction activities under the Proposed Action would include demolition of the dams and their associated structures, power generation facilities, transmission lines, installation of temporary cofferdams, road upgrading, hauling, reservoir restoration, and other activities*

(as described in Section 2.4.3.1). Deconstruction activities are scheduled to occur between January 10 and June 26, with cofferdam installation scheduled to occur between 2 January 2020 and 6 February 2020. Therefore, cofferdam installation would occur during the first month of reservoir drawdown and the period of peak SSCs associated with mobilization of reservoir sediment deposits during drawdown. While the magnitude of short-term effects on SSCs due to erosion of the large volume of reservoir sediment deposits trapped behind the dams would be substantially greater than those due to dam deconstruction activities, this does not alleviate the requirement to reduce impacts from deconstruction-related activities. Although suspended materials from deconstruction would not likely reach the Klamath Estuary or marine nearshore environment, the potential for sediments to enter the water from deconstruction site runoff or in-water deconstruction work can be minimized or eliminated through the implementation of BMPs for deconstruction activities that would occur in or adjacent to the Klamath River. **Under the Proposed Action, the effect of stormwater runoff from deconstruction activities on SSCs in the lower Klamath River and the Klamath Estuary would be a less-than-significant impact. There would be no change from existing conditions on the marine nearshore environment.**

*Under the Proposed Action, revegetation associated with management of the reservoir footprint area could decrease the transport of fine sediments eroded from exposed reservoir terraces into the lower Klamath River and Klamath Estuary.* As described for the Upper Klamath Basin, establishment of herbaceous vegetation in drained reservoir areas will be undertaken to stabilize the surface of the sediment and minimize erosion from exposed terrace surfaces following drawdown (O'Meara et al. 2010). Hydroseeding would be undertaken using standard BMPs for reducing water quality impacts during deconstruction and/or construction activities and restoration projects (Appendix B). Additional BMPs specific to hydroseeding, such as avoiding over-spray onto roads, trails, existing vegetation, and the stream channel, would also be implemented so that the hydroseed mixture itself would not easily runoff or be directly sprayed into the Klamath River. **Under the Proposed Action, hydroseeding would decrease the short-term (<2 years following dam removal) transport of fine sediments eroded from exposed reservoir terraces into the lower Klamath River and Klamath Estuary and would be beneficial. There would be no change from existing conditions on the marine nearshore environment.**

*Under the Proposed Action, the lack of continued interception and retention of mineral (inorganic) suspended material behind the dams at the Four Facilities could result in long-term (2–50 years following dam removal) increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* As would be the case for the Upper Klamath Basin, peak concentrations of mineral (inorganic) suspended materials in the Lower Klamath Basin during the winter/early spring (November through April) would likely remain associated with high-flow events and any increases due to the lack of interception by the KHP dams would not be large; estimates of baseline sediment delivery for the Klamath Basin indicate that a relatively small fraction of total sediment (199,300 tons/yr or 3.4 percent of the cumulative average annual delivery from the basin) is supplied to the Klamath River on an annual basis from

the upper and middle Klamath River (i.e., from Keno Dam to the Shasta River) (Stillwater Sciences 2010).

**Under the *Proposed Action*, the long-term (2–50 years following dam removal) increases in mineral (inorganic) suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than-significant impact.**

*Under the Proposed Action, the lack of continued interception and retention of algal-derived (organic) suspended material by the dams at the Four Facilities could result in slight long-term (2–50 years following dam removal) increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* While removal of the Four Facilities would eliminate the potential for downstream increases in suspended material due to seasonal algal blooms occurring within the reservoirs at the Four Facilities, overall sediment trapping in the Hydroelectric Reach would no longer occur, such that, in the long-term, summertime algal-derived suspended material originating from Upper Klamath Lake may move farther downstream into the lower basin and cause a relative increase in suspended material. However, similar to the No Action/No Project Alternative, interception and retention of suspended material from upstream sources would still occur to a large degree in the Keno Impoundment (including Lake Ewauna), as would additional decreases in concentration due to mechanical breakdown of algal remains in the turbulent river reaches between Keno Dam and Copco 1 Reservoir, and dilution from the springs downstream of J.C. Boyle Dam.

Because existing conditions indicate that average June–October suspended sediment values decrease from over 16 mg/L at the mouth of Link River to 6 mg/L in the Klamath River downstream of J.C. Boyle Reservoir (2001–2003), with median turbidity values following a similar pattern over the long-term historical record (1950–2001) (see Section 3.2.3.1 and Appendix C, Section C.2), it is likely that the suspended sediment signal would not increase beyond typical existing conditions concentrations of 10–15 mg/L. Therefore, summertime suspended sediment in the lower Klamath River is unlikely to increase beyond a sustained 30 mg/L for four weeks, the water quality criterion adopted for significant adverse impacts on the cold freshwater habitat (COLD) beneficial use for the Klamath Facilities Removal EIS/EIR analysis (see Section 3.2.4.2.2.1). If slight long-term increases in suspended materials did occur, they would likely be offset by the loss of algal-derived suspended material previously produced in Copco 1 and Iron Gate Reservoirs and would not exceed levels that would substantially adversely affect the cold freshwater habitat (COLD) beneficial use.

**Under the *Proposed Action*, the long-term (2–50 years following dam removal) increases algal-derived (organic) suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than-significant impact.**

### 3.2.4.3.2.3 Nutrients

#### Upper Klamath Basin

*Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) increases in sediment-associated nutrients.* Short-term increases in TN and TP concentrations in the Hydroelectric Reach would occur because particulate (primarily organic) nutrients contained in reservoir sediment deposits would be transported along with the sediments themselves. However, minimal deposition of fine suspended sediments, including associated nutrients, would occur in the river channel (Greimann et al. 2011, Stillwater Sciences 2008). Further, reservoir drawdown under the Proposed Action would occur during winter months when rates of primary productivity and microbially mediated nutrient cycling (e.g., nitrification, denitrification) are also expected to be low. Light limitation for primary producers that do persist during winter months is also likely to occur, further decreasing the potential for uptake of TN and TP released along with reservoir sediment deposits. Therefore, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the Hydroelectric Reach. **Under the Proposed Action, the short-term (<2 years following dam removal) increase in nutrients in the Hydroelectric Reach would be a less-than-significant impact.**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause long-term (2–50 years following dam removal) increases in nutrient levels in the Hydroelectric Reach.* The Four Facilities intercept and retain suspended material behind the dams, including phosphorus and nitrogen originating from Upper Klamath Lake (see Section 3.2.3.1). Under the Proposed Action, these nutrients would be transported downstream and potentially be available for uptake (e.g., by nuisance algae species). Analyses of the effects of dam removal on nutrients have been conducted by PacifiCorp for its relicensing efforts (FERC 2007), NCRWQCB for development of the California Klamath River TMDLs (NCRWQCB 2010a), and the Yurok Tribe as part of an evaluation to improve previous mass-balance estimates of nutrients in the Klamath River and increase understanding of retention rates in free-flowing river reaches (Asarian et al. 2010). While the results of all of the evaluations recognize the trapping efficiency of the reservoirs with respect to TP and TN, such that under the Proposed Action total nutrient concentrations in the Klamath River downstream of Iron Gate Dam would increase, the majority of the results are focused on the Klamath Basin downstream of Iron Gate Dam.

However, modeling conducted for development of the California Klamath River TMDLs (NCRWQCB 2010a) provides some information applicable to the assessment of long-term (2–50 years following dam removal) effects of the Proposed Action on nutrients at locations in the Upper Klamath Basin (i.e., upstream of Iron Gate Dam) (Kirk et al. 2010). Klamath TMDL model results indicate that under the Proposed Action (similar to the TMDL TOD2RN scenario, which includes Oregon TMDL allocations), TP and TN in the Hydroelectric Reach immediately downstream of J.C. Boyle Dam would increase slightly (<0.015 mg/L and <0.05 mg/L, respectively) during summer months compared to those of the No Action/No Project Alternative (similar to the TMDL T4BSRN scenario)

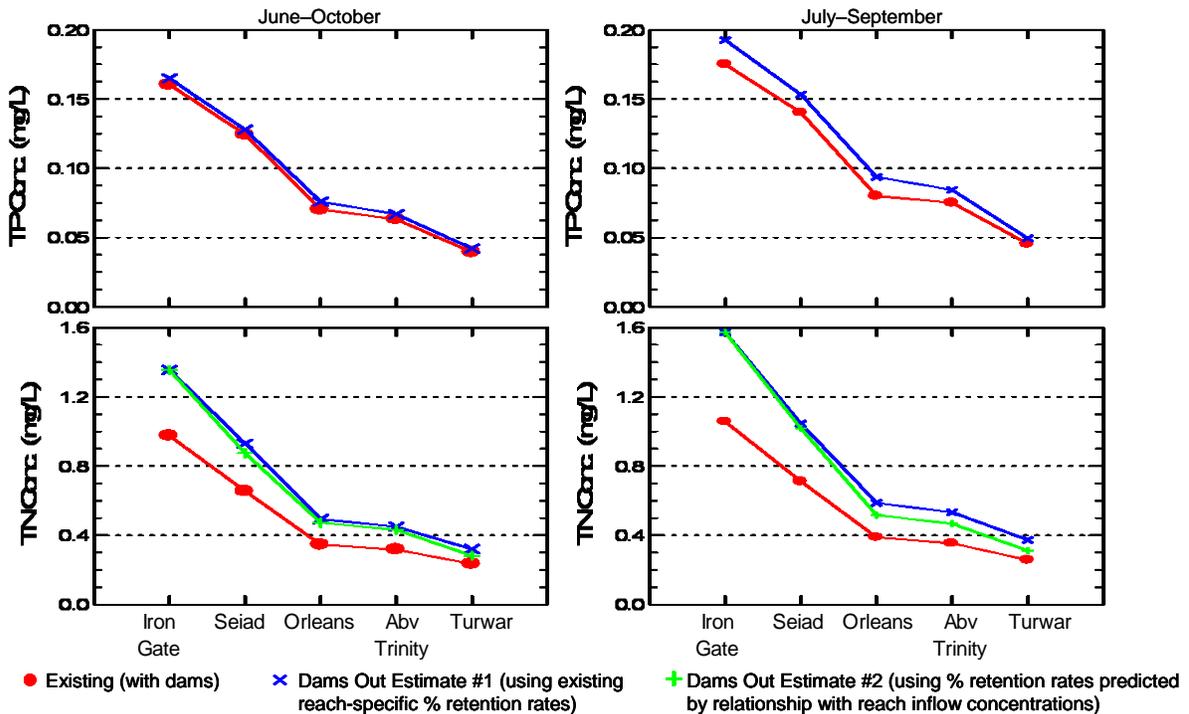
due to the absence of nutrient interception and retention in both Keno Impoundment and J.C. Boyle Reservoir (the former because the TMDL model TOD2RN scenario includes the historic Keno Reef instead of Keno Dam [Appendix D]). At the Oregon-California state line, the situation would be much the same, although the lack of hydropower peaking operations under the Proposed Action may result in decreased daily variation in TP and ortho-phosphorus, as well as nitrate and ammonium (NCRWQCB 2010a). Overall however, the predicted increases would be very small and these increases may be at least partially due to the assumption that the historic Keno Reef exists rather than Keno Dam. Regardless, the increases would not be expected to result in exceedances of either Oregon water quality objectives for nuisance algae growth, or California North Coast Basin Plan water quality objectives for biostimulatory substances, beyond levels experienced under the No Action/No Project Alternative. Further, the lacustrine environment that supports the growth of nuisance algae blooms of such as *M. aeruginosa* or other cyanobacteria would be eliminated under the Proposed Action (see Section 3.4, Algae), reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species. **Under the Proposed Action, the long-term (2–50 years following dam removal) increase in nutrients in the Hydroelectric Reach would be a less-than-significant impact.**

#### Lower Klamath Basin

*Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) increases in sediment-associated nutrients in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* **Under the Proposed Action, the short-term (<2 years following dam removal) increase in nutrients in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be the same as in the Hydroelectric Reach and would be a less-than-significant impact.**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause long-term (2–50 years following dam removal) increases in nutrient levels in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* The reservoirs at the Four Facilities currently intercept and retain suspended material behind the dams, including phosphorus and nitrogen originating from Upper Klamath Lake (see Section 3.2.3.1). Under the Proposed Action, these nutrients would be transported downstream and potentially be available for uptake by algae, including nuisance algae species. Analyses of the effects of dam removal on nutrients have been conducted by PacifiCorp for its relicensing efforts (FERC 2007), NCRWQCB for development of the California Klamath River TMDLs (NCRWQCB 2010a), and the Yurok Tribe as part of an evaluation to improve previous mass-balance estimates of nutrients in the Klamath River and increase understanding of retention rates in free-flowing river reaches (Asarian et al. 2010). Results of all of the evaluations recognize the trapping efficiency of the reservoirs with respect to TP and TN, such that under the Proposed Action total nutrient concentrations in the Klamath River downstream of Iron Gate Dam would increase.

Based on the Yurok Tribe analysis, TP concentrations would increase approximately 2-12 percent for the June–October period under the Proposed Action, while increases in TN concentrations would be relatively larger, at an estimated 37-42 percent for June–October and 48-55 percent for July–September (see Figure 3.2-15). Asarian et al. (2010) conducted their analysis using two different approaches; 1) calculated reach-specific nutrient retention rates based on measured nutrient concentration data, and 2) predicted retention rates using an empirical relationship between observed retention rates and measured concentrations developed for the river from Iron Gate Dam to Turwar (this approach was only applicable to TN because TP data demonstrated a weak relationship between retention rate and measured TP concentrations). Both approaches yield similar results, indicating small increases in TP and relatively larger increases in TN concentrations downstream of the Hydroelectric Reach under the Proposed Action, which diminish with distance downstream due to both tributary dilution and nutrient retention (i.e., uptake of nutrients).



**Figure 3.2-15. Comparison of TP and TN Concentrations from Iron Gate Dam to Turwar (RM 5.8) for June–October and July–September 2007–2008: (a) Measured Current Conditions (Red Circle), (b) Dams-Out Estimate using Calculated Percent Retention Rates by Reach (Blue Cross), and (c) Dams-Out Estimate using Percent Retention Rates Predicted by the Empirical Relationship between Reach Inflow Concentration and Retention (Green Cross). Source: Asarian et al. 2010.**

Due to a lack of available data, the Yurok Tribe analysis does not consider other possible factors that may decrease nutrients upstream of Copco 1 Reservoir under the Proposed Action, such as TMDL implementation or elimination of peaking flows from hydropower operations (Asarian et al. 2010). If reductions in nutrient concentrations do occur upstream of Copco 1, then less nutrients would be available for removal in the reservoirs and dam removal would likely result in smaller long-term increases in nutrient concentration than predicted by the Yurok Tribe analysis (Asarian et al. 2010) analysis.

Klamath TMDL modeling efforts include an assumption of compliance with upstream TP and TN load allocations for both Oregon and California (NCRWQCB 2010a). Results are in general agreement with PacifiCorp (FERC 2007) and Yurok Tribe (Asarian et al. 2010) analyses regarding dam removal effects on nutrients, with very small annual increases in TP (0.01–0.015 mg/L) and relatively larger annual increases in TN (0.1–0.125 mg/L) immediately downstream of Iron Gate Dam (RM 190.1). Increases in nutrients would diminish with distance downstream. Note that while following the same relative trend as the Yurok Tribe analysis, the absolute increases predicted by TMDL model are much lower (e.g., 0.1–0.125 mg/L TN increase for the TMDL model vs. 0.1–0.5 mg/L TN increase for the Yurok Tribe analysis).

Continuing increased variability in TP and TN are predicted by the Klamath TMDL model (see Appendix D) during summer months, presumably due to nutrient uptake dynamics by periphyton and macrophytes. The TMDL model does not include denitrification as a possible nitrogen removal term in riverine segments (Tetra Tech 2009), meaning that TN concentrations under the Proposed Action (but also the No Action/No Project Alternative) may be slightly overpredicted. Corresponding small differences in ortho-phosphorus, nitrate, and ammonium concentrations under the Proposed Action (as compared with the No Action/No Project Alternative, including TMDL compliance) are predicted by the model; however, within the uncertainty of future nutrient dynamics these differences are not clearly discernable as increases or decreases. TMDL model results indicate that while resulting TP levels would meet the existing Hoopa Valley Tribe numeric water quality objective (0.035 mg/L TP) at the Hoopa reach (≈RM 45–46) of the Klamath River, TN levels would continue to be in excess of the existing objective (0.2 mg/L TN) (NCRWQCB 2010a).

Despite the overall increases in absolute nutrient concentrations anticipated under the Proposed Action, the relatively greater increases in TN may not result in significant biostimulatory effects on primary productivity (i.e., periphyton growth). Existing data indicate that the Klamath River is generally N-limited (TN:TP <10), with some periods of co-limitation by N and P (see Section 3.2.3.4 and Appendix C, Section C.3.2.1). However, concentrations of both nutrients are high enough in the river from Iron Gate Dam (RM 190.1) to approximately Seiad Valley (RM 129.4) (and potentially further downstream) that nutrients are not likely to be limiting primary productivity (i.e., periphyton growth) in this portion of the Klamath River (FERC 2007, HVTEPA 2008, Asarian et al. 2010). In addition, N-fixing species dominate the periphyton communities in the lower reaches of the Klamath River where inorganic nitrogen concentrations are low (Asarian et al. 2010). Since these species can fix their own nitrogen from the

atmosphere, increases in TN due to dam removal may not significantly increase their growth (see also Section 3.4, Algae), particularly if overall TN increases are less than those predicted by existing models due to implementation of TMDLs and general nutrient reductions in the Klamath Basin. **Under the *Proposed Action*, the long-term (2–50 years following dam removal) increase in nutrients in the lower Klamath River and the Klamath Estuary would be a less-than-significant impact.**

#### **3.2.4.3.2.4 Dissolved Oxygen**

##### Upper Klamath Basin

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in oxygen demand and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir.* While modeled oxygen demand is not available downstream of J.C. Boyle Reservoir, model results are available downstream of Iron Gate Dam as a function of SSC (see Section 3.2.4.3.2.4, Lower Klamath Basin) and can be applied to the Hydroelectric Reach downstream of J.C. Boyle Reservoir. This assumes as a worst case scenario that the effects of sediment release on short-term oxygen demand (and reductions in dissolved oxygen) in the Hydroelectric Reach downstream of J.C. Boyle Dam would be the same as those for the lower Klamath River. This is a conservative assumption because peak SSCs downstream of J.C. Boyle Reservoir would be much lower and of shorter duration (i.e., 2,000–3,000 mg/L occurring within 1–2 months of reservoir drawdown) than those predicted downstream of Iron Gate Dam (i.e., 7,000–14,000 mg/L occurring within 2–3 months of reservoir drawdown) (see Section 3.2.4.3.2.2 and Figures 3.2-8 through 3.2-10). Like the effect determination for the Klamath River downstream of Iron Gate Dam, this would be a significant impact (see detailed analysis for Lower Klamath Basin, below).

**Under the *Proposed Action*, the short-term (<2 years following dam removal) decrease in dissolved oxygen concentrations would be a significant impact on the riverine reaches of the Klamath River downstream of J.C. Boyle Dam to the Oregon-California state line.**

*Removal of the Four Facilities under the Proposed Action could cause long-term (2–50 years following dam removal) increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach.* Modeling conducted for development of the Oregon and California Klamath River TMDLs indicates that under the Proposed Action (similar to the TMDL TOD2RN scenario), dissolved oxygen concentrations in the Hydroelectric Reach downstream of J.C. Boyle Dam and at the Oregon-California state line would be slightly greater during July through October than those under the No Action/No Project (similar to the TMDL T4BSRN scenario), due to the removal of J.C. Boyle Reservoir (see Figure 3.2-16 and Figure 3.2-17; NCRWQCB 2010a). The same pattern is predicted for 30-day mean minimum and 7-day mean minimum dissolved oxygen criteria. The Klamath TMDL model (see Appendix D) also predicts that daily fluctuations in dissolved oxygen at these locations during this same period may be greater under the Proposed Action (TCD2RN) than the No Action/No Project Alternative (T4BSRN), a condition potentially linked to greater periphyton biomass and associated daily photosynthetic swings in oxygen production in the free-

flowing river. Modeling predictions are generally in compliance with the Oregon water quality objectives for supporting warm water (5.5 mg/L) and cool water (6.5 mg/L) fish beneficial uses, where lower dissolved oxygen concentrations in June–August would meet the Oregon narrative natural conditions criterion that supersedes the numeric objectives for the cold water beneficial use (8.0 mg/L). The same would occur for predicted concentrations in mid-February–May as related to the spawning (11 mg/L) beneficial use (Figure 3.2-16 and Figure 3.2-17; NCRWQCB 2010a).

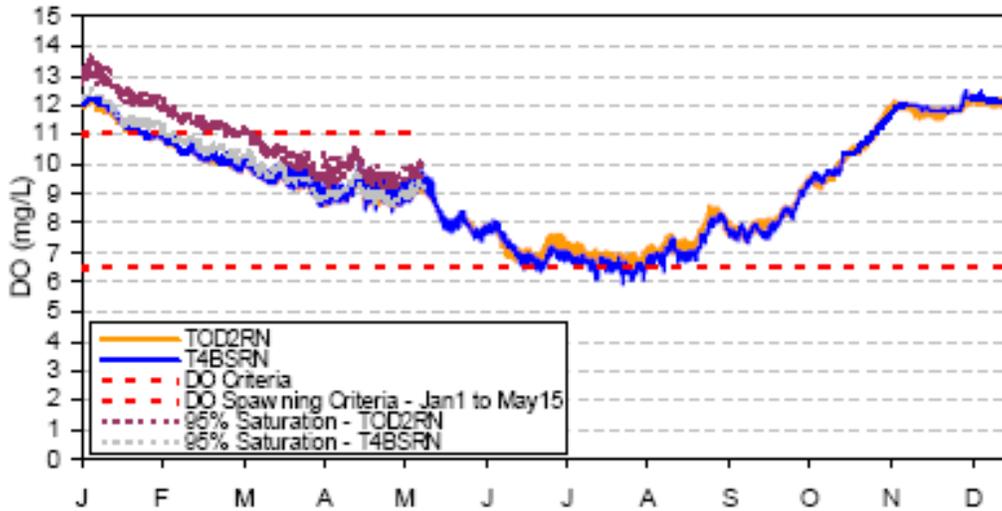


Figure 3.2-16. Predicted Dissolved Oxygen Downstream of J.C. Boyle Dam (RM 224.7 to 228.3) for the Klamath TMDL Scenarios Similar to the Proposed Action (TOD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.

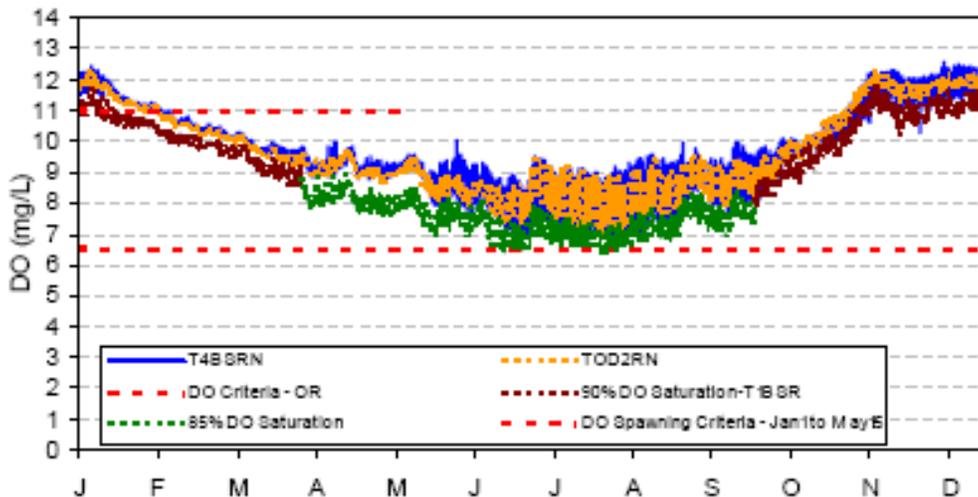


Figure 3.2-17. Predicted Dissolved Oxygen at the Oregon-California State Line (RM 208.5) for the Klamath TMDL Scenarios Similar to the Proposed Action (TOD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.

For the free-flowing reaches of the river replacing the reservoirs, long-term dissolved oxygen levels would differ substantially from the super-saturation (i.e., >100% saturation) that currently occurs in surface waters and the hypolimnetic oxygen depletion in that occurs in bottom waters of Copco 1 and Iron Gate Reservoirs during the April/May through October/November period (see Section 3.2.3.5). Dissolved oxygen in the free-flowing reaches of the river replacing the reservoirs would not exhibit such extremes, instead possessing the riverine signal described above. Relative changes in dissolved oxygen under the Proposed Action would be less pronounced in the reach currently occupied by J.C. Boyle Reservoir, due to the lack of persistent thermal stratification in that reservoir.

The increased daily fluctuations in dissolved oxygen indicated by the Klamath TMDL modeling efforts are not entirely certain; the role of photosynthesis and community respiration from periphyton growth in the free-flowing reaches of the river replacing the reservoirs at the Four Facilities is unknown because nutrient cycling and resulting rates of primary productivity under the No Action/No Project Alternative are uncertain (see Section 3.2.1.1).

**Under the *Proposed Action*, the long-term (2–50 years following dam removal) increase in summer and fall dissolved oxygen concentrations in the Hydroelectric Reach would be beneficial.**

#### Lower Klamath Basin

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the lower Klamath River, the Klamath Estuary and the marine nearshore environment.* Under the Proposed Action, high SSCs are expected in the middle and lower Klamath River immediately following dam removal (see Alternative 2 – Full Facilities Removal of Four Dams – Suspended Sediments). The high fraction of organic carbon present in the reservoir sediments (see Section 3.2.3.1) allows for the possibility of oxygen demand generated by microbial oxidation of organic matter exposed to the water column from deep within the sediment profile and mobilized during dam removal.

Based on results from a dissolved oxygen spreadsheet model (see Section 3.2.4.1), IOD downstream of Iron Gate Dam would be 0–8.6 mg/L and BOD would be 0.3–43.8 mg/L for all water year types considered (i.e., wet, median, dry) and for all six months following drawdown (see Table 3.2-12). The highest predicted oxygen demand levels (i.e., IOD and BOD) would occur during the first four to eight weeks following drawdown of Copco 1 and Iron Gate Reservoirs (i.e., in February 2020) corresponding to the peak SSCs in the river (see above section on suspended sediments). Despite the relatively high predicted IOD and BOD values, dissolved oxygen concentrations downstream of Iron Gate Dam would generally remain greater than 5 mg/L (see Table 3.2-13), the minimum acceptable dissolved oxygen concentration for salmonids. Exceptions include predicted concentrations in February 2020 for median (WY1976) and

typical dry year (WY2001) hydrologic conditions, which exhibit minimum values of 3.5 mg/L and 1.3 mg/L, respectively.

**Table 3.2-12. Estimated Short-term Immediate Oxygen Demand (IOD) and Biochemical Oxygen Demand (BOD) by Month for Modeled Flow and SSCs Immediately Downstream of Iron Gate Dam Under the Proposed Action.**

Year	Avg. Monthly Temperature (deg C) <sup>1</sup>	80% Dissolved Oxygen <sup>2</sup>	Flow (cfs) <sup>3</sup>	Flow (cms)	SSC (mg/L) <sup>4</sup>	IOD (mg/L)	BOD (mg/L)
<b>Typical Wet Hydrology (WY 1984 Conditions Assumed)</b>							
11/30/2019	9.9	7.29	3,343	95	444	0.3	1.6
12/1/2019	5.0	9.40	7,139	202	430	0.3	1.5
1/21/2020	3.7	9.73	8,675	246	1,962	1.2	6.9
2/15/2020	4.4	9.55	3,949	112	7,116	4.5	25.1
3/1/2020	6.7	9.00	4,753	135	593	0.4	2.1
4/15/2020	8.4	8.63	4,374	124	939	0.6	3.3
<b>Median Hydrology (WY 1976 Conditions Assumed)</b>							
11/12/2019	9.9	7.29	2,074	59	96.2	0.1	0.3
12/12/2019	5.0	9.40	2,156	61	202.5	0.1	0.7
1/22/2020	3.7	9.73	6,533	185	2,593.5	1.6	9.1
2/14/2020	4.4	9.55	2,933	83	9,893.2	6.2	34.8
3/1/2020	6.7	9.00	3,016	85	1,461.2	0.9	5.1
4/7/2020	8.4	8.63	2,657	75	509.3	0.3	1.8
<b>Typical Dry Hydrology (WY 2001 Conditions Assumed)</b>							
11/19/2019	9.9	7.29	1,141	32	79.1	0.0	0.3
12/23/2019	5.0	9.40	1,284	36	122.2	0.1	0.4
1/17/2020	3.7	9.73	4,245	120	3,513.7	2.2	12.4
2/16/2020	4.4	9.55	1,040	29	13,573.5	8.6	47.8
3/2/2020	6.7	9.00	1,344	38	2,420.7	1.5	8.5
4/5/2020	8.4	8.63	1,150	33	551.1	0.3	1.9

Source: Stillwater Sciences 2011

<sup>1</sup> Raw daily water temperature data for 2009 from <http://www.pacificorp.com/es/hydro/hl/kr.html#> (PacifiCorp 2009). Monthly summary data also presented in Table 3.2-12.

<sup>2</sup> Initial dissolved oxygen downstream of Iron Gate Dam calculated for 80% saturation using average monthly water temperature, salinity = 0 ppt, and elevation = 707 m (2,320 ft). An initial dissolved oxygen at 70% saturation was used for the November model runs based on 2009 conditions (Appendix C, Table C-7).

<sup>3</sup> Predicted daily flow values from Reclamation hydrologic model output (Greimann et al. 2011). Daily flow values correspond to the peak suspended sediment concentration (SSC) for each month.

<sup>4</sup> Predicted peak suspended sediment concentration (SSC) by month from Reclamation model output under the Proposed Action (Greimann et al. 2011).

**Table 3.2-13. Estimated Location of Minimum Dissolved Oxygen and Location at which Dissolved Oxygen Would Return to 5 mg/L Downstream of Iron Gate Dam Due to High Short-term SSCs Under the Proposed Action.**

Date	Boundary Conditions at Iron Gate Dam			Spreadsheet Model Output		
	Initial Dissolved Oxygen (at 80% Saturation) <sup>1</sup>	IOD	BOD	Minimum Dissolved Oxygen	Location of Minimum Dissolved Oxygen	Location at which Dissolved Oxygen Returns to 5 mg/L <sup>2</sup>
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	RM	RM
<b>Typical Wet Hydrology (WY 1984 Conditions Assumed)</b>						
11/30/2019	7.29	0.3	1.6	7.10	189.5	190.1
12/1/2019	9.40	0.3	1.5	9.18	188.9	190.1
1/21/2020	9.73	1.2	6.9	8.56	188.2	190.1
2/15/2020	9.55	4.5	25.1	5.21	188.9	190.1
3/1/2020	9.00	0.4	2.1	8.70	188.9	190.1
4/15/2020	8.63	0.6	3.3	8.11	188.9	190.1
<b>Median Hydrology (WY 1976 Conditions Assumed)</b>						
11/12/2019	7.29	0.1	0.3	7.29	190.1	190.1
12/12/2019	9.40	0.1	0.7	9.34	189.5	190.1
1/22/2020	9.73	1.6	9.1	8.18	188.2	190.1
2/14/2020	9.55	6.2	34.8	3.49	188.9	175.2
3/1/2020	9.00	0.9	5.1	8.19	188.9	190.1
4/7/2020	8.63	0.3	1.8	8.38	189.5	190.1
<b>Typical Dry Hydrology (WY 2001 Conditions Assumed)</b>						
11/19/2019	7.29	0.0	0.3	7.29	190.1	190.1
12/23/2019	9.40	0.1	0.4	9.40	190.1	190.1
1/17/2020	9.73	2.2	12.4	7.62	188.9	190.1
2/16/2020	9.55	8.6	47.8	1.33	189.5	177.1
3/2/2020	9.00	1.5	8.5	7.62	189.5	190.1
4/5/2020	8.63	0.3	1.9	8.39	189.5	190.1

Source: *Stillwater Sciences 2011*.

<sup>1</sup> Initial dissolved oxygen downstream of Iron Gate Dam calculated for 80% saturation using average monthly water temperature, salinity = 0 ppt, and elevation = 707 m (2,320 ft). An initial dissolved oxygen at 70% saturation was used for the November model runs. See average monthly dissolved oxygen (% saturation) for 2009 in Appendix C, Table C-7. Raw daily water temperature data from <http://www.pacificorp.com/es/hydro/hl/kr.html#> (PacifiCorp 2009).

<sup>2</sup> Minimum acceptable dissolved oxygen concentration for salmonids.

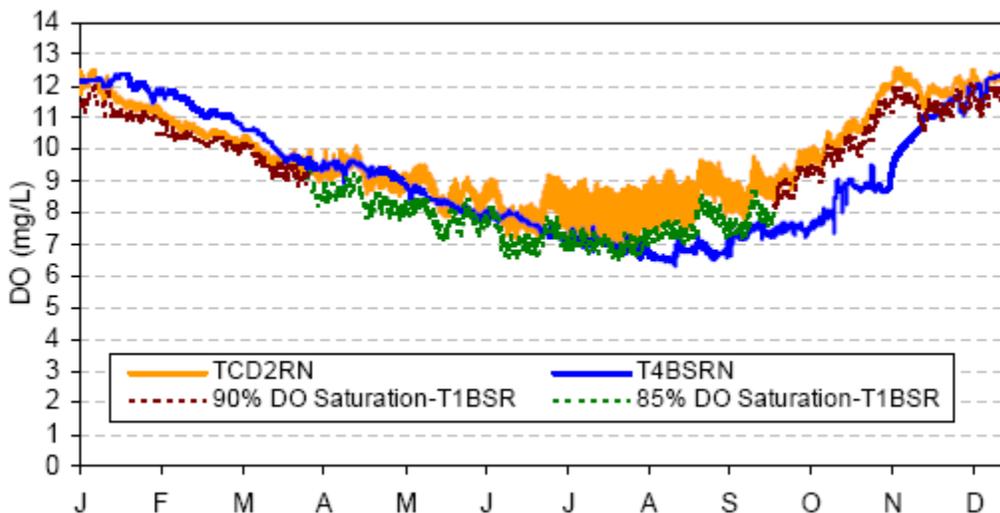
For all water year types (wet, median, dry), the predicted dissolved oxygen minimum values would occur by approximately RM 188–190 ( $\approx$  1–3 km downstream of Iron Gate Dam) and would return to at least 5 mg/L by approximately RM 175–177 (within 20–25 km of the dam), or near the confluence with the Shasta River (RM 176.7) (see Table 3.2-13). The North Coast Basin Plan water quality objective for dissolved oxygen is expressed as percent saturation; at 90 percent saturation, the water quality objective for

November through April, assuming average February (2009) water temperatures, would be 9.6–10.6 mg/l (see Table 3.2-5). Based on the spreadsheet model results, recovery to the North Coast Basin Plan water quality objective of 90 percent saturation would occur generally within the reach from Seiad Valley (RM 129.4) to the mainstem confluence with Clear Creek (see Figure 3.2-1 for location of Clear Creek), or within a distance of 100–150 km (62–93 mi) downstream of the Hydroelectric Reach, for all water year types considered (i.e., wet, median, dry). Thus, model results indicate that short-term (<2 years following dam removal) effects on dissolved oxygen would resolve well upstream of the Klamath Estuary and the Proposed Action would not affect dissolved oxygen in the estuary or the marine nearshore environment.

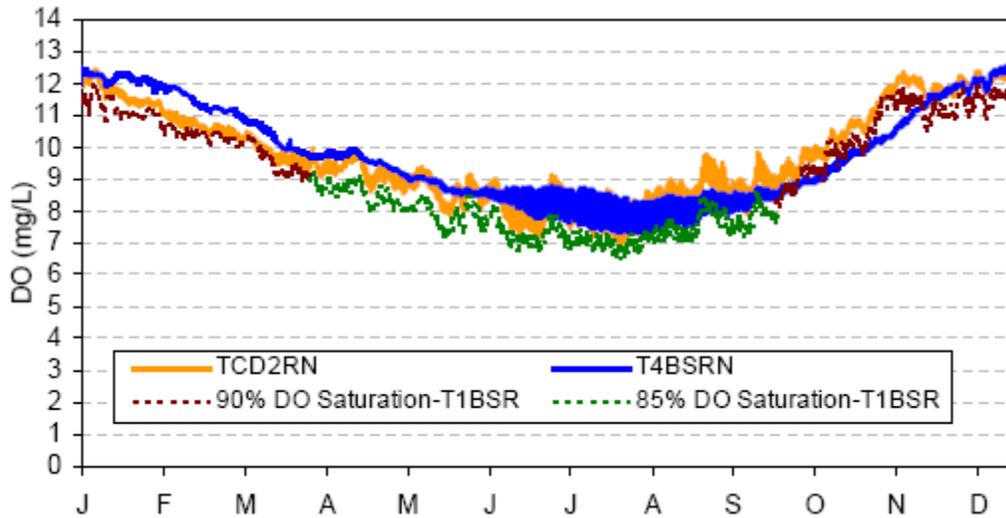
While predicted short-term increases in oxygen demand under the Proposed Action generally result in dissolved oxygen concentrations above the minimum acceptable level (5 mg/L) for salmonids, exceptions to this would occur four to eight weeks following drawdown of J.C. Boyle and Iron Gate reservoirs (i.e., in February 2020), when dissolved oxygen would remain below 5 mg/L from Iron Gate Dam to near the confluence with the Shasta River (RM 176.7), or for a distance approximately 20–25 km downstream of the dam. Recovery to the North Coast Basin Plan water quality objective of 90 percent saturation (i.e., 10–11 mg/L) would occur within a distance of 100–150 km (62–93 mi) downstream of Iron Gate Dam, or generally in the reach from Seiad Valley to the mainstem confluence with Clear Creek, and would therefore not effect dissolved oxygen in the estuary or the nearshore environment. Since the estimated reductions in dissolved oxygen described above would occur as a result of high short-term SSCs following dam removal, they would not extend to the long-term (2-50 years following dam removal). **Under the Proposed Action, the short-term (<2 years following dam removal) decrease in dissolved oxygen concentrations would be a significant impact on the lower Klamath River from Iron Gate dam possibly to Clear Creek, but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment.**

*Removal of the Four Facilities under the Proposed Action could cause long-term (2-50 years following dam removal) overall increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the lower Klamath River, particularly for the reach immediately downstream of Iron Gate Dam. KRWQM (see Section 3.2.1.1 for model background) results using 2001–2004 data indicate that substantial improvements in long-term dissolved oxygen may occur immediately downstream of Iron Gate Dam if the Four Facilities are removed, with increases of 3 to 4 mg/L possible during summer and late fall (PacifiCorp 2004b). KRWQM output also predicts greater daily variations in dissolved oxygen concentrations downstream of Iron Gate Dam to the Trinity River confluence (RM 42.5) in the absence of the KHP dams, based upon the assumption that periphyton growth would occur in this reach if the dams were removed and would increase daily dissolved oxygen fluctuations. However, the KRWQM does not include nutrient retention in the mainstem river downstream of Iron Gate Dam and assumes relatively high nutrient contributions from tributaries (Asarian and Kann 2006a), which could amplify model predicted daily variations in dissolved oxygen due to periphyton growth.*

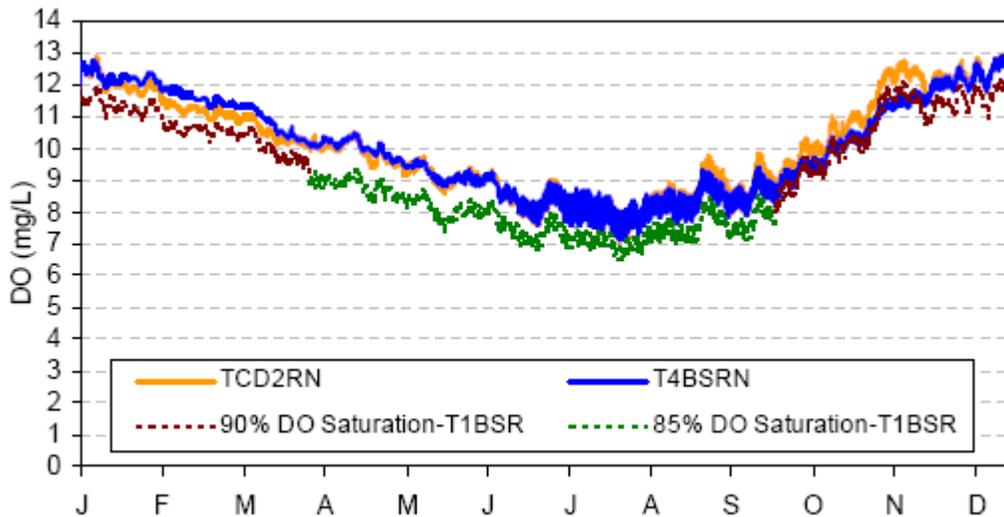
The Klamath TMDL model (see Appendix D) also indicates that under the Proposed Action (similar to the TMDL TCD2RN scenario), dissolved oxygen concentrations immediately downstream of Iron Gate Dam during July through November would be greater than those under the No Action/No Project (similar to the TMDL T4BSRN scenario), due to the lack of stratification and oxygen depletion in bottom waters in the upstream reservoirs as compared with a free-flowing river condition (see Figure 3.2-18 to Figure 3.2-21; NCRWQCB 2010a). The model also predicts that daily fluctuations in dissolved oxygen at this location during this same period would be greater under the Proposed Action (TCD2RN) than the No Action/No Project Alternative (T4BSRN) (Figure 3.2-18), a condition potentially linked to periphyton establishment in the free-flowing reaches of the river that are currently occupied by reservoirs and associated photosynthetic swings in oxygen production. The Klamath TMDL model indicates consistent compliance with the California North Coast Basin Plan water quality objective of 85 percent saturation. Results also indicate that while minimum values may occasionally dip below the current Hoopa Valley Tribe minimum water quality objective (8 mg/L), they would not fall below the 90 percent saturation objective awaiting approval by USEPA (see Table 3.2-6). Winter time (January–March) dissolved oxygen concentrations would be slightly lower under the Proposed Action, but would not fall below Basin Plan minimum criteria for the winter season (90 percent saturation; see Table 3.2-4). Differences in long-term dissolved oxygen concentrations between the Proposed Action and the No Action/No Project Alternative diminish with distance downstream of Iron Gate Dam, with similar or the same predicted dissolved oxygen concentrations and similar magnitude and duration of daily fluctuations by Seiad Valley (RM 129.4) and no differences by the confluence with the Trinity River (RM 42.5) (see Figure 3.2-18 to Figure 3.2-21).



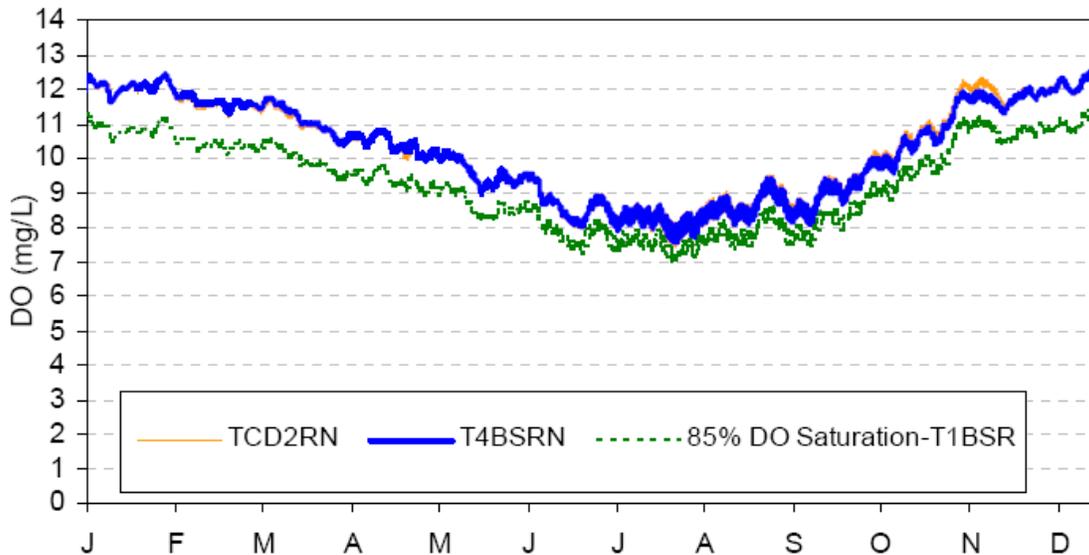
**Figure 3.2-18. Predicted Dissolved Oxygen Downstream of Iron Gate Dam (RM 190.1) for the Klamath TMDL Scenarios Similar to the Proposed Action (TCD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**



**Figure 3.2-19. Predicted Dissolved Oxygen Downstream of the Mainstem Confluence with the Shasta River (RM 176.7) for the Klamath TMDL Scenarios Similar to the Proposed Action (TCD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**



**Figure 3.2-20. Predicted Dissolved Oxygen at Seiad Valley (RM 129.4) for the Klamath TMDL Scenarios Similar to the Proposed Action (TCD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**



**Figure 3.2-21. Predicted Dissolved Oxygen Just Upstream of the Confluence with the Trinity River (RM 42.5) for the Klamath TMDL Scenarios Similar to the Proposed Action (TCD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**

The increased daily fluctuations in dissolved oxygen immediately downstream of Iron Gate Dam predicted by the PacifiCorp and Klamath TMDL modeling efforts are not entirely certain; the role of photosynthesis and community respiration from periphyton growth in the free-flowing reaches of the river replacing the reservoirs at the Four Facilities is unknown because nutrient cycling and resulting rates of primary productivity under the No Action/No Project Alternative are uncertain (see Section 3.4, Algae). Therefore, overall, the removal of the Four Facilities under the Proposed Action would cause long-term increases in summer and fall dissolved oxygen in the lower Klamath River immediately downstream of Iron Gate Dam, along with potentially increasing daily variability. Effects would diminish with distance downstream of Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen by the confluence with the Trinity River. **Under the Proposed Action, the long-term (2–50 years following dam removal) increases in summer and fall dissolved oxygen concentrations immediately downstream of Iron Gate Dam would be beneficial.**

#### 3.2.4.3.2.5 pH

##### Upper Klamath Basin

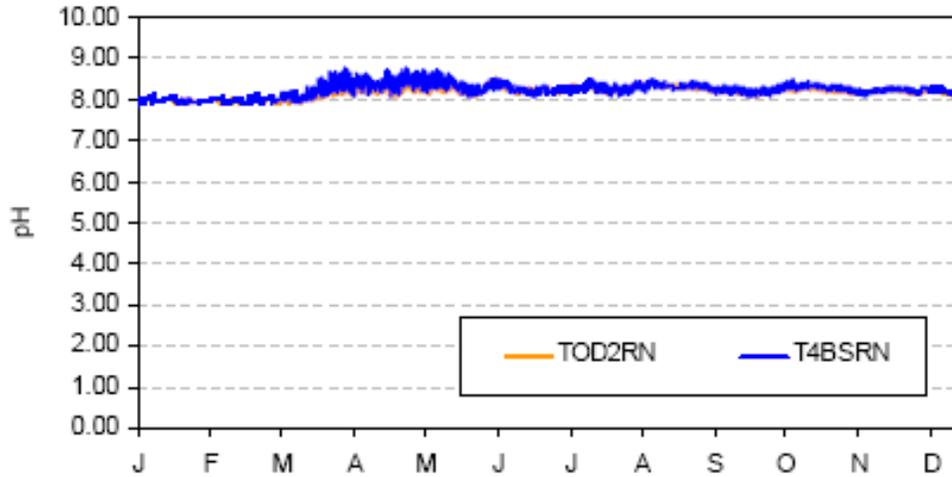
*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in summertime pH in the Hydroelectric Reach.* Modeling of pH conducted for development of the Oregon and California Klamath River TMDLs (Kirk et al. 2010, NCRWQCB 2010a) provides information applicable to the assessment of long-term effects of the Proposed Action on pH in the Upper Klamath Basin.

While reaches upstream of the Hydroelectric Reach (i.e., from RM 231 to RM 251, Upper Klamath Lake, Agency Lake, and the Sprague River) are included on Oregon's 303(d) list for pH, the hydropower reach itself is not currently identified as being impaired (see Table 3.2-8). Further, Klamath TMDL model results indicate that under the Proposed Action (similar to the TMDL TOD2RN scenario), pH in the Hydroelectric Reach immediately downstream of J.C. Boyle Dam would be the same as pH levels modeled under the No Action/No Project (similar to the TMDL T4BSRN scenario), with the potential for some decreases in minimum daily values (see Figure 3.2-22). At the Oregon-California state line, pH levels under the Proposed Action would be roughly the same as those predicted under the No Action/No Project, but with less daily variability during spring (March–May) and fall (October–November) (see Figure 3.2-23) due to the removal of reservoir habitat for suspended algal growth. Similar to dissolved oxygen (see above section), the changes in daily fluctuations for pH indicated by the Klamath TMDL modeling efforts are not entirely certain; the role of photosynthesis and community respiration from periphyton growth in the free-flowing reaches of the river replacing the reservoirs at the Four Facilities (including Keno Impoundment and Lake Ewauna as an assumption of the TOD2RN model [Appendix D]) is unknown because nutrient cycling and resulting rates of primary productivity under the No Action/No Project Alternative are uncertain (see Section 3.2.1.1). Periphyton growth may increase in the Hydroelectric Reach under the Proposed Action and increase daily variability in pH.

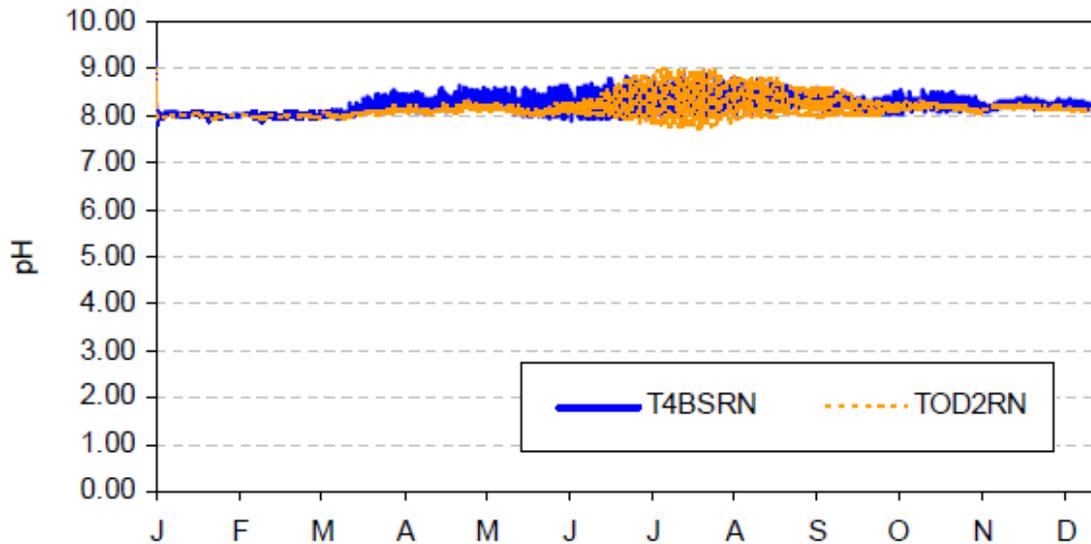
However, based on TMDL model results, pH under the Proposed Action in the Hydroelectric Reach upstream of the Oregon-California state line would consistently meet the Oregon water quality objective of 9.0 units for support of beneficial uses (based on Klamath TMDL model results).

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects. Because drawdown of the reservoirs would begin in winter and would be largely complete by March/April of 2020, pH effects of the Proposed Action in the Hydroelectric Reach would occur, either partially or fully, within the first 1 to 2 years following dam removal and be a short-term effect as well as a long-term effect. The exception to this is the potential for increased daily variability in pH due to increases in periphyton growth in the Hydroelectric Reach. Increased daily variability due to periphyton growth likely would not occur in the short-term because high SSCs and scour in the river 1-2 years following dam removal would limit the establishment of periphyton in the free-flowing river reaches.

**Under the *Proposed Action*, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decrease in high summertime daily pH fluctuations in the Hydroelectric Reach would be beneficial.**



**Figure 3.2-22. Predicted pH Downstream of J.C. Boyle Reservoir (RM 224.7) for the Klamath TMDL Scenarios Similar to the Proposed Action (TOD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**



**Figure 3.2-23. Predicted pH at the Oregon-California State Line (RM 208.5) for the Klamath TMDL Scenarios Similar to the Proposed Action (TOD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**

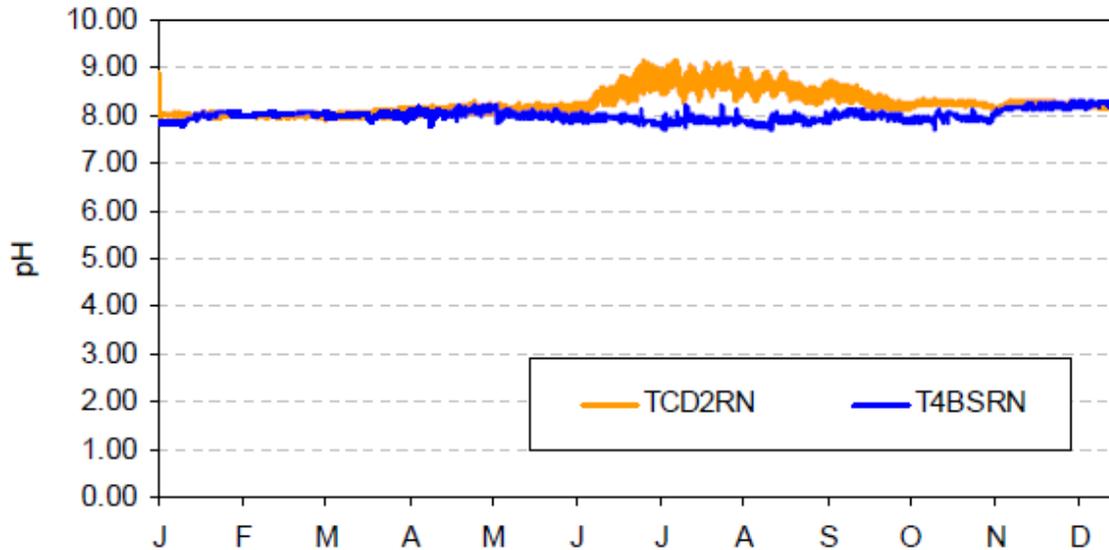
### Lower Klamath Basin

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in long-term (2–50 years following dam removal) summertime increases in pH in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* Modeling of pH conducted for the development of the California Klamath River TMDLs provides information applicable to the assessment of long-term effects of the Proposed Action on pH in the Lower Klamath Basin. In general, results from the Klamath TMDL model (see Appendix D for a summary of model attributes) indicate that spikes in photosynthetic activity in the relatively low alkalinity (typically <100 mg/L; PacifiCorp [2004b], Karuk Tribe of California [2010]) water of the Klamath River, coupled with high air temperatures and high levels of biostimulatory nutrients during the late-summer and early-fall months, would result in large daily variation in pH and generally high pH levels in the Klamath River downstream of Iron Gate Dam (see Figure 3.2-24). This may result in instantaneously exceeding the North Coast Basin Plan water quality objective maximum pH value of 8.5 (see Table 3.2-4), which may be stressful to fish and other aquatic life and adversely affect beneficial uses.

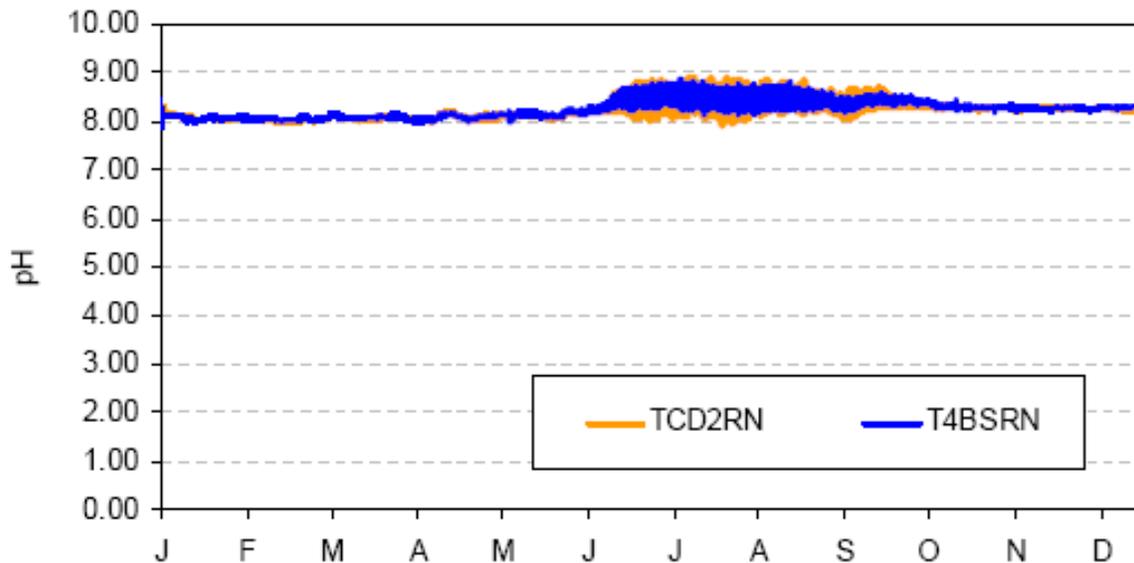
Predicted differences in pH between the Proposed Action and No Action/No Project Alternative decrease in magnitude with distance downstream of Iron Gate Dam, and would no longer be evident by the Scott River confluence (RM 143.0) (see Figure 3.2-25). The Hoopa Valley Tribe water quality objective for pH (7.0-8.5) (see Table 3.2-6) is met at all times under the Proposed Action (similar to the TMDL TCD2RN scenario) for the Klamath River at the reach of Hoopa jurisdiction (≈45–46). Therefore, under the Proposed Action, pH would not be affected in the lower river downstream of the Scott River, including the Klamath Estuary and the marine nearshore environment.

Although the California Klamath River TMDL model predicts long-term increases in pH due to enhanced periphyton growth and increased rates of photosynthesis immediately downstream of Iron Gate Dam, this condition may be counteracted by increased scour at this location under the Proposed Action (see Section 3.4, Algae). Given the uncertainty in the model output from Iron Gate Dam to the Shasta River, and given the localized and instantaneous nature of the predicted high pH levels during summer months, these long-term pH increases would be less than significant.

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects. Because drawdown of the reservoirs would begin in winter and would be largely complete by March/April of 2020, pH effects of the Proposed Action in the Hydroelectric Reach would occur, either partially or fully, within the first 1 to 2 years following dam removal and be a short-term effect as well as a long-term effect. The exception to this is the potential for increases in pH due to increases in periphyton growth in the Hydroelectric Reach. The latter likely would not occur in the short-term because high SSCs and scour in the river 1-2 years following dam removal would limit the establishment of periphyton in the free-flowing river reaches.



**Figure 3.2-24. Predicted Klamath River pH Immediately Downstream of Iron Gate Dam for the Klamath TMDL Scenarios Similar to the Proposed Action (TCD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**



**Figure 3.2.25. Predicted Klamath River pH upstream of the Scott River (RM 143.0) for the Klamath TMDL Scenarios Similar to the Proposed Action (TCD2RN Scenario) and the No Action/No Project Alternative (T4BSRN Scenario). Source: NCRWQCB 2010a.**

**Long-term summertime increases in pH under the *Proposed Action* would be less than significant for the reach from Iron Gate Dam to the Scott River (RM 143). There would be no change from existing conditions on pH in the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) for the Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the marine nearshore environment.**

#### **3.2.4.3.2.6 Chlorophyll-a and Algal Toxins**

##### Upper Klamath Basin

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in levels of chlorophyll-a and algal toxins in the Hydroelectric Reach.* Despite the slightly increased total nutrient concentrations anticipated under the Proposed Action in the Hydroelectric Reach (see Alternative 2 – Full Facilities Removal of Four Dams – Nutrients), elimination of the lacustrine (reservoir) environment that currently supports growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* would result in decreases in high seasonal concentrations of chlorophyll-a (>10 µg/L) and periodically high levels of algal toxins (> 8 µg/L microcystin) generated by suspended blue-green algae. While algal toxins and chlorophyll-a produced in Upper Klamath Lake may still be transported into the Hydroelectric Reach at levels exceeding water quality objectives for Oregon and California, additional *in situ* production of the toxins and chlorophyll-a associated with suspended algae would be significantly less likely to occur in the free-flowing river under the Proposed Action.

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects. Because drawdown of the reservoirs would begin in winter and would be largely complete by March/April of 2020 (i.e., the beginning of the growth season), elimination of the lacustrine (reservoir) environment under the Proposed Action would occur, either partially or fully, within the first 1 to 2 years following dam removal. Therefore, this would be a short-term effect on chlorophyll-a and algal toxins in the Hydroelectric Reach as well as a long-term effect.

**Under the *Proposed Action*, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decrease in production of algal toxins and chlorophyll-a in the Hydroelectric Reach would be beneficial.**

##### Lower Klamath Basin

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in levels of chlorophyll-a and algal toxins transported into the lower Klamath River and the Klamath Estuary.* In addition to the decreases in high seasonal concentrations of chlorophyll-a (>10 µg/L) and periodically high levels of algal toxins (>8 µg/L microcystin) generated by nuisance algal species that are described for the Hydroelectric Reach (see Section 3.2.4.3.2.6, Upper Klamath Basin), growth of *M. aeruginosa* in reaches of the Klamath

River downstream of Iron Gate Dam would be reduced in the absence of significant reservoir blooms. While algal toxins and chlorophyll-*a* produced in Upper Klamath Lake (see Section 3.2.3.1) may still be transported into the Lower Klamath Basin, existing data indicate that concentrations of microcystin leaving Upper Klamath Lake have rarely, if ever, been measured at levels that exceed water quality objectives for Oregon and California. In contrast, algal production in Iron Gate and Copco Reservoirs is responsible for the observed public health exceedances occurring in the Klamath River downstream of Iron Gate Dam (see Section 3.2.3.7 and Appendix C, Section C.6). Under the Proposed Action, the *in situ* production of toxins and chlorophyll-*a* associated with suspended algae in the reservoirs would be eliminated.

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects. Because drawdown of the reservoirs would begin in winter and would be largely complete by March/April of 2020 (i.e., the beginning of the growth season), effects of the Proposed Action on chlorophyll-*a* and algal toxins in the lower Klamath River would occur, either partially or fully, within the first 1 to 2 years following dam removal and be a short-term effect as well as a long-term effect.

**Under the Proposed Action, the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in the production of algal toxins and chlorophyll-*a* in upstream reservoirs and subsequent transport into the lower Klamath River and the Klamath Estuary would be beneficial.**

#### **3.2.4.3.2.7 Inorganic and Organic Contaminants**

##### Upper Klamath Basin

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the Hydroelectric Reach.* Due to the relatively small volume of the sediment deposits behind J.C. Boyle Dam (i.e., 15 percent of total volume for the Four Facilities), concentrations of suspended sediments downstream of J.C. Boyle Reservoir would be considerably less than those anticipated to occur downstream of Iron Gate Reservoir. Because the transport of contaminants would be associated with the elevated SSCs, as a conservative estimate, effects of sediment release on inorganic and organic contaminants in the Hydroelectric Reach downstream of J.C. Boyle Dam would be the same as those for the lower Klamath River. **Under the Proposed Action, the short-term (< 2 years following dam removal) and long-term (2–50 years following dam removal) effects of sediment release on freshwater aquatic species due to low-level exposure to sediment-associated inorganic and organic contaminants in the Hydroelectric Reach would be a less-than-significant impact.**

*The Proposed Action could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) human exposure to contaminants from contact with deposited sediments on exposed reservoir terraces and river banks following reservoir drawdown.* Potential human health risks associated with exposure to sediments deposited on exposed reservoir terraces and river banks within the Hydroelectric Reach

were evaluated using comparisons of the 2009–2010 Secretarial Determination reservoir sediment core data to USEPA residential soil screening levels, and calculation of human/mammal TEQs and comparison to ODEQ Bioaccumulation SLVs (exposure “Scenario 3” in CDM [2011]). No samples exceeded the total non-carcinogenic screening levels. Forty-seven samples exceeded the USEPA total carcinogenic screening level for arsenic or nickel, including samples from J.C. Boyle, Copco 1 and Iron Gate Reservoirs (and the Klamath Estuary, although this location is not relevant to reservoir deposits under the Proposed Action). However, these screening levels were developed assuming residential exposure patterns (a 30-year exposure duration with soil ingestion rate of 200 mg/day for children over 6 years and 100 mg/day for adults over 24 years) (USEPA 1991), which is quite conservative and the measured values are well within typical background concentrations for the Klamath Basin (arsenic may be naturally elevated in the Upper Klamath Basin [see Section 3.2.2.8, Inorganic and Organic Contaminants]). For 19 analytes measured during 2009–2010, laboratory analytical reporting limits were greater than the applicable human health screening levels, including PCBs, VOCs, and SVOCs (CDM 2011). It is not possible to directly confirm that these compounds are above or below applicable human health screening levels.

TEQs calculated for dioxin, furan, and dioxin-like PCBs were at concentrations above ODEQ Bioaccumulation SLVs for mammals in sediments from each of the reservoirs (CDM 2011). ODEQ Bioaccumulation SLVs are not applicable to water bodies in California; however, they provide a reference for comparison purposes. Although site-specific background data are lacking, TEQs are also only slightly above regional background concentrations and thus have limited potential for adverse effects for humans exposed to sediment deposits on reservoir terraces or river banks. The sources of the slightly elevated dioxin, furan, and dioxin-like PCB compounds are not known; however, sources may include atmospheric deposition, regional forest fires, and possibly burning of plastic items (CDM 2011).

Results from the 2009–2010 Secretarial Determination sediment chemistry analyses indicate that sediment deposits associated with the Proposed Action would cause no adverse effects on humans (terrestrial biota were also evaluated qualitatively, but are not discussed here) (see Figure 3.2-2). **Under the Proposed Action, the effects of sediment deposition on reservoir terraces and river banks on short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) human exposure to sediment-associated inorganic and organic contaminants in the Hydroelectric Reach would be a less-than-significant impact.**

*Dam deconstruction and revegetation (i.e., hydroseeding) activities could cause short-term (<2 years following dam removal) increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation (i.e., hydroseeding) equipment in the Hydroelectric Reach.* These effects would be reduced through implementation of BMPs for deconstruction and revegetation activities that would occur in or adjacent to the Klamath River. BMPs would minimize or eliminate the potential for toxic substances to enter the water. **Under the Proposed Action, the short-term (<2 years following dam removal) effects on inorganic and organic**

**contaminants in the Hydroelectric Reach from dam deconstruction and restoration (i.e., hydroseeding) activities would be a less-than-significant impact.**

*Under the Proposed Action, herbicide application associated with management of the reservoir footprint area could result in short-term (<2 years following dam removal) levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach.* Based on the reservoir area management planning currently underway, establishment of herbaceous vegetation in drained reservoir areas will be undertaken to stabilize the surface of the sediment and minimize erosion from exposed terrace surfaces following drawdown (O'Meara et al. 2010). Herbicides would be necessary during this period to control the growth of invasive plant species, with application occurring during the first year following dam removal and potentially during the second, if further treatments are necessary. Herbicide application would be required for 25 percent, 50 percent, and 75 percent of the total reservoir area for the low, most probable, and high cost restoration estimates, respectively (O'Meara et al. 2010).

The reservoir area management plan recognizes the potential water quality effects of herbicide application and calls for the use of herbicides with low soil mobility, and thus low potential to leach into groundwater or surface waters. It also calls for low use rates of herbicides and application of chemicals that pose a low toxicity risk to fish and aquatic organisms. Glyphosate is suggested in the management plan as one potential herbicide with such characteristics (O'Meara et al. 2010). To minimize use rates, spot treatments of a post-emergent herbicide such as glyphosate would be used rather than aerial application.

If glyphosate is chosen as a suitable herbicide for reservoir invasive plan management, it is recommended that glyphosate formulations containing POEA or R-11 are avoided to reduce risks to amphibians and other aquatic organisms (BLM 2010). Aquatic formulations of glyphosate (i.e., Glyphos Aquatic) are developed for use in sensitive protected environments such as habitat restoration sites and wetlands. Additionally, best management practices such as the "no rain" rule should be followed, such that glyphosate would never be applied when weather reports predict precipitation within 24 hours of application, before or after (BLM 2010). If another herbicide is chosen, it should meet the characteristics of low soil mobility and low toxicity to fish and aquatic organisms, and should be applied using BMPs such as low use rates (i.e., spot treatments), avoidance of application in the rain, avoidance of treatments during periods when fish are in life stages most sensitive to the herbicide(s) used, and adherence to appropriate buffer zones around stream channels (BLM 2010). **Under the Proposed Action, given implementation of applicable BMPs, the effect of herbicide application on toxicity and/or bioaccumulation in the Hydroelectric Reach during the revegetation period would be a less-than-significant impact.**

### Lower Klamath Basin

#### *Freshwater Aquatic Life Toxicity and/or Bioaccumulation*

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the lower Klamath River.* Organic and inorganic contaminants have been identified in the sediment deposits currently trapped behind the dams (see Section 3.2.3.1). Under the Proposed Action, short-term (<2 years following dam removal) pathways of contaminant exposure for freshwater aquatic species include exposure during sediment transit through the Lower Klamath Basin river reaches (exposure “Scenario 2” in CDM [2011]), while long-term (2-50 years following dam removal) pathways include exposure following deposition of sediments along river beds and the estuary bottom (exposure “Scenario 4” in CDM [2011]).

As described for the No Action/No Project Alternative, existing sediment chemistry data (2004–2005) collected from 26 cores in J.C. Boyle, Copco 1, and Iron Gate Reservoirs indicate generally low levels of metals, pesticides, chlorinated acid herbicides, PCBs, VOCs, SVOCs, cyanide, and dioxins (Shannon & Wilson, Inc. 2006; see Section 3.2.3.8). Collection of additional sediment cores in 2009–2010 for the Secretarial Determination process indicates no positive exceedances of applicable screening levels indicating a low risk of toxicity to freshwater sediment-dwelling organisms in the lower Klamath River under the Proposed Action. Results from acute (10-day) sediment bioassays for two national benchmark toxicity species (see above discussion under No Action/No Project Alternative) indicate generally equal or greater survival in reservoir sediments as compared with laboratory control samples. The exception is J.C. Boyle Reservoir, which exhibited considerably lower survival for *Chironomus dilutus* in the on-thalweg sample as compared with the laboratory control (64 percent vs. 95 percent) and somewhat lower survival for the off-thalweg sample (83 percent vs. 95 percent) (CDM 2011).

Although this result suggests potential for toxicity to freshwater benthic organisms downstream of the dams, under the Proposed Action, sediments from all three reservoirs will mix as they move downstream, exposing downstream aquatic biota to an “average” sediment composition rather than a reservoir-specific composition. Further, the total volume of erodible sediments in Copco 1 and Iron Gate Reservoirs (2.7 million yd<sup>3</sup> and 2.83 million yd<sup>3</sup>, respectively; see Section 2.5.1) is considerably greater than that of J.C. Boyle Reservoir (0.94 million yd<sup>3</sup>; see Section 2.5.1), diminishing the potential influence of J.C. Boyle Reservoir sediments downstream biota exposure. Finally, fine sediments released during drawdown and dam removal will be transported by large water volumes, and are unlikely to settle along the riverbed (Greimann et al. 2011, Stillwater Sciences 2008); therefore, downstream freshwater benthic organisms are unlikely to experience the same intensity of exposure to sediment elutriate concentrations or reservoir sediments as during the bioassays themselves. Overall, the freshwater sediment bioassays indicate a low likelihood of acute toxicity to downstream benthic organisms due to sediment release under the Proposed Action.

Elutriate chemistry results indicate that before consideration of dilution, aluminum, chromium, copper, lead, and mercury are present at concentrations above fresh water quality criteria for samples from J.C. Boyle, Copco 1, and Iron Gate Reservoirs (CDM 2011). However, as described above, dilution of mobilized sediments with reservoir and river water is anticipated during drawdown and dam removal activities, with further dilution occurring downstream of Iron Gate Dam due to tributary inflows. Thus, water column toxicity due to the concentrations under the Proposed Action is unlikely (CDM 2011).

Elutriate bioassay results indicate no statistically significant reduction of mean 96-hour rainbow trout survival for exposure to samples from Copco 1 and Iron Gate Reservoirs tested at 1 percent and 10 percent elutriate treatments, but a significant reduction from Copco 1 at 100 percent elutriate treatment and from Iron Gate at 50 percent and 100 percent elutriate treatments. Of these, the 1 percent and 10 percent treatments are considered to be most representative of field conditions upon reservoir drawdown due to the expectation of substantial mixing and dilution with river water and tributary inputs (CDM 2011). For J.C. Boyle Reservoir, elutriate bioassay results indicate that no further dilution would be required to prevent water column toxicity to freshwater fish, even without considering the dilution that will take place during drawdown and dam removal (CDM 2011).

Combined, results from the 2004–2005 Shannon & Wilson, Inc. (2006) study and the 2009–2010 Secretarial Determination study (CDM 2011) indicate that in the short-term (<2 years following dam removal), one or more chemicals are present at levels with potential to cause minor or limited adverse effects on freshwater aquatic species (see Figure 3.2-2). In the long-term, one or more chemicals present, but at levels unlikely to cause adverse effects based on the lines of evidence.

**Under the *Proposed Action*, the short-term (< 2 years following dam removal) and long-term (2–50 years following dam removal) effects of sediment release, transit, and potential downstream river-bank deposition on freshwater aquatic species due to low-level exposure to sediment-associated inorganic and organic contaminants in the lower Klamath River would be a less-than-significant impact.**

*Marine Aquatic Life Toxicity and/or Bioaccumulation*

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in concentrations of inorganic and organic contaminants and result in low-level exposure for aquatic species in the Klamath Estuary and marine nearshore environment. Organic and inorganic contaminants have been identified in the sediment deposits currently trapped behind the dams (see Section 3.2.3.8). Under the Proposed Action, short-term pathways of contaminant exposure for marine aquatic species include short-term exposure during sediment transit through the Klamath Estuary and marine nearshore environment as well as exposure following deposition in the marine nearshore environment (exposure “Scenario 5” in CDM [2011]).*

For the 2009–2010 Secretarial Determination study, there were no positive exceedances of the applicable and available maximum marine screening levels (CDM 2011), with the exception of a small number of sediment samples from J.C. Boyle Reservoir, which exceeded the applicable marine screening level for dieldrin and 2,3,4,7,8,-PECDF (CDM 2011). As the marine screening levels are designed to be protective of direct toxicity to benthic and epibenthic organisms, corresponding to a “no adverse effects level,” the vast majority of 2009–2010 samples indicate a low risk of toxicity to sediment-dwelling organisms. Additionally, the Proposed Action would result in mixing and dilution during sediment release and transit through the Klamath River estuarine and/or marine nearshore environment, exposing downstream aquatic biota to an “average” water column concentration rather than a reservoir- or site-specific concentration. For 33 analytes, laboratory analytical reporting limits were greater than the marine screening level itself (CDM 2011). For these analytes, it is not possible to determine whether these compounds are present in reservoir sediments either above or below levels of concern.

Sediment bioassays from a single upper Klamath Estuary sample indicate greater survival (89–99 percent survival) of national benchmark toxicity species in the estuary sediment sample as compared with the laboratory control samples (81–94 percent survival) (see CDM 2011). A simple comparison between the estuary area composite acute toxicity results and the reservoir super-composite results indicates similar survival for *Chironomus dilutus* (89 percent vs. 64–94 percent, respectively) and greater survival for *Hyalella azteca* (99 percent vs. 80–94 percent, respectively). The similarity in results is suggestive that under the Proposed Action, no further acute toxicity would be anticipated in the estuarine and/or marine environment as compared with that of the reservoir sediments; however, additional toxicity testing using estuarine and marine test organisms is needed to confirm this assumption. Elutriate chemistry results (prior to consideration for mixing and dilution) do not indicate likely toxicity in the marine nearshore environment under the Proposed Action (CDM 2011).

With respect to bioaccumulation potential, there are no exceedances of applicable marine bioaccumulation screening levels (CDM 2011). Further, with the exception of four samples in J.C. Boyle Reservoir (CDM 2011), levels of other known bioaccumulative compounds did not exceed ODEQ bioaccumulation SLVs for marine fish. Note that ODEQ bioaccumulatory screening levels are not strictly applicable in the California marine offshore environment; however, they are indicative of potentially bioaccumulative compounds.

Elutriate chemistry results indicate that several chemical concentrations in elutriate exceed one or more water quality criteria for evaluation of surface water exposures for marine biota. Chemicals that exceed marine surface water criteria include those generally considered to be nontoxic (e.g., phosphorus) as well as those with substantial potential for contributing to adverse effects (e.g., copper). Exposures to suspended sediment with elevated concentrations of potentially toxic chemicals are of lower concern for marine receptors than exposures to elevated concentrations of dissolved chemicals. The chemicals with the greatest potential to cause adverse effects in elutriate (e.g., copper)

are, under field conditions associated with this exposure scenario, expected to bind to particulate matter and therefore are unlikely to contribute substantially to elevated concentrations of dissolved forms in the water column. Further, substantial dilution of river water and associated suspended sediments in the marine environment would reduce the amount of sediment suspended in the water column compared to conditions directly below Iron Gate Dam (CDM 2011).

Although not conducted specifically for estuarine or marine organisms, additional lines of evidence from the 2009–2010 Secretarial Determination study including the evaluation of elutriate toxicity bioassay results for rainbow trout, sediment toxicity bioassay results for benthic invertebrate national benchmark species, comparisons of tissue-based TRVs to chemical concentrations in laboratory-reared freshwater clams and worms exposed to field collected sediments (see prior discussion of Proposed Action potential effects on freshwater aquatic species), and comparisons of tissue-based TRVs and TEQs to chemical concentrations in field collected fish tissue (see discussion under No Action/No Project, Section 3.2.4.3.1.7), exposure to inorganic and organic compounds in sediments released from the reservoirs under the Proposed Action is unlikely to cause adverse long-term impacts on estuary and marine near shore aquatic species (see Figure 3.2-2).

**Under the *Proposed Action*, the short-term (< 2 years following dam removal) and long-term (2–50 years following dam removal) effects of sediment release, transit, and deposition on aquatic species due to low-level exposure to sediment-associated inorganic and organic contaminants in the Klamath Estuary and marine nearshore environment would be a less-than-significant impact.**

#### *Human Health*

*Sediment release associated with the Proposed Action could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) human exposure to contaminants from contact with deposited sediments on downstream river banks following reservoir drawdown.* Under the Proposed Action, potential human exposure to inorganic and organic chemicals during periods of drawdown and near-term flushing of elevated SSCs in the lower Klamath River (i.e., through ingestion of contaminants from drinking water withdrawals or dermal contact with water) is likely to be of limited occurrence and shorter duration and is not further addressed.

Short-term human exposure through fish consumption (i.e., a food web pathway) can not be assessed with the available data. Resident fish species in the reservoirs are considered unlikely to survive and populate the riverine environment following the Proposed Action (see Section 3.3, Aquatic Resources). Exposure and bioaccumulation by resident riverine species in the lower Klamath River and estuary from water and suspended sediments transported under the Proposed Action is understood to be short-term (<2 years following dam removal). Human exposure to contaminants from contact with residual sediments deposited on downstream river banks is possible and the mechanism for exposure is the same as that for potential contaminants deposited on exposed reservoir terraces and river banks in the Hydroelectric Reach (see Section 3.2.4.3.2.7, Upper Klamath Basin and Figure 3.2-2).

**Under the *Proposed Action*, the effects of sediment release on human health due to short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) exposure to sediment-associated inorganic and organic contaminants in the lower Klamath River would be a less-than-significant impact.**

*Dam deconstruction and restoration (i.e., hydroseeding) activities could cause short-term (<2 years following dam removal) increases in inorganic and organic contaminants from hazardous materials associated with construction and restoration (i.e., hydroseeding) equipment in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment. These short-term effects would be a significant impact. However, the impacts may be reduced through implementation of BMPs for deconstruction and restoration activities that would occur in or adjacent to the Klamath River. BMPs would minimize or eliminate the potential for toxic substances to enter the water during the deconstruction and revegetation period. Under the *Proposed Action*, the short-term (<2 years following dam removal) effects on inorganic and organic contaminants in the lower Klamath River and the Klamath Estuary from dam deconstruction and restoration (i.e., hydroseeding) activities would be a less-than-significant impact. There would be no change from existing conditions on the marine nearshore environment.*

#### **3.2.4.3.2.8 Keno Transfer**

*Implementation of the Keno Transfer could cause adverse water quality effects. The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on water quality compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (see KHSA Section 7.5.4). Therefore, implementation of the Keno Transfer would result in no change from existing conditions.*

#### **3.2.4.3.2.9 East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause adverse water quality effects. Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.*

#### **3.2.4.3.2.10 KBRA**

The KBRA, which is a component of the Proposed Action, encompasses several programs that could affect water quality, including:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan

- Wood River Wetland Restoration
- Water Diversion Limitations
- Water Use Retirement Program
- Interim Flow and Lake Level Program
- Upper Klamath Lake and Keno Nutrient Reduction

*Implementation of restoration actions, programs, and/or plans presented in the KBRA would accelerate restoration actions currently underway throughout the Klamath Basin (with the exception of the Trinity Basin) including KHSA implementation (i.e., dam removal) and could affect short-term (i.e., during construction activities) and long-term water quality.* Within the KBRA, the Fisheries Program and the Water Resources Program encompass the majority of the restoration actions envisioned under the agreement (see Section 2.4.3.8). Many of the KBRA implementation actions are for fisheries restoration, reintroduction, and actions that enhance the amount and timing of water available for fish. Restoration actions include, but are not limited to, prevention of fish entrainment, rehabilitation of uplands, flood plains, riparian habitats, and stream channels, provision of fish passage, and re-introduction of fish to the Upper Klamath Basin, and instream riparian, and upslope actions that protect water quality, improve water quality and/or increase habitat complexity. KBRA elements under both the Fisheries Program and Water Resources Program are also likely to affect water quality in the basin. Some actions will affect water quality through flow augmentation, while others, including the restoration and permanent protection of riparian vegetation, are anticipated to have non-flow-related water quality effects. The following sections present a programmatic analysis of potential KBRA effects on water quality.

#### Phase I Fisheries Restoration Plan

*Implementation of the Phase I Fisheries Restoration Plan could result in long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels.* Several ongoing resource management actions related to water quality may be amplified under the Phase I Plan (see Section 2.4.3.8). The following sections describe the ongoing actions and types of new programs that could be implemented, and their anticipated short-term and long-term effects at a programmatic level.

#### *Floodplain Rehabilitation*

Floodplain rehabilitation work would include activities to improve or restore connections between channels and floodplains to create and maintain off-channel habitat accessible to overwintering juvenile salmonids. Floodplain rehabilitation may also include activities such as riparian planting and understory thinning to facilitate the development of mature riparian stands that would provide streamside shade and large and small wood to stream channels and floodplains. Additionally, wetland restoration and levee setback or dike removal may be used to reconnect floodplain hydrology.

In the short-term (i.e., during construction activities), these activities may involve the use of backhoe equipment to dig channels, remove/reposition levees and dikes, and conduct mechanical planting. These activities could increase suspended sediments and increase

the potential for inorganic and organic contaminants from hazardous materials associated with construction activities. In the long term, increased seasonal off-channel habitat, wetland restoration, and levee setbacks, may reduce fine sediment deposition in the main channel by allowing sediments and associated nutrients to deposit on floodplains and in wetlands during high flows. Increased stream shading would decrease summer temperatures and increase dissolved oxygen concentrations.

*Wetland and Aquatic Habitat Restoration*

Upstream of Upper Klamath Lake, activities would include the purchase of restoration easements and the creation of grass banks to facilitate habitat improvement and landowner economic stability. In the short term (i.e., during construction activities), these activities may involve the use of hydroseeding to conduct grass planting. In the long term, restoration easements may reduce fine sediment deposition in the main channel by allowing sediments and associated nutrients to deposit along streambanks and wetlands protected by easements and grass banks during high flows.

*Woody Debris Placement*

In-stream and streambank large woody debris placement may include both mobile wood (i.e., unanchored) and complex stationary (i.e., anchored) structures and may be used to create off-channel fish habitat or provide cover in deeper pools. In the short term, these activities may involve the use of construction equipment to place large wood in the stream channel or along banks.

*Fish Passage Correction*

Correction of fish passage issues throughout the Klamath Basin may include culvert upgrades or replacement to meet current fish passage standards and correction of other fish blockages to restore access to new or historical habitats. In the short term, these activities may include in-channel construction of culverts through existing roadways.

*Cattle Exclusion Fencing*

Cattle exclusion would include the construction of fencing as allowed by federal and state regulations and local land management plans to prevent cattle from trampling stream banks and would allow the regeneration of riparian vegetation and improving channel structure. Cattle exclusion may be conducted in conjunction with riparian planting as part of the aforementioned floodplain rehabilitation activities. In the long-term, these activities would decrease fine sediment inputs and associated nutrients (primarily phosphorus) to water bodies in the Klamath Basin and promote increased stream shading and reduced summer water temperatures.

*Mechanical Thinning and Prescribed Burning*

Mechanical thinning and prescribed burning of upland forest areas may be used to mimic some of the functions and characteristics historically provided by a natural fire regime. In the long term, thinning and prescribed burning may reduce the potential for catastrophic fires and the associated high rates of erosion and nutrient release (primarily phosphorus) to tributaries and the main-stem Klamath River.

*Purchase of Conservation Easements and/or Land*

Purchase of conservation easements and land from willing sellers may allow for more direct land management for habitat enhancement purposes, where the majority of the land involved would be agricultural land. In the long term, these activities would remove acreage from fertilizer and pesticide/herbicide applications, and would decrease nutrients (primarily nitrogen) and organic contaminants runoff to the Klamath River.

*Road Decommissioning*

Road decommissioning would reduce road densities in areas with a high potential for slope failure and would stabilize hillsides. These activities would decrease the incidence of road failure and would minimize a source of chronic fine sediment and nutrient (primarily phosphorus) input into water bodies in the Klamath Basin.

*Treatment of Fine Sediment Sources*

Treatment of fine sediment sources would include management of stormwater runoff from roads and improved agricultural and forestry management practices. In the long term, these activities would help decrease the input of fine sediment and associated nutrients (primarily phosphorus) into water bodies in the Klamath Basin.

*Gravel Augmentation*

Gravel augmentation involves the direct placement of spawning size gravel into the stream channel. Gravel augmentation can increase spawning habitat in systems by increasing the amount of area with suitable substrate. Gravel augmentation activities may involve transportation of gravel from an off-site source using dump trucks and placement in the stream using backhoes. In the short term, these activities would increase suspended sediments in waters proximal to the gravel deposition site and would increase the potential for inorganic and organic contaminants from hazardous materials associated with construction activities.

Individual resource management actions under the Phase I Fisheries Restoration Plan would require separate project-level evaluations under NEPA and ESA; at the programmatic level considered for this EIS/EIR, there is insufficient information to evaluate project-specific short-term (i.e., during construction activities) effects on water quality from these actions. The timing of and specific locations where these resource management actions could be undertaken is not certain, but it is assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Although negative short-term effects of increased suspended sediments and increased potential for inorganic and organic contaminants from hazardous materials associated with construction equipment could occur, implementation of construction-related BMPs would occur as part of the Phase I Fisheries Plan resource management actions. **Given these BMPs (including the BMP requiring biodegradable oils in construction equipment used in streams or rivers, see Appendix B.1.1 Water Quality, the short-term effects on suspended sediment concentrations and inorganic and organic contaminants would be less-than-significant.**

In the long term, most of the above resource management actions would reduce fine sediment inputs into streams in the Klamath Basin. Treatment of fine sediment sources may also include other management actions, including managing stormwater runoff from roads and other developed areas, improved agricultural and forestry management practices, and other specific actions depending on the sources of fine sediments. The Phase I Fisheries Restoration Plan activities would also improve shading and thus cool summer water temperatures, increase riparian and wetland nutrient interception and transformation, and increase dissolved oxygen levels (through decreased water temperatures and decreased nutrient loading). As noted above the timing of and specific locations where these resource management actions could be undertaken is not certain, but it is assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. **Resource management actions implemented under the KBRA Phase I Fisheries Restoration Plan would accelerate long-term improvements in fine sediment, water temperature, nutrients, and dissolved oxygen in the Klamath Basin and would be beneficial.**

#### Phase II Fisheries Restoration Plan

*Implementation of the Phase II Fisheries Restoration Plan under the KBRA (see KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I.* Individual resource management actions under the Phase II Fisheries Restoration Plan would require separate project-level evaluations under NEPA and ESA; at the programmatic level considered for this EIS/EIR, there is insufficient information to evaluate project-specific short-term (i.e., during construction activities) effects on water quality from these actions. The timing of and specific locations where these resource management actions could be undertaken is not certain but it is assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Although short-term adverse effects of increased suspended sediments and increased potential for inorganic and organic contaminants from hazardous materials associated with construction equipment could occur, implementation of construction-related BMPs would occur as part of the Phase II Fisheries Plan resource management actions. **Given these BMPs (see Appendix B.1.1 Water Quality), the short-term effects on suspended sediment concentrations and inorganic and organic contaminants would be less-than-significant. Resource management actions implemented under the KBRA Phase II Fisheries Restoration Plan would accelerate long-term improvements in fine sediment, water temperature, nutrients, and dissolved oxygen in the Klamath Basin and would be beneficial.**

#### Fisheries Reintroduction and Management Plan

*Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction.* In the short-term (i.e., during construction activities), constructing fish handling facilities downstream from Keno Dam and at Link River Dam would involve the use of construction equipment for site work and building construction. These activities could increase suspended sediments

and increase the potential for inorganic and organic contaminants from hazardous materials associated with construction activities. Although negative short-term effects could occur, implementation of construction-related BMPs would reduce these effects. **Given these BMPs (see Appendix B.1.1 Water Quality), the short-term effects on water quality would be less-than-significant.**

#### Wood River Wetland Restoration

*Implementation of Wood River Wetland Restoration could result in warmer long-term spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake.* Under the KBRA, the Wood River Wetland Restoration Project (see KBRA Section 18.2.3) would be a new project designed to provide additional water storage for a total of 16,000 acre-feet (AF) of storage in or adjacent to Agency Lake (see Section 2.4.3.8). Wood River Wetland is approximately 3,200 acres in size and is adjacent to Agency Lake and to the north of Agency Lake Ranch. Over 3,000 acres of wetland and two miles of Wood River channel have or are undergoing restoration actions. Options for water management may include using diked areas for pumped storage or breaching levees to reconnect former wetland areas to Agency Lake. Long-term water quality effects associated with the Wood River Restoration Project include the creation of warmer spring temperatures that would be beneficial for rearing juvenile fish in the wetlands (as compared to the cooler temperatures in the Wood River or Upper Klamath Lake) and improved interception and treatment of fine sediment from the Wood River, prior to entering Agency Lake. This may decrease overall nutrient inputs to Upper Klamath Lake by inundating wetland (peat) soils and creating anaerobic conditions that support nutrient retention, particularly in the case of phosphorus (Snyder and Morace 1997). Specific options still need to be developed and studied as part of a separate project-level NEPA evaluation and ESA consultation. There is insufficient information to evaluate project-specific construction-related effects on water quality from the Wood River Wetland Restoration project. The geographic location and timing of this project reduce the potential for any negative water quality effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. Although negative short-term effects could occur, implementation of construction-related BMPs would occur. **Given these BMPs (see Appendix B.1.1 Water Quality), the short-term effects would be less-than-significant. Under the KBRA, the Wood River Wetland Restoration Project would accelerate ongoing long-term improvements in water temperature, fine sediment, and nutrients in Agency Lake and would be beneficial.**

#### Water Diversion Limitations

*Implementation of Water Diversion Limitations could result in long-term decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach.* Under the KBRA, the Water Diversions Limitations (see KBRA Section 15.1) would be a new project that provides specific allocations of water for refuges and limitations on specific diversions for Reclamation's Klamath Project (see Section 2.4.3.8). Actions reducing availability of irrigation water would increase stream flow and decrease summer water temperatures in the Klamath River upstream of the Hydroelectric Reach, as needed for fisheries. The water quality improvements generated by these water diversion

limitations would contribute to the long-term improvements anticipated from hydroelectric facility removal. **In the short term, there would be no change from existing conditions on water quality. In the long term, the KBRA Water Diversion Limitations would decrease summer water temperatures in the Klamath River upstream of the Hydroelectric Reach and would be beneficial.**

#### Water Use Retirement Program

*Implementation of the Water Use Retirement Program could result in long-term decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.* Under the KBRA, the Water Use Retirement Program (WURP) (see KBRA Section 16.2.2) would be a new project that seeks to increase the inflow to Upper Klamath Lake by 30,000 acre-feet on an average annual basis (see Section 2.4.3.8). Actions reducing surface water use, such as the sale and retirement of irrigation surface water rights, split season irrigation, shift to dryland crops, and fallowing of crop land, would increase stream flows through decreased surface water withdrawals and increased groundwater recharge. Increased stream flows would improve water quality by decreasing summer water temperatures and decreased irrigation and fallowing of crop land would decrease fertilizer (nutrient) and pesticide/herbicide (inorganic and organic contaminants) inputs. The water quality improvements generated by the WURP would contribute to the long-term improvements anticipated from hydroelectric facility removal. **In the short-term, there would be no change from existing conditions on water quality. The KBRA Water Use Retirement Program would decrease long-term water temperatures and decrease nutrients in Upper Klamath Lake and would be beneficial.**

#### Interim Flow and Lake Level Program

*Implementation of the Interim Flow and Lake Level Program could result in long-term decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.* Under the KBRA, the Interim Flow and Lake Level Program (see KBRA Section 20.4) would be an interim program of water purchase and lease to further the goals of the fisheries programs during the interim period prior to full implementation of the On-Project Allocation and WURP. Because it is focused on reducing surface water use, it would have the same effects on water quality as the WURP. The water quality improvements generated by the Interim Flow and Lake Level Program would contribute to the long-term improvements anticipated from hydroelectric facility removal. **In the short-term, there would be no change from existing conditions on water quality. The KBRA Interim Flow and Lake Level Program would decrease long-term water temperatures and decrease nutrients in Upper Klamath Lake and would be beneficial.**

#### Upper Klamath Lake and Keno Nutrient Reduction

*Implementation of the Upper Klamath Lake and Keno Nutrient Reduction Program could result in long-term decreases in nutrient inputs, increases in seasonal dissolved oxygen, and decreases in concentrations of nuisance algal species in these waterbodies.* KBRA (Appendix C-2, line 11) includes a program to study and reduce nutrient concentrations in the Keno Impoundment and Upper Klamath Lake in order to reduce dissolved oxygen and nuisance algal problems in both water bodies. Restoration actions to control

nutrients have not been developed, and there are many possible actions that could require construction of treatment wetlands, construction of facilities, or chemical treatments of bottom sediment, among other possibilities. A nutrient reduction program in the Keno Impoundment and Upper Klamath Lake would be designed to improve water quality (increasing seasonally low dissolved oxygen and reducing seasonal algal blooms) and fish passage through the Keno Impoundment in summer and fall months, however implementation of this nutrient reduction program will require future environmental compliance investigations and a determination on significance cannot be made at this time.

#### **3.2.4.3.3 Alternative 3: Partial Facilities Removal of Four Dams**

The Partial Facilities Removal of Four Dams Alternative would remove enough of the material from each dam to allow the river to retain a free-flowing condition and volitional fish passage under all river stages and flow conditions. Some portion of each dam and much of the appurtenant infrastructure would remain, such as the dam foundations, power houses, buildings, tunnels, and pipes. All tunnel openings would be sealed with concrete, remaining buildings would be fenced, and all hazardous materials would be removed from the site. This alternative would include the transfer of the Keno Facility to the DOI and implementation of the KBRA. The Partial Facilities Removal of Four Dams Alternative would result in the release of sediments trapped behind the dams and would have the same short-term (<2 years following dam removal) effects on suspended sediments, dissolved oxygen, nutrients, and inorganic and organic contaminant concentrations in both the Upper and Lower Klamath Basin as the Proposed Action, as follows:

- **The short-term increases in SSCs in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a significant impact.**
- **The short-term decrease in dissolved oxygen concentrations would be a significant impact on the lower Klamath River from Iron Gate Dam to approximately Clear Creek (≈RM 100). There would be no change from existing conditions on the Klamath Estuary or the marine nearshore environment.**
- **The short-term increase in nutrients in the Hydroelectric Reach, the lower Klamath River, and the Klamath Estuary would be a less-than-significant impact.**
- **The short-term effects on organic and inorganic contaminants in the Hydroelectric Reach, the lower Klamath River, and the Klamath Estuary would be a less-than-significant impact.**

**Dam deconstruction activities under the *Partial Facilities Removal of Four Dams Alternative* would have the same short-term effects on suspended sediments in the Hydroelectric Reach, the lower Klamath River, and the Klamath Estuary as the Proposed Action and would be a less-than-significant impact. There would be no change from existing conditions on the marine nearshore environment.**

**Construction activities associated with implementation of IMs 7 (J.C. Boyle Gravel Placement and/or Habitat Enhancement) and 16 (Water Diversions) would have the same short-term effects on suspended sediments in the Hydroelectric Reach as the Proposed Action and would be a less-than-significant impact. There would be no change from existing conditions on the lower Klamath River, Klamath Estuary, or the marine nearshore environment.**

**Construction activities for the Yreka Pipeline under the *Partial Facilities Removal of Four Dams Alternative* would have the same short-term effects on suspended sediments in the Hydroelectric Reach as the Proposed Action and would be a less-than-significant impact. There would be no change from existing conditions on the lower Klamath River, Klamath Estuary, or the marine nearshore environment.**

**Revegetation activities (i.e., hydroseeding) under the *Partial Facilities Removal of Four Dams Alternative* would have the same short-term effects on erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach and transport into the lower Klamath River and Klamath Estuary as the Proposed Action and would be beneficial. There would be no change from existing conditions on the marine nearshore environment.**

Under the Partial Facilities Removal Alternative, interception and retention of sediments and nutrients behind the dams at the Four Facilities would no longer occur and would have the same long-term (2–50 years following dam removal) effects in both the Upper and Lower Klamath Basin as the Proposed Action. **Long-term increases in suspended sediments and nutrients in the Hydroelectric Reach, the lower Klamath River, the Klamath Estuary, and the marine nearshore environment as the Proposed Action and would be a less-than-significant impact.**

Additionally, elimination of the lacustrine environment of the reservoirs would have the same long-term (2–50 years following dam removal) effects on water temperature, dissolved oxygen, pH, algal toxins and chlorophyll-*a*, and inorganic and organic concentrations in both the Upper and Lower Klamath Basin as the Proposed Action, as follows:

- **The long-term increases in summer/fall water temperatures and daily fluctuations in the J.C. Boyle bypass reach due to the elimination of hydropower peaking operations would be a significant impact. Slight decreases in long-term summer/fall water temperatures and less daily fluctuation in the J.C. Boyle peaking reach would be beneficial. Downstream of Copco 1 and Iron Gate Dams, the long-term increase in spring water temperatures would be potentially significant, while the decrease in late summer/fall water temperatures would be beneficial for the Hydroelectric Reach and the lower Klamath River from Iron Gate Dam to the confluence with the Salmon River. There would be no direct effect on water temperature for Klamath River downstream of the Salmon River, the Klamath Estuary, or the marine nearshore environment.**

- **Long-term increases in summer and fall dissolved oxygen concentrations in the Hydroelectric Reach and immediately downstream of Iron Gate Dam would be beneficial. There would be no change from existing conditions on dissolved oxygen by the confluence with the Trinity River.**
- **Long-term summertime increases in pH would be beneficial for the Hydroelectric Reach and the lower Klamath River from Iron Gate Dam to the confluence with the Scott River. There would be no change from existing conditions on pH for Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the marine nearshore environment.**
- **The long-term decrease in production of algal toxins and chlorophyll-*a* in the Hydroelectric Reach and subsequent transport into the lower Klamath River and the Klamath Estuary would be beneficial.**
- **Long-term effects on inorganic and organic contaminants in the Hydroelectric Reach, the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than-significant impact.**

#### **3.2.4.3.3.1 Keno Transfer**

*Implementation of the Keno Transfer could cause adverse water quality effects.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on water quality compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (see KHSA Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

#### **3.2.4.3.3.2 East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause adverse water quality effects.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

#### **3.2.4.3.3.3 KBRA**

KBRA Actions under the Partial Facilities Removal of Four Dams Alternative would be the same as those under the Proposed Action. **Therefore, under the *Partial Facilities Removal of Four Dams Alternative*, KBRA actions would accelerate long-term improvements in water quality (i.e., suspended sediment, water temperature, nutrients, and dissolved oxygen) anticipated under KHSA implementation (i.e., dam removal) and would be beneficial.**

#### **3.2.4.3.4 Alternative 4: Fish Passage at Four Dams**

The Fish Passage at Four Dams Alternative would provide upstream and downstream fish passage at the Four Facilities, but would not include implementation of the KBRA. The ongoing restoration actions, described in the No Action alternative, would continue. The alternative would incorporate the mandatory prescriptions from the Departments of Interior and Commerce imposed during the FERC relicensing process, including fishway installation for both upstream and downstream migrations at all facilities and barriers to prevent juvenile salmonid entrainment into turbines. In addition to the fishways, there is a series of flow-related measures, including a condition that requires at least 40 percent of the inflow to the J.C. Boyle reservoir to be released downstream. This alternative would limit generation of peaking power at J.C. Boyle Powerhouse to one day per week as water supplies allow, and would include recreation flows one day a week. The flow requirements would reduce the overall power generation.

Short-term (<2 years following dam removal) effects on water quality from construction activities associated with new fish passage facilities would occur, including increased suspended sediments and increased potential for inorganic and organic contaminants from hazardous materials associated with construction equipment. These short-term effects would be a significant impact. However, the impacts would be reduced through implementation of BMPs for construction activities that occur in or adjacent to the reservoirs and the Klamath River. BMPs would minimize in-water work and would minimize or eliminate the potential for sediment or toxic substances entering the water.

**Under the *Fish Passage at Four Dams Alternative*, short-term (<2 years following construction of passage facilities) increases in SSCs and potential inorganic and organic contaminants in the Hydroelectric Reach, the lower Klamath River, the Klamath Estuary and the marine nearshore environment due to construction activities would be a less-than-significant impact.**

Under the Fish Passage at Four Dams Alternative, the reduction in frequency of J.C. Boyle peaking operations (from daily to weekly) and overall higher flow releases would result in warmer and more variable water temperatures in the bypass reach during summer and early fall, and cooler temperatures in late fall and winter. These effects would be similar to those under the Proposed Action and would move this short reach away from support of core coldwater habitat during summer and early fall months; however, water temperatures would approach the natural thermal regime of the river. As with the Proposed Action, areas adjacent to the coldwater springs in the bypass reach would continue to serve as thermal refugia for aquatic species because the springs themselves would not be affected by the Fish Passage at Four Dam Alternative. Similar to the Proposed Action, water temperatures in the peaking reach would be slightly cooler and less variable, also due to higher overall flows and the lower frequency of peaking operations at the J.C. Boyle Powerhouse. Further downstream, at the Oregon-California state line, water temperatures would likely be similar to those under the No Action/No Project Alternative since large temperature effects of the peaking operations do not extend this far downstream.

**Under the *Fish Passage at Four Dams Alternative*, long-term (2–50 years following construction of fish passage facilities) increases in summer/fall water temperatures and daily fluctuations in the J.C. Boyle bypass reach, due to the reduction in frequency of hydropower peaking operations and higher overall flows, would be a significant impact. Slight decreases in long-term summer/fall water temperatures and less daily fluctuation in the J.C. Boyle peaking reach would be beneficial. Long-term water temperature effects in the remainder of the Hydroelectric Reach would be similar to those under the No Action/No Project Alternative (i.e., no change from existing conditions).**

The altered (more stable) flow regime in the J.C. Boyle peaking reach may also affect dissolved oxygen, pH, and nutrients due to increased periphyton growth at this location. However, changes in these parameters are not certain; the role of photosynthesis and community respiration from periphyton growth in the peaking reach is unknown because nutrient cycling and resulting rates of primary productivity under the No Action/No Project Alternative are uncertain (see Section 3.2.1.1). Other than this potential and unknown effect related to the flow regime downstream of J.C. Boyle Dam, the presence of fish passage facilities at each of the Four Facilities would not affect other long-term water quality parameters in the Hydroelectric Reach. **Under the *Fish Passage at Four Dams Alternative*, long-term (2–50 years following construction of passage facilities) effects on water quality in the Upper or Lower Klamath Basin would be the same as effects under the No Action/No Project Alternative (i.e., no change from existing conditions).**

#### **3.2.4.3.4.1 Trap and Haul – Programmatic Measure**

*Implementation of the trap and haul measure could affect water quality during construction.* In the short-term (i.e., during construction activities), constructing fish handling facilities downstream from Keno Dam and at Link River Dam would involve the use of construction equipment for site work and building construction. These activities could increase suspended sediments and increase the potential for inorganic and organic contaminants from hazardous materials associated with construction activities. Although negative short-term effects could occur, implementation of construction-related BMPs would reduce these effects. **Given these BMPs (see Appendix B.1.1 Water Quality), the short-term effects on water quality would be less-than-significant.**

#### **3.2.4.3.5 Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative proposes to remove the two largest dams in the Hydroelectric Reach and install fishways for volitional fish passage on the remaining installations. Most of the mandatory prescriptions associated with fish passage would still apply to the remaining dams, including flow requirements and standards for fish passage facilities. Alternative 5 would include no peaking power generation or release of flow for recreation at J.C. Boyle Powerhouse because Copco 1 and Iron Gate Dams would not be present to reregulate flows downstream. For the purposes of this analysis, alternatives that would not result in full implementation of the KHSAs do not include the KBRA as a connected action to the

alternative. In the Hydroelectric Reach of the Upper Klamath Basin, this alternative would result in the release of sediments trapped behind Copco 1 and Iron Gate Dams. This release would have short-term (<2 years following dam removal/construction of fish passage facilities) effects on sediment and turbidity, dissolved oxygen, nutrients, and inorganic and organic contaminant concentrations in the Klamath River.

Interception and retention of sediments would still occur behind J.C. Boyle and Copco 2 Dams; this would have long-term (2–50 years following dam removal/construction of fish passage facilities) effects on sediment and turbidity. Additionally, elimination of the lacustrine environment of Copco 1 and Iron Gate Reservoirs under this alternative would have long-term effects on water temperature, dissolved oxygen, nutrients, pH, algal toxins and chlorophyll-*a* in the downstream river. The following sections provide detail regarding the anticipated effects of this alternative on water quality.

#### **3.2.4.3.5.1 Water Temperature**

##### Upper Klamath Basin

Since Alternative 5 would include no peaking power generation or release of flow for recreation at J.C. Boyle, water temperature effects in the J.C. Boyle bypass and peaking reaches would be the same as under the Proposed Action i.e., warmer and more variable water temperatures in the bypass reach during summer and early fall, and cooler temperatures in late fall and winter; and, slightly cooler and less variable water temperatures in the peaking reach during summer and early fall. Further downstream, at the Oregon-California state line, water temperatures would be similar to those under the No Action/No Project Alternative since large temperature effects of the peaking operations do not extend this far downstream.

Within the remainder of the Hydroelectric Reach, effects on water temperature under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as effects for the Hydroelectric Reach under the Proposed Action. The effects of removing Iron Gate and Copco 1 Reservoirs and converting the reservoir areas to a free-flowing river under this alternative would be similar to effects for the lower Klamath River immediately downstream of Iron Gate Dam under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, long-term (2–50 years following dam removal/construction of fish passage facilities) increases in summer/fall water temperatures and daily fluctuations in the J.C. Boyle bypass reach due to the elimination of hydropower peaking operations would be a significant impact. Slight decreases in long-term summer/fall water temperatures and less daily fluctuation in the J.C. Boyle peaking reach would be beneficial. From the J.C. Boyle peaking reach to Copco 1 Reservoir, long-term water temperature effects would be similar to those under the No Action/No Project Alternative (i.e., no change from existing conditions). From Copco 1 Reservoir to Iron Gate Reservoir, long-term increases in spring water temperatures would be potentially significant and decreases in late summer/fall**

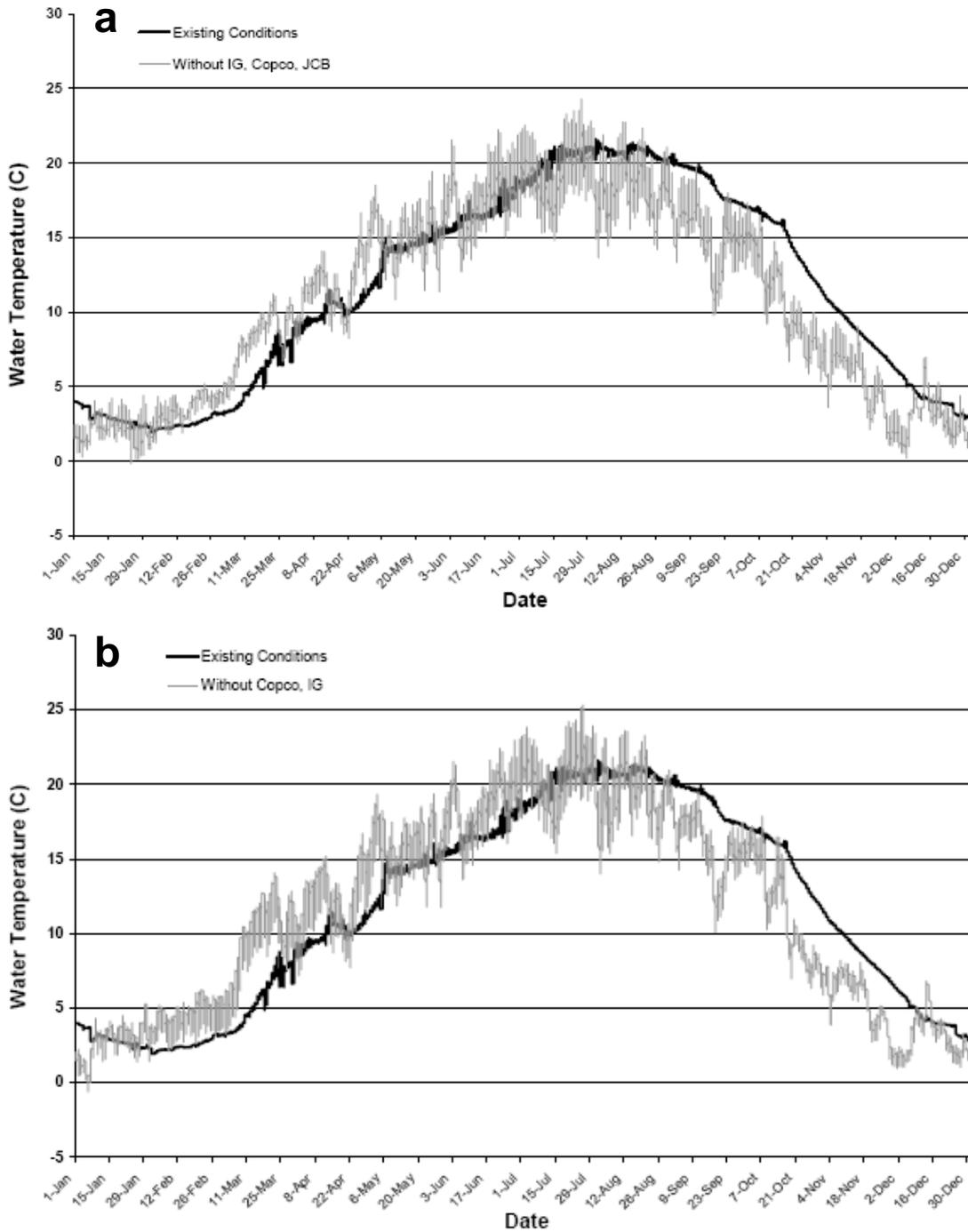
**water temperatures in the Hydroelectric Reach would be similar to the Proposed Action and would be beneficial.**

Lower Klamath Basin

While model results analyzed for the Proposed Action do not explicitly isolate the effects of the four individual reservoirs on water temperatures, the KRWQM includes a scenario in which only Iron Gate, Copco 1, and Copco 2 Dams are removed but J.C. Boyle remains in place (“WIGC” PacifiCorp 2004b, Dunsmoor and Huntington 2006, see also Appendix D). This scenario is analogous to the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative because Copco 2 Reservoir has no active storage and thus has a negligible effect on hydraulic residence time and water temperature. KRWQM WIGC results indicate that compared with removal of all four reservoirs (“WIGCJCB”), the long-term effects of removing Iron Gate and Copco 1 Reservoirs and converting the reservoir areas to a free-flowing river under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to effects on water temperature for the Lower Klamath Basin under the Proposed Action (see Figure 3.2-26).

This is not surprising because Copco 1 and Iron Gate Reservoirs are the two deepest and largest reservoirs, which stratify during summer months and affect downstream water temperature through the discharge of warm surface waters (see Section 3.2.3.1). Comparison of KRWQM model output for WIGC and WIGCJCB also indicates that springtime daily variability in water temperature may be somewhat greater under this alternative than under the Proposed Action, which may be due to assumptions regarding peaking operations at J.C. Boyle Powerhouse. However, overall, the effects of removing Iron Gate and Copco 1 Dams on water temperature in the Lower Klamath Basin would be similar to effects under the Proposed Action.

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the long-term (2-50 years following dam removal/construction of fish passage facilities) increases in spring water temperatures would be potentially significant and decreases in late summer/fall water temperatures would be beneficial for the lower Klamath River from Iron Gate Dam to the confluence with the Salmon River. There would be no change from existing conditions on water temperature for lower Klamath River downstream of the Salmon River, the Klamath Estuary, and the marine nearshore environment.***



**Figure 3.2-26. Simulated Hourly Water Temperature Downstream of Iron Gate Dam (RM 190.1) Based on Year 2004 for Current Conditions Compared to Hypothetical Conditions: (a) without Iron Gate (IG), Copco 1 and 2, and J.C. Boyle (JCB) Dams and (b) without Iron Gate (IG) and Copco 1 and 2 Dams. Source: PacifiCorp 2004a.**

### **3.2.4.3.5.2 Suspended Sediments**

#### Upper Klamath Basin

Upstream of Copco 1 Dam, short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) SSCs under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as SSCs under the No Action/No Project Alternative. However, because Copco 1 and Iron Gate Reservoirs contain 85 percent of the total erodible sediment contained with the reservoirs at the Four Facilities (CDM 2011), the short-term effects of sediment release on SSCs downstream of Copco 1 Dam under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to effects for the Hydroelectric Reach under the Proposed Action. Compared to the Proposed Action, there would be approximately 15 percent less sediment mobilized from the reservoirs at the Four Facilities (sediments in J.C. Boyle would remain in place) and short-term SSCs within the Hydroelectric Reach may exhibit somewhat lower peaks. However, the overall pattern and duration of high SSCs would be the same, as would the general magnitude of the effect.

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, short-term (<2 years following dam removal/construction of fish passage facilities) increases in SSCs in the Hydroelectric Reach due to mobilization of sediment deposits from Copco 1 Reservoir and Iron Gate Reservoir would be a significant impact.***

Stormwater runoff from deconstruction activities under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 2 and Iron Gate Alternative may cause increases in suspended material in the Hydroelectric Reach during the deconstruction period. Dam deconstruction effects on suspended sediments would be limited to Copco 1 and Iron Gate Reservoirs and downstream river reaches, while fish passage construction effects would be limited to J.C. Boyle and Copco 2 Reservoirs and downstream river reaches. However, both dam deconstruction and fish passage construction activities would be complex and overlapping in terms of resulting river concentrations of suspended sediments and would require implementation of BMPs at each reservoir site. Therefore, dam deconstruction and fish passage construction activities in the Hydroelectric Reach under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be essentially the same as those for the Hydroelectric Reach under the Proposed Action.

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, short-term (<2 years following dam removal/construction of fish passage facilities) deconstruction-related increases in SSCs in the Hydroelectric Reach would be a less-than-significant impact.***

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, construction activities for the Yreka Pipeline would have the same short-term effects on suspended sediments in the Hydroelectric Reach as the Proposed Action and would be a less-than-significant impact.***

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, revegetation activities (i.e., hydroseeding) would have the same short-term (< 2 years following dam removal) effects on erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach as the Proposed Action and would be beneficial.**

Due to the lack of continued interception and retention of mineral (inorganic) and algal-derived (organic) suspended materials behind Copco 1 and Iron Gate Dams under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, long-term (2-50 years following dam removal/construction of fish passage facilities) effects on SSCs for the Hydroelectric Reach would be similar to those for the Hydroelectric Reach under the Proposed Action. **Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, long-term (2–50 years following dam removal/construction of fish passage facilities) increases in mineral (inorganic) and algal-derived (organic) suspended material in the Hydroelectric Reach would be a less-than-significant impact.**

#### Lower Klamath Basin

Because Copco 1 and Iron Gate Reservoirs contain 85 percent of the total erodible sediment contained with the reservoirs at the Four Facilities (CDM 2011), the short-term (<2 years following dam removal/construction of fish passage facilities) effects of sediment release on concentrations of suspended sediments in the Lower Klamath Basin under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to those for the Lower Klamath Basin under the Proposed Action. Because there would be approximately 15 percent less sediment mobilized (sediments in J.C. Boyle would remain in place), short-term (<2 years following dam removal/construction of fish passage facilities) SSCs in the Lower Klamath Basin may exhibit somewhat lower peaks. However, the overall pattern and duration of high SSCs would be the same, as would the general magnitude of the effect.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, short-term (<2 years following dam removal/construction of fish passage facilities) increases in SSCs in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than-significant impact.**

Stormwater runoff from deconstruction activities under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate alternative may cause increases in suspended material in the Klamath River downstream of Iron Gate Dam during the deconstruction period. Dam deconstruction effects on suspended sediments would be limited to Copco 1 and Iron Gate Reservoirs and downstream river reaches, while fish passage construction effects would be limited to J.C. Boyle and Copco 2 Reservoirs and downstream river reaches. However, both dam deconstruction and fish passage construction activities would be complex and overlapping in terms of river SSCs and would require implementation of BMPs at each reservoir site. Therefore, dam deconstruction and fish passage construction activities would have the same effects on

SSCs in the Lower Klamath Basin as the Proposed Action and the Fish Passage at Four Dams Alternative.

***Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, deconstruction-related increases in SSCs in the lower Klamath River and the Klamath Estuary would be a less-than-significant impact. There would be no change from existing conditions on the marine nearshore environment.***

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, revegetation activities (i.e., hydroseeding) would have the same short-term (< 2 years following dam removal) effects on erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach and transport into the lower Klamath River and Klamath Estuary as the Proposed Action and would be beneficial. There would be no change from existing conditions on the marine nearshore environment.***

Under this alternative, long-term (2–50 years following dam removal/construction of fish passage facilities) effects on mineral (inorganic) and algal-derived (organic) suspended materials in the Lower Klamath Basin due to the lack of continued interception and retention of sediment behind Copco 1 and Iron Gate Dams would be similar to those for the Lower Klamath Basin under the Proposed Action.

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the long-term (2–50 years following dam removal/construction of fish passage facilities) increases on mineral (inorganic) and algal-derived (organic) suspended materials in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than-significant impact.***

### **3.2.4.3.5.3 Nutrients**

#### **Upper Klamath Basin**

Upstream of Copco 1 Reservoir, effects on nutrients under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as effects under the No Action/No Project Alternative because J.C. Boyle Dam would remain in place. However, Copco 1 and Iron Gate Reservoirs are the largest and deepest reservoirs in the Hydroelectric Reach with the longest residence times (FERC 2007), and the short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) the effects of removing them and converting the reservoir areas to a free-flowing river under this alternative would be similar to removing all four dams. Therefore, under this alternative, effects on nutrients would be the same as effects for the lower Klamath River immediately downstream of Iron Gate Dam under the Proposed Action.

***Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish***

**passage facilities) increases in nutrients in the Hydroelectric Reach would be a less-than-significant impact.**

#### Lower Klamath Basin

Copco 1 and Iron Gate Reservoirs are the largest and deepest reservoirs in the Hydroelectric Reach with the longest residence times, so the short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) effects of removing them and converting the reservoir areas to a free-flowing river under this alternative would be similar to removing all four dams. Therefore, under this alternative, effects on nutrients would be the same as effects for the lower Klamath River under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) increases in nutrients in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment would be a less-than-significant impact.**

#### **3.2.4.3.5.4 Dissolved Oxygen**

##### Upper Klamath Basin

Upstream of Copco 1 Dam, short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) dissolved oxygen under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as dissolved oxygen under the No Action/No Project Alternative. However, because Copco 1 and Iron Gate Reservoirs contain 85 percent of the total erodible sediment contained within the reservoirs at the Four Facilities (CDM 2011), the short-term effects of sediment release on dissolved oxygen concentrations downstream of Copco 1 Dam under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to effects for the Hydroelectric Reach under the Proposed Action. Compared to the Proposed Action, there would be approximately 15 percent less sediment mobilized (sediments in J.C. Boyle would remain in place) and short-term SSCs in the Lower Klamath Basin may exhibit somewhat lower peaks. However, the overall pattern and duration of high SSCs would be the same, as would the general magnitude of the effect on dissolved oxygen. The short-term effects of sediment release on oxygen demand and dissolved oxygen concentrations in the Hydroelectric Reach under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be essentially the same as those for the Lower Klamath Basin under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, short-term (<2 years following dam removal/construction of fish passage facilities) decreases in dissolved oxygen in the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir would be a significant impact. The long-term (2-50 years following dam removal) increase in summer and fall dissolved oxygen concentrations in the Hydroelectric Reach would be beneficial.**

### Lower Klamath Basin

Because Copco 1 and Iron Gate Reservoirs contain 85 percent of the total erodible sediment contained within the reservoirs at the Four Facilities (CDM 2011), the short-term (<2 years following dam removal/construction of fish passage facilities) effects of sediment release on concentrations of dissolved oxygen in the Lower Klamath Basin under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to those for the Lower Klamath Basin under the Proposed Action. Because there would be approximately 15 percent less sediment mobilized (sediments in J.C. Boyle would remain in place), short-term SSCs in the Lower Klamath Basin may exhibit somewhat lower peaks and dissolved oxygen demand may also decrease. However, the overall pattern and duration of high SSCs would be the same, as would the general magnitude of the effect on dissolved oxygen.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the short-term (<2 years following dam removal/construction of fish passage facilities) decrease in dissolved oxygen concentrations would be a significant impact on the lower basin from Iron Gate Dam to approximately Clear Creek (≈RM 100), but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment. The long-term (2–50 years following dam removal) increases in summer and fall dissolved oxygen concentrations immediately downstream of Iron Gate Dam would be beneficial.**

### **3.2.4.3.5.5 pH**

#### Upper Klamath Basin

Upstream of Copco 1 Reservoir, effects on pH under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as effects under the No Action/No Project Alternative because J.C. Boyle Dam would remain in place. The effects of removing Iron Gate and Copco 1 Reservoirs and converting the reservoir areas to a free-flowing river under this alternative would be similar to effects on pH for the lower Klamath River immediately downstream of Iron Gate Dam under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the long-term (2–50 years following dam removal/construction of fish passage facilities) decrease in high summertime daily pH fluctuations in the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir would be beneficial.**

#### Lower Klamath Basin

Because J.C. Boyle Reservoir does not currently appear to substantially alter pH in the river downstream of the dam (see Figure 3.2-22. ) having this dam in place would not affect pH downstream of the Hydroelectric Reach in the Lower Klamath Basin. However, apparent seasonal and daily pH fluctuations in Copco 1 and Iron Gate Reservoirs would be altered once these reservoir areas were converted to a free-flowing river. Therefore, effects on pH under this alternative would be similar to effects on pH

for the lower Klamath River immediately downstream of Iron Gate Dam under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, long-term (2–50 years following dam removal/construction of fish passage facilities) summertime increases in pH would be less than significant for the lower Klamath River from Iron Gate Dam to the confluence with the Scott River. There would be no change from existing conditions on pH for the Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the marine nearshore environment.**

#### **3.2.4.3.5.6 *Chlorophyll-a and Algal Toxins***

##### Upper Klamath Basin

Upstream of Copco 1 Reservoir, effects on algal toxins and chlorophyll-*a* under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as effects under the No Action/No Project Alternative because J.C. Boyle Dam would remain in place. Copco 1 and Iron Gate Reservoirs are the largest reservoirs in the Hydroelectric Reach with the longest hydraulic residence times (FERC 2007) and potential for *in situ* algal growth, so the effects of removing them and converting the reservoir areas to a free-flowing river under this alternative would be similar to removing all four dams. Therefore, under this alternative, effects on algal toxins and chlorophyll-*a* would be the same as effects for the Upper Klamath Basin under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the long-term (2–50 years following dam removal/construction of fish passage facilities) decrease in production of algal toxins and chlorophyll-*a* in the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir would be beneficial.**

##### Lower Klamath Basin

Copco 1 and Iron Gate Reservoirs are the largest reservoirs in the Hydroelectric Reach with the longest residence times (FERC 2007) and hence potential for *in situ* algal growth, so the effects of removing them and converting the reservoir areas to a free-flowing river under this alternative would be similar to removing all four dams. Therefore, under this alternative, effects on algal toxins and chlorophyll-*a* would be the same as effects for the Lower Klamath Basin under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the long-term (2–50 years following dam removal/construction of fish passage facilities) decrease in production of algal toxins and chlorophyll-*a* in upstream reservoirs and subsequent transport into the lower Klamath River and the Klamath Estuary would be beneficial.**

### **3.2.4.3.5.7 Inorganic and Organic Contaminants**

#### Upper Klamath Basin

Under this alternative, continued retention of sediments behind J.C. Boyle Dam and release of sediments trapped behind Copco 1 and Iron Gate Dams would occur. In J.C. Boyle Reservoir, short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) effects of sediment retention on concentrations of inorganic and organic contaminants, and the potential for bioaccumulation and/or toxicity to freshwater aquatic biota and humans, would be the same as those for the Hydroelectric Reach under the No Action/No Project Alternative. However, for the two largest reservoirs in the Hydroelectric Reach, Copco 1 and Iron Gate Reservoirs, short-term and long-term effects of sediment release on concentrations of inorganic and organic contaminants under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as those for the Hydroelectric Reach under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) increases in potential inorganic and organic contaminants in the Hydroelectric Reach due to sediment release would be a less-than-significant impact.**

*Dam deconstruction and fish passage construction activities could cause increases in inorganic and organic contaminants from hazardous materials associated with construction equipment that could exceed applicable Oregon DEQ and North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the Hydroelectric Reach. These effects would be a significant impact. However, the impacts would be reduced through implementation of BMPs for deconstruction and construction activities that would occur in or adjacent to the Klamath. BMPs would minimize or eliminate the potential for toxic substances to enter the water.*

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the effects on inorganic and organic contaminants in the Hydroelectric Reach due to construction/deconstruction activities would be a less-than-significant impact.**

#### Lower Klamath Basin

Under this alternative, release of the sediments trapped behind Copco 1 and Iron Gate Dams) would occur. Because Copco 1 and Iron Gate Reservoirs contain 85 percent of the total erodible sediment contained within the reservoirs at the Four Facilities (CDM 2011), the short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) effects of sediment release on concentrations of inorganic and organic contaminants, and the potential for bioaccumulation and/or toxicity to freshwater aquatic biota, marine aquatic biota, and humans in the Lower Klamath Basin, would be similar to those for the Lower Klamath Basin under the Proposed Action.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) increases in potential inorganic and organic contaminants due to sediment release would be a less-than-significant impact.**

*Dam deconstruction and fish passage construction activities could cause increases in inorganic and organic contaminants from hazardous materials associated with construction equipment that could exceed applicable North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* These effects would be a significant impact. However, the impacts would be reduced through implementation of BMPs for deconstruction and construction activities that would occur in or adjacent to the Klamath River. BMPs would minimize or eliminate the potential for toxic substances to enter the water.

**Under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the increases in potential inorganic and organic contaminants due to construction/deconstruction activities would be a less-than-significant impact.**

#### **3.2.4.3.5.8 Trap and Haul – Programmatic Measure**

The impacts from the trap and haul measure under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as those under the Fish Passage at Four Dams Alternative. **Therefore, under the *Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative*, the short-term effects on water quality would be less-than-significant because of implementation of BMPs (see Appendix B.1.1 Water Quality).**

#### **3.2.5 Mitigation Measures**

The timing of reservoir drawdown under the Proposed Action was optimally developed to minimize environmental effects (i.e., high SSCs, low DO) (see also Section 2, Proposed Action and Description of the Alternatives). While the Alternatives Formulation Report identified the option of mechanical sediment removal as mitigation for sediment erosion impacts associated with removal of the Four Facilities, subsequent analysis found this measure to be infeasible (Lynch 2011).

### **3.2.5.1 Mitigation Measures Associated with Other Resource Areas**

Several other mitigation measures require construction, including mitigation measures H-2 (flood-proof structures), GW-1 (deepen or replace affected wells), WRWS-1 (modify or screen affected water intakes), PHS-4 (repair damaged roads), PHS-5 (construct water storage tanks for fire fighting), REC-1 (develop new recreational facilities and access to river), TR-6 (assess and improve roads to carry construction loads), and TR-7 (assess and improve bridges to carry construction loads). Short-term effects on water quality from construction activities may include increased suspended sediments and inorganic and organic contaminants from hazardous materials associated with construction equipment to enter nearby or adjacent water bodies. Implementation of deconstruction and/or construction-related BMPs would also apply to these construction efforts.

**Implementation of BMPs would reduce effects of these mitigation measures to less-than-significant levels.**

### **3.2.6 Summary of Short-term and Long-term Impacts on Water Quality**

Table 3.2-14 summarizes the short-term (<2 years following dam removal/construction of fish passage facilities) and long-term (2–50 years following dam removal/construction of fish passage facilities) impacts of the Proposed Action and alternatives on water quality.

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Water Temperature</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable ODEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the Hydroelectric Reach.	1, 4,5	NCFEC	None	NCFEC
Dam removal and/or elimination of hydropower peaking operations at J.C. Boyle Powerhouse could cause short-term and long-term alterations in daily water temperatures and fluctuations in the J.C. Boyle bypass and peaking reaches.	2, 3, 5	S for J.C. Boyle bypass reach B for J.C. Boyle peaking reach	None	S for J.C. Boyle bypass reach B for J.C. Boyle peaking reach
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term increases in spring time water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir.	2, 3, 5	S for springtime B for late summer/fall	None	S for springtime B for late summer/fall
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term and long-term increases in sediment deposition in the Klamath River or Estuary that could alter morphological characteristics and indirectly affect seasonal water temperatures.	2, 3, 5	NCFEC	None	NCFEC

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable California North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free flowing river could result in short-term and long-term increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River.	2,3,5	S – Iron Gate Dam to Salmon River for springtime and B – in late summer/fall NCFEC – Klamath River downstream of Salmon River, the Klamath Estuary, and marine near shore environment	None	S – Iron Gate Dam to Salmon River for springtime and B – in late summer/fall NCFEC – Klamath River downstream of Salmon River, the Klamath Estuary, and marine near shore environment
<b><i>Suspended Sediments</i></b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could result in short-term and long-term interception and retention of mineral (inorganic) suspended material by the KHP dams.	1, 4	NCFEC	None	NCFEC
Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach.	1, 2, 3	LTS	None	LTS
Implementation of IM 8, J.C. Boyle Bypass Barrier Removal, could result in short-term increases in mineral suspended material in the Hydroelectric Reach due to deconstruction activities.	1	LTS	None	LTS

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of IM 16, Water Diversions, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach due to diversion screening deconstruction and construction activities.	2, 3	LTS	None	LTS
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the Hydroelectric Reach due to in-reservoir algal blooms.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam.	2, 3, 5	S	None	S
Construction/deconstruction activities could cause short-term increases in suspended material in the Hydroelectric Reach due to stormwater runoff from construction/deconstruction areas.	2, 3, 4, 5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities would include the demolition of various recreation facilities which could cause short-term increases in suspended material in the Hydroelectric Reach from stormwater runoff from the demolition areas.	2, 3, 5	LTS	None	LTS
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach.	2, 3, 5	B	None	B

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the lower Klamath River and the Klamath Estuary.	2, 3, 5	S	None	S
Draining the reservoirs and release of sediment could cause short-term increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material and rates of deposition in the marine nearshore environment.	2, 3, 5	LTS	None	LTS

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued impoundment of water in the reservoirs could cause short-term and long-term interception and retention of mineral (inorganic) sediments by the dams and correspondingly low levels of suspended material immediately downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could result in short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the KHP reservoirs and subsequent transport into the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Construction/deconstruction activities could cause short-term increases in suspended material in the lower Klamath River, Klamath Estuary, and marine nearshore environment due to stormwater runoff from construction/deconstruction areas.	2, 3, 5	LTS	None	LTS
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces into the lower Klamath River and Klamath Estuary.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Nutrients</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could result in long-term interception and retention of TP and TN in the Hydroelectric Reach on an annual basis but release (export) of TP and TN from reservoir sediments on a seasonal basis.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in sediment-associated nutrients in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term interception and retention of TP and TN on an annual basis but release (export) of TP and TN on a seasonal basis	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment to the lower Klamath River could cause short-term increases in sediment-associated nutrients in the river and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Dissolved Oxygen</i></b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term <sup>7</sup> seasonal and daily variability in dissolved oxygen concentrations in the Hydroelectric Reach, such that levels do not meet Oregon DEQ and California North Coast Basin Plan water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term <sup>8</sup> increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir.	2, 3, 5	S	None	S
Dam removal and conversion of reservoir areas to free-flowing river conditions could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach.	2, 3	B	None	B
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term seasonal and daily variability in dissolved oxygen concentrations in the Klamath River downstream of Iron Gate Dam, such that levels do not meet California North Coast Basin Plan and Hoopa Valley Tribe water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC

<sup>7</sup> Long-term is defined as 2-50 years

<sup>8</sup> Short-term is defined as <2 years

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal and sediment release could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	S (lower Klamath River from Iron Gate Dam to Clear Creek) NCFEC (Klamath Estuary or Marine Nearshore Environment)	None	S (lower Klamath River from Iron Gate Dam to Clear Creek) NCFEC (Klamath Estuary or Marine Nearshore Environment)
Dam removal and conversion of reservoir areas to a free-flowing river could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the lower Klamath River, particularly for the reach immediately downstream of Iron Gate Dam.	2, 3, 5	B	None	B
<b>pH</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in summertime pH in the Hydroelectric Reach.	2, 3, 5	B	None	B
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the lower Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in summertime pH in the lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 5	B	None	B

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term summertime increases in pH in the lower Klamath River downstream of Iron Gate Dam.	2, 3, 5	LTS (from Iron Gate Dam to confluence with the Scott River) NCFEC (Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the Marine Nearshore Environment)	None	LTS (from Iron Gate Dam to confluence with the Scott River) NCFEC (Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the Marine Nearshore Environment)
<b><i>Chlorophyll-a and Algal Toxins</i></b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as <i>M. aeruginosa</i> , resulting in high seasonal concentrations of chlorophyll-a and algal toxins in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and algal toxins in the Hydroelectric Reach.	2, 3, 5	B	None	B

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as <i>M. aeruginosa</i> , resulting in high seasonal concentrations of chlorophyll-a and algal toxins transported into the Klamath River from downstream of Iron Gate Dam to the Klamath Estuary, and potentially to the marine nearshore environment.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and algal toxins in the lower Klamath River and the Klamath Estuary.	2, 3, 5	B	None	B
<b>Inorganic and Organic Contaminants</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants for freshwater aquatic species in the Hydroelectric Reach.	1, 4, 5	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants in the Hydroelectric Reach through human consumption of resident fish tissue.	1, 4, 5	NCFEC	None	NCFEC
Draining the reservoirs and sediment release could cause short-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed reservoir terraces and river banks within the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities could cause short-term increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation equipment in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Reservoir area restoration activities could include herbicide application which could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Dam removal and sediment release could cause short-term and long-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the lower Klamath River and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed downstream river terraces and downstream river banks following reservoir drawdown.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities could cause short-term increases in suspended sediments and the potential for inorganic and organic contaminants from hazardous materials associated with construction equipment to be transported into the lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 4, 5	LTS	None	LTS
<b>Trip and Haul Operations</b>				

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan would affect water quality during construction.	4,5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of the Phase I Fisheries Restoration Plan could result in short-term construction-related increases in suspended materials and long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels. .	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction.	2,3	LTS	None	LTS
Implementation of Wood River Wetland Restoration could result in short-term construction-related increases in suspended materials and long-term warmer spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)

**Table 3.2-14. Summary of Short-Term (<2 years) and Long-Term (2–50 years) Water Quality Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of Water Diversion Limitations could result in decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)
Implementation of the Water Use Retirement Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)
Implementation of the Upper Klamath Lake and Keno Nutrient Reduction Program could result in long-term decreases in nutrient inputs, increases in seasonal dissolved oxygen, and decreases in concentrations of nuisance algal species in these waterbodies.	2, 3	Not determined at this time	None	Not determined at this time

Key:

NCFEC = No change from existing conditions; B = Beneficial; LTS = Less than significant; S = Significant

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### 3.3 Aquatic Resources

This section describes the effects that the Proposed Action and alternatives would have on aquatic resources, and specifically fish, freshwater mussels, and aquatic macroinvertebrates.

#### 3.3.1 Areas of Analysis

This section of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) analyzes impacts on fish populations, fish species recovery, and changes to habitat in the Klamath River watershed, excluding the Lost River watershed, Tule Lake watershed, and most of the Trinity River. However, because the lower quarter-to-half mile of the Trinity River could be used as a refuge by Klamath River fish attempting to avoid exposure to sediment pulses that would result from dam removal, this use of the Trinity River was considered in the analysis.

The Lead Agencies assessed potential impacts within and across five study reaches of the Klamath Basin separated by changes in physiography (e.g., Upper and Lower Klamath Basins), the presence of Klamath Hydroelectric Project facilities, and degree of marine influence (Figure 3.3-1). The five study reaches with the area of analysis are as follows:

1. Upper Klamath River: upstream of the influence of J.C. Boyle Reservoir, including the following:
  - a. Upper Klamath Lake, Agency Lake, Keno Impoundment/Lake Ewauna, and Tule Lake
  - b. Tributaries to Upper Klamath Lake (Sycan, Wood, and Williamson Rivers)
  - c. Bureau of Reclamation (Reclamation) Klamath Project facilities (e.g., Link River Dam)
2. Hydroelectric Reach: from the upstream end of J.C. Boyle Reservoir to Iron Gate Dam, including the following:
  - a. Tributaries to the Klamath River (examples include Jenny, Spencer, Slate, Shovel, and Fall Creeks)
  - b. J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs
  - c. J.C. Boyle Bypass and Peaking Reaches
  - d. Klamath downstream of the Copco 2 tailrace
3. Lower Klamath River: downstream of Iron Gate Dam, including the following:
  - a. Major tributaries to the Klamath River (Shasta, Scott, and Salmon Rivers)
  - b. Minor tributaries to the Klamath River (examples include Bogus, Beaver, Humbug, and Cottonwood Creeks)
  - c. The lower portion of the Trinity River
4. Klamath River estuary
5. Pacific Ocean nearshore environment

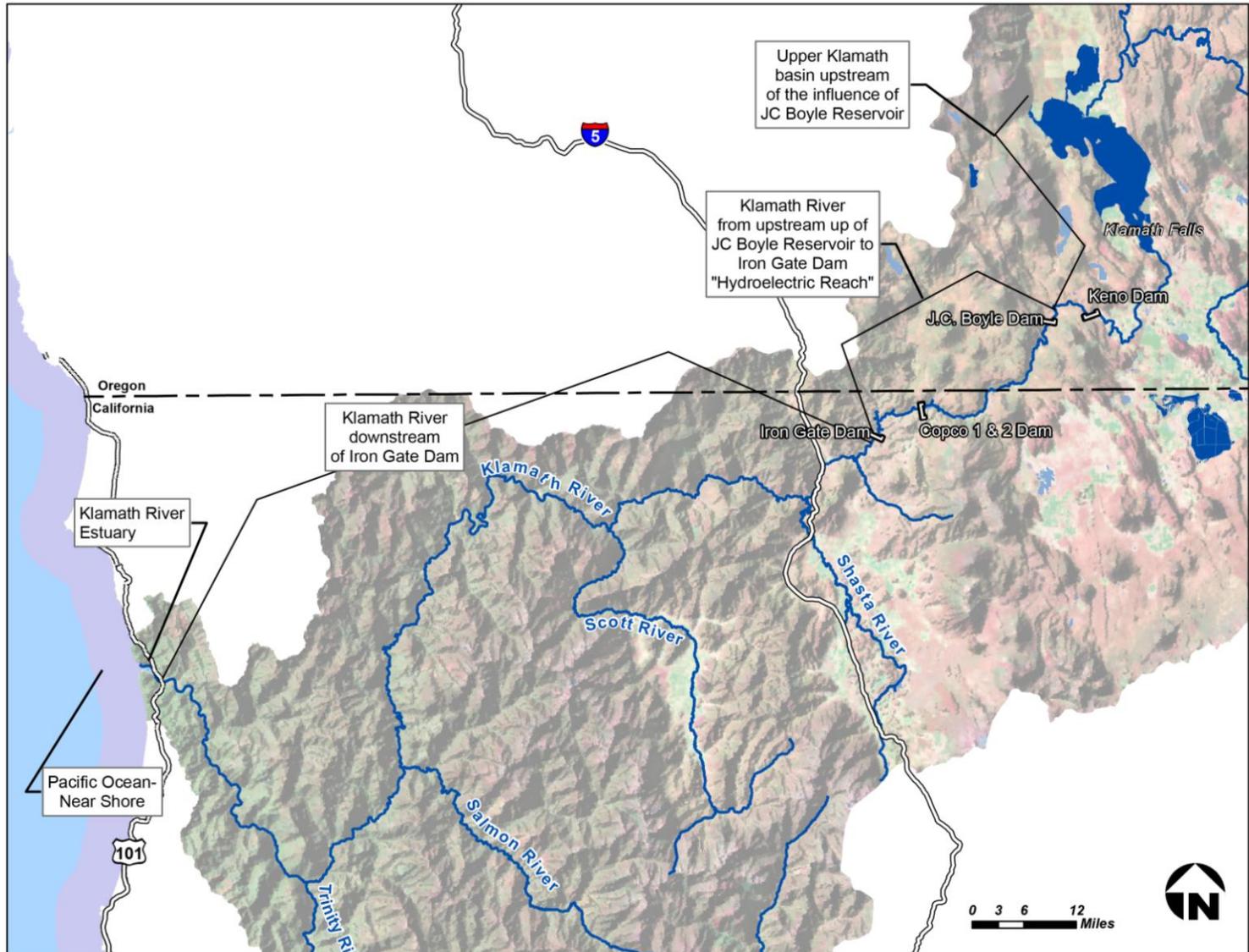


Figure 3.3-1. Five Study Reaches within the Area of Analysis for the Aquatic Resources Analysis

The Klamath Basin has traditionally been divided into the Upper and Lower Klamath Basins at Iron Gate Dam (Natural Resources Council [NRC] 2004, 2008). For purposes of this evaluation, the Upper Basin was subdivided into two reaches at the upstream influence of J.C. Boyle Reservoir. The area upstream of the influence of J.C. Boyle Reservoir could experience some changes in flow in riverine reaches or water surface elevation in lakes and reservoirs due to changes in Reclamation's Klamath Project operations under some of the alternatives, but the physical structure of the habitat would remain similar to existing conditions. The Hydroelectric Reach encompasses the four dams proposed for removal. Under several of the alternatives, the physical structure of some or all reservoir habitat within the Hydroelectric Reach would be changed from lacustrine (lake) to riverine habitat. The Lower Klamath River: downstream of Iron Gate Dam corresponds to the traditional “Lower Basin” designation.

### **3.3.2 Regulatory Framework**

Aquatic species within the area of analysis are regulated by several federal and state laws and regulations, which are listed below.

#### **3.3.2.1 Federal Authorities and Regulations**

- Federal Endangered Species Act
- Fish and Wildlife Coordination Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Marine Mammal Protection Act
- Wild and Scenic Rivers Act
- Federal Power Act
- Coastal Zone Management Act

#### **3.3.2.2 State Authorities and Regulations**

- California Endangered Species Act
- California Fish and Game Code
- Oregon Endangered Species Act
- Oregon Removal-Fill Law
- Oregon Statewide Planning Program

#### **3.3.2.3 Local Authorities and Regulations**

- Klamath Act

The regulation and protection of water quality as related to beneficial uses and aquatic species is discussed in Section 3.2, Water Quality.

### **3.3.3 Existing Conditions/Affected Environment**

This section describes existing conditions in the area of analysis, including discussion of aquatic species (Section 3.3.3.1); physical habitat, water bodies within the different regions for the analysis (Section 3.3.3.2); and important factors affecting aquatic resources that the Lead Agencies anticipate would likely change if the Proposed Action or the alternatives are implemented (Section 3.3.3.3).

The species descriptions include a brief account of the current and historical distribution, life-history patterns, and habitat requirements of aquatic species. This section is subdivided into anadromous fish, native riverine fish, introduced species, estuarine species, and listed species. The last category includes species that would otherwise be included in the anadromous, riverine, or estuarine species.

The description of physical habitat provides information on the physical structure of the habitat. It contains a brief description of the water quality and other factors that may limit fish production in those water bodies, and describes the species that occur in these water bodies. This section also describes Endangered Species Act (ESA) critical habitat and Magnuson-Stevens Fishery Conservation Management Act Essential Fish Habitat (EFH) occurring within the area of analysis.

Section 3.3.3.3, *Factors Expected to be Affected by the Project*, provides a more detailed description of existing conditions for factors that are thought to have a major influence on aquatic resources. These factors form the basis for the effects evaluation in Section 3.3.4.

### **3.3.3.1 Aquatic Species**

#### **Fish**

Numerous fish species use the Klamath Basin during all or some portion of their lives, including salmonids, lamprey, sturgeon, suckers, minnows, and sculpin. Many other species are present in the estuary. Species that have been introduced into the basin include yellow perch, largemouth bass, spotted bass, sunfish, and catfish. The species include introduced resident species, estuarine species, and species listed under the federal or state ESAs. The number of species prohibits evaluation of each species. To address the impacts and benefits of the Proposed Action, target species have been selected for analysis based on their legal status or importance for tribal, commercial or recreational fisheries, and based on adequate data to conduct analysis. These target species are discussed below.

#### **Anadromous Fish Species**

The Klamath Basin provides habitat for many species of anadromous fish, many of which are salmonids, but which also include green sturgeon (*Acipenser medirostris* Ayres), Pacific lamprey, and American shad (non-native). Anadromous fish within the Klamath River watershed are nearly all in decline (Table 3.3-1). Green sturgeon appear to be in less decline than other fish species. Van Eenennaam et al. (2006) carefully suggests that the Klamath River green sturgeon population appears strong and stable, while cautioning against conclusions based on short time frames relative to their life history.

**Table 3.3-1. Declines in Klamath River Anadromous Fish**

Species	Historical Level	Percent Reduction from Historical Levels (estimates of individual runs)	Source
Pacific Lamprey	Unknown	98% (Represents reduction in tribal catch per effort )	Petersen Lewis 2009
Steelhead	400,000 <sup>(1)</sup>	67% (130,000)	Leidy and Leidy 1984; Busby et al. 1994
Coho salmon	15,400-20,000	52% to 95% (760 to 9,550)	Moyle et al. 1995; Ackerman et al. 2006
Fall-run Chinook salmon	500,000 <sup>(3)</sup>	92% to 96% (20,000-40,000)	Moyle 2002
Shasta River Chinook salmon <sup>(4)</sup>	20,000-80,000	88% to 95% (A few hundred to a few thousand )	Moyle 2002
Spring-run Chinook salmon	100,000	98% (2,000) <sup>(2)</sup>	Moyle 2002

<sup>(1)</sup> This estimate is from 1960. Anadromous fish numbers were already in decline in the early 20th century (Snyder 1931)

<sup>(2)</sup> Includes Klamath River and Trinity River Chinook salmon

<sup>(3)</sup> Excludes hatchery influenced escapement

<sup>(4)</sup> Shasta River is a subset of the overall Klamath River Chinook salmon population

Anadromous salmonids in the Klamath River include fall- (including late-fall) and spring-run Chinook salmon; coho salmon; fall-, winter-, and summer-run steelhead; and coastal cutthroat trout. Anadromous salmonids share many similar life-history traits, but the timing of their upstream migrations, habitat preferences, and distributions differ. All anadromous salmonids spawn in gravel or cobble substrates that are relatively free of fine sediment with suitable surface and subsurface flow to carry oxygen to the eggs and carry metabolic waste away from the eggs. Once suitable spawning habitat is found, the adult female digs one or more nests and deposits up to 3,000 eggs. Her mate(s) will simultaneously fertilize the eggs and fend off other males and egg-eating predators. The female continues digging upstream of the nest, which forms a distinctive pit just upstream and a protective mound of gravel and cobble over the eggs. The female will continue the mound-building process and defend her nest location until her demise. Steelhead and coastal cutthroat trout have similar life histories, but may survive spawning, re-enter the ocean, and return to spawn the following year(s). The eggs hatch several weeks or months later, depending on species and water temperature. The resulting yolk-sac fry, also referred to as alevins, reside in the gravel for several more weeks until their yolk sac is depleted. The fry then emerge from the redd and seek slow shallow areas near shoreline or vegetative cover, gradually moving into deeper and faster water as they grow. Anadromous salmonids are generally considered "juveniles" when they have grown to a size of approximately 55 mm. Juveniles feed and grow on their way downstream and may also rear for some time in the estuary prior to entering the ocean, but before entering brackish or salt water, they must undergo a physiological process called smoltification. After entering the ocean, smolts range up and down the coast as they grow to adulthood. Most adult salmonids return to spawn in the stream where they were born, although some straying does occur. Specific details of life history and distribution are described for each run of anadromous salmonid in the following section.

### Chinook Salmon

Two Chinook salmon Evolutionarily Significant Units (ESUs) occur in the Klamath Basin—the Southern Oregon and Northern California Coastal ESU, which includes all naturally spawned Chinook salmon in the lower Klamath River downstream from its confluence with the Trinity River, and the Upper Klamath and Trinity Rivers ESU, which includes all naturally spawned populations of Chinook salmon in the Klamath and Trinity rivers upstream of the confluence of the Klamath and Trinity Rivers. A status review in 1999 determined that neither ESU warranted listing (National Oceanic and Atmospheric Administration (NOAA) Fisheries Service 1999a). A petition to list the Upper Klamath and Trinity Rivers ESU was submitted to the NOAA Fisheries Service in January 2011 (CBD et al. 2011); in April, NOAA Fisheries Service announced that the petition contained substantial scientific information warranting federal review and that a finding as to whether they should be listed as threatened or endangered will be made by January 28, 2012 ([http://www.noaanews.noaa.gov/stories2011/20110411\\_chinook.html](http://www.noaanews.noaa.gov/stories2011/20110411_chinook.html)). Two races of Chinook salmon occur in the Klamath River: fall-run and spring-run. Although wild spring-run Chinook salmon in the Klamath River system differs from fall-run Chinook salmon genetically, as well as in terms of life history and habitat requirements (NRC 2004), both runs are included within these ESUs (Myers et al. 1998). Both races are described below.

**Fall-Run Chinook Salmon** Fall-run Chinook salmon (*Oncorhynchus tshawytscha*) are distributed throughout the Klamath River downstream of Iron Gate Dam. Historical records reviewed by Hamilton et al. (2005) and genetic information obtained from archaeological sites analyzed by Butler et al (2010) indicate that prior to the construction of Copco 1 Dam, Chinook salmon spawned in the tributaries upstream of Upper Klamath Lake, including the Sprague, Williamson, and Wood Rivers.

Adult upstream migration through the estuary and lower Klamath River peaks in early September and continues through late October (Moyle 2002; Federal Energy Regulatory Commission [FERC] 2007; Strange 2009). Spawning peaks in late October and early November, and fry begin emerging from early February through early April (Stillwater Sciences 2009a), although timing may vary somewhat depending on temperatures in different years and tributaries.

Fall-run Chinook salmon in the Klamath Basin exhibit three juvenile life-history types: Type I (ocean entry at age 0<sup>1</sup> in early spring within a few months of emergence), Type II (ocean entry at age 0 in fall or early winter), and Type III (ocean entry at age 1 in spring) (Sullivan 1989). Based on outmigrant trapping at Big Bar on the Klamath River from 1997 to 2000, 63 percent of natural Chinook salmon outmigrants are Type I, 37 percent are Type II, and less than 1 percent are Type III (Scheiff et al. 2001). Although, trapping efforts are not equal among seasons, the results are consistent with scale analysis of adult returns by Sullivan (1989).

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<sup>1</sup> A fish emerging in spring is designated as age 0 until January 1st of the following year, when it is designated as age 1 until January 1st of the next year, when it is designated age 2.

Critical stressors on fall-run Chinook salmon in the basin include water quality and quantity in the mainstem and within spawning tributaries. Downstream of Iron Gate Dam, the mainstem Klamath River undergoes seasonal changes in flows, water temperature, dissolved oxygen, and nutrients, as well occasional blooms of *Microcystis aeruginosa*. During outmigration, juvenile Chinook salmon are vulnerable to contracting disease from pathogens, including the bacterium *Flavobacterium columnare*, and myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta*.

**Spring-Run Chinook Salmon** Spring-run Chinook salmon in the Klamath Basin are distributed mostly in the Salmon and Trinity Rivers and on the mainstem below these tributaries during migratory periods, although a few fish are occasionally observed in other areas (Stillwater Sciences 2009a). Based on data from 1992 to 2001 (California Department of Fish and Game [CDFG], unpublished data 2004), the Salmon River contributions to the overall escapement ranged from 1 to 20 percent of the total escapement, and from 2 to 35 percent of the natural escapement. No spawning has been observed in the mainstem Klamath River (Shaw et al. 1997). Historically, the spring run may have been as abundant as the fall run (Moyle 2002). Large numbers of Chinook salmon once spawned in the basin above Klamath Lake in the Williamson, Sprague, and Wood Rivers, but the completion of Copco Dam in 1917 eliminated these runs (Snyder 1931, as cited in NRC 2004). It is believed that spring Chinook salmon spawned in the tributaries of the upper basin (Moyle 2002; Hamilton et al. 2005; Butler et al. 2010). Large runs of spring Chinook salmon also returned to the Shasta, Scott, and Salmon rivers. The construction of Dwinnell Dam on the Shasta River in 1926 was soon followed by the disappearance of the spring Chinook salmon run in that tributary.

Wild spring-run Chinook salmon from the Salmon River appear to primarily express a Type II life history, based on scale analyses of adults returning from 1990 to 1994 in the Salmon River (Olson 1996), as well as otolith analyses of Salmon River fry and adults (Sartori 2006). A small number of fish employ the Type III life history, although apparently not nearly as prevalent as the Type II.

Spring-run Chinook salmon upstream migration is observed during two time periods—spring (April through June) and summer (July through August) (Strange 2008). Snyder (1931) also describes a run of Chinook salmon occurring in Klamath River during July and August under historical water quality and temperature conditions. Adults spawn from mid-September to late-October in the Salmon River and from September through early November in the South Fork Trinity River (Stillwater Sciences 2009a). Emergence takes place from March and continues until early-June (West et al. 1990). Age-0+ juveniles rearing in the Salmon River emigrate at various times of the year, with one of the peaks of outmigration occurring in April through May (Olson 1996), which would be considered Type I life history. Based on outmigrant trapping from April to November in 1991 at three locations in the South Fork Salmon River, Olson (1996) reported that the greatest peak in outmigration of age-0+ juveniles (69 percent) was in mid-October, which would be considered Type II life history. Scale circuli patterns of adults with an identified Type II life history were consistent with those from juveniles outmigrating in mid-October. Sullivan (1989) reported that outmigration of Type II age-0+ juveniles can occur as late in the year as early-winter. On the South Fork Trinity River outmigration

occurs in late-April and May with a peak in May (Dean 1994, 1995), although it is not possible to differentiate between spring and fall race juveniles and so the spring-run may have different run timing. Age-1 juveniles (Type III) have been found to outmigrate from the South Fork Trinity River during the following spring (Dean 1994, 1995).

It is unclear how much time outmigrating age-0+ juveniles spend in the Klamath River mainstem and estuary before entering the ocean. Sartori (2006) did identify a period of increased growth (estimated mean of 24 days) just prior to reaching an estuarine environment based on otolith analyses of returning adults to the Salmon River, but this period was never clearly linked to mainstem residence. From March to May, there were fair numbers of age-1 juvenile outmigrants captured in the Klamath River estuary (Wallace 2004). Most were identified to be hatchery age-1 juvenile fall-run Chinook salmon, but nearly half were identified to be of natural origin, based on tag expansions.

Stressors on spring-run Chinook salmon related to water quality and quantity are similar to those for fall-run Chinook salmon in the mainstem Klamath River. Although water quality tends to improve in the mainstem downstream of the confluence with the Salmon River (the upstream-most spawning tributary), degradation of water quality (especially temperature and dissolved oxygen) can create critically stressful conditions for spring-run Chinook salmon for much of the summer (June through September). Production in the Salmon River is primarily controlled by high water temperatures that reduce adult holding and summer rearing habitat in the mainstem Salmon River, while increased fine sediment input reduces spawning and rearing habitat quality (Elder et al. 2002).

### Steelhead

Klamath Basin summer steelhead and winter steelhead (*O. mykiss irideus*) populations both belong to the Klamath Mountain Province ESU. NOAA Fisheries Service (2001) status review found that this ESU was not in danger of extinction or likely to become so in the foreseeable future, based on estimated populations for the ESU and lower estimates of genetic risk from naturally spawning hatchery fish than estimated in previous reviews, and consideration of existing conservation efforts that are benefiting steelhead in the ESU (NOAA Fisheries Service 2001).

**Summer Steelhead** Summer steelhead are distributed throughout the Klamath River downstream of Iron Gate Dam and in its tributaries, and genetic information obtained from archaeological sites analyzed by Butler et al (2010) suggests that steelhead historically used habitat upstream of Upper Klamath Lake prior to the construction of Copco 1 Dam. Based on available escapement data, approximately 55 percent of summer steelhead spawn in the Trinity River and other lower-elevation tributaries. Most remaining summer steelhead are believed to spawn in tributaries between the Trinity River (River Mile [RM] 43) and Seiad Creek (RM 129), with high water temperatures limiting their use of tributaries farther upstream (NRC 2004). The mainstem Klamath River is used primarily as a migration corridor for adult summer steelhead to access holding and spawning habitat in tributaries to the Klamath River.

Summer steelhead adults enter and migrate up the Klamath River from March through June while sexually immature (Hopelain 1998), then hold in cooler tributary habitat until

spawning begins in December (United States Fish and Wildlife Service [USFWS] 1998). Forty to 64 percent of summer steelhead in the Klamath River exhibit repeat spawning, with adults observed to migrate downstream to the ocean after spawning (also known as “runbacks”) (Hopelain 1998). Summer steelhead in the basin also have a “half-pounder” life-history pattern, in which an immature fish emigrates to the ocean in the spring, returns to the river in the fall, spends the winter in the river, then emigrates to the ocean again the following spring (Busby et al. 1994; Moyle 2002).

Juvenile summer steelhead in the Klamath Basin may rear in freshwater for up to 3 years before outmigrating. Although many juveniles migrate downstream at age 1+ (Scheiff et al. 2001), those that outmigrate to the ocean at age 2+ appear to have the highest survival (Hopelain 1998). Juveniles outmigrating from tributaries at age 0+ and age 1+ may rear in the mainstem or in non-natal tributaries (particularly during periods of poor water quality) for 1 or more years before reaching an appropriate size for smolting. Age-0 juvenile steelhead have been observed migrating upstream into tributaries, off-channel ponds, and other winter refuge habitat in the lower Klamath River (Stillwater Sciences 2010b). Juvenile outmigration can occur from the spring through fall. Smolts are captured in the mainstem and estuary throughout the fall and winter (Wallace 2004), but peak smolt outmigration normally occurs from April through June, based on estuary captures (Wallace 2004). Temperatures in the mainstem are generally suitable for juvenile steelhead, except during periods of the summer, especially upstream of Seiad Valley (for more species information see USFWS 1998; Moyle 2002; NRC 2004; and Stillwater Sciences 2009a). Critical limiting factors for summer steelhead are believed to include degraded habitats, fish passage, predation, and competition (Moyle et al. 2008).

**Winter Steelhead** Moyle (2002) describes steelhead in the Klamath Basin as having a summer- and winter-run. Some divide the winter-run into fall and winter runs (Barnhart 1994; Hopelain 1998; USFWS 1998; Papa et al. 2007). In this report “winter steelhead” refers to both fall and winter runs except in cases when the distinction is pertinent to the discussion. Effects on winter- and fall-run steelhead were differentiated wherever data was sufficient to analyze them separately.

Winter steelhead are widely distributed throughout the Klamath River and its tributaries downstream of Iron Gate Dam, and are believed to have historically used habitat upstream of Upper Klamath Lake (Butler et al. 2010). The Trinity, Scott, Shasta, and Salmon Rivers are the most important spawning streams for winter steelhead. Winter steelhead adults generally enter the Klamath River from July through October (fall run) and from November through March (winter run) (USFWS 1998; Stillwater Sciences 2010b). Winter steelhead primarily spawn in tributaries from January through April (USFWS 1998), with peak spawn timing in February and March (ranging from January to April) (NRC 2004). Adults may repeat spawning in subsequent years after returning to the ocean. Half-pounders typically utilize the mainstem Klamath River until leaving the following March (NRC 2004), although they also utilize larger tributaries such as the Trinity River (Dean 1994, 1995).

Fry emerge in spring (NRC 2004), with fry observed in outmigrant traps in Bogus Creek and Shasta River from March through mid-June (Dean 1994). Age-0+ and 1+ juveniles

have been captured in outmigrant traps in spring and summer in tributaries to the Klamath River above Seiad Creek (CDFG 1990a, 1990b, as cited in USFWS 1998). These fish are likely rearing in the mainstem or non-natal tributaries before leaving as age-2+ outmigrants.

Juvenile outmigration appears to primarily occur between May and September with peaks between April and June, although smolts are captured in the estuary as early as March and as late as October (Wallace 2004). Most adult returns (86 percent) originate from fish that smolt at age 2+, representing 86 percent of adult returns; in comparison with only 10 percent for age-1 juveniles and 4 percent for age 3+ juveniles (Hopelain 1998).

Similar limiting factors listed for summer steelhead also affect winter steelhead populations, including degraded habitats, decreased habitat access, fish passage, predation, and competition (for more species information see USFWS 1998; NRC 2004; Wallace 2004; and Stillwater Sciences 2009a).

#### Coastal Cutthroat Trout

Klamath River coastal cutthroat trout (*Oncorhynchus clarki clarki*) belong to the Southern Oregon California Coasts ESU. In a 1999 status review, NOAA Fisheries Service determined that the Southern Oregon California Coasts ESU did not warrant ESA listing (Johnson et al. 1999). Coastal cutthroat trout are distributed primarily within smaller tributaries to the lower 22 miles of the Klamath River mainstem above the estuary (NRC 2004), but also within tributaries to the Trinity River (Moyle et al. 1995).

Cutthroat trout have not been extensively studied in the Klamath basin, but it has been noted that their life history is similar to fall and winter steelhead in the Klamath River (NRC 2004). Both resident and anadromous life histories are observed in the Klamath Basin. Anadromous adults enter the river to spawn in the fall. Generally, spawning of anadromous and resident coastal cutthroat trout may occur from September to April (Moyle 2002). Sea-run adults may either return in summer to feed, or return in September or October to spawn and/or possibly overwinter (NRC 2004). Moyle (2002) noted that upstream migration in northern California spawning streams tends to occur from August to October after the first substantial rain.

Juveniles may spend anywhere from one to three years in freshwater to rear. Juveniles outmigrate during April through June, at the same time as Chinook salmon juvenile downstream migration (Hayden and Gale 1999, as cited in NRC 2004; Moyle 2002). Juveniles also appear to spend at least some time rearing in the estuary. Wallace (2004) found that estuary residence time ranged from 5 to 89 days, with mean of 27 days, based on a mark-recapture study.

#### Pacific Lamprey

Pacific lamprey are the only anadromous lamprey species in the basin. It is not clear whether residual populations of this species still exist above Iron Gate Dam. Pacific lamprey, along with three other lamprey species, was petitioned for ESA listing in 2003 (Nawa 2003). Although the USFWS halted species status review in December 2004 due to inadequate information (NOAA Fisheries Service 2004), efforts to list Pacific lamprey

are anticipated to resume as more information is obtained. No current status assessments are available for any Klamath lampreys and little is known of their biology or sensitivity to environmental changes in the Klamath drainage (Hamilton et al. 2011).

Pacific lamprey are found in Pacific coast streams from Alaska to Baja California. They occur throughout the mainstem Klamath River downstream of Iron Gate Dam and its major tributaries: the Trinity, Salmon, Shasta, and Scott River Basins (Stillwater Sciences 2009a). The extent of their historical upstream distribution is uncertain due to the occurrence of several resident species of lamprey in the upper parts of the Klamath Basin (FERC 2007). Pacific lamprey are capable of migrating long distances, and show similar distributions to anadromous salmon and steelhead (Hamilton et al. 2005). Preliminary results of radio telemetry studies by the Yurok Tribe show an extended period of time for adult presence in the river (Yurok Tribe 2011, unpublished data).

Pacific lamprey are anadromous nest builders that die shortly after spawning. They enter the Klamath River during all months of the year, with peak upstream migration occurring from December through June (Stillwater Sciences 2009a). Spawning occurs at the upstream edge of riffles in sandy gravel from mid-March through mid-June (Stillwater Sciences 2009a). After lamprey eggs hatch, the larvae (ammocoetes) drift downstream to backwater areas and burrow into the substrate, feeding on algae and detritus (FERC 2007). Based on observations and available habitat, most ammocoete rearing likely occurs in the Salmon, Scott, and Trinity Rivers, as well as in the mainstem Klamath River. The Klamath River upstream of the Shasta River appears to have less available spawning and rearing habitat, and Pacific lamprey are not regularly observed there. Juveniles remain in freshwater for 5 to 7 years before they migrate to the ocean and transform into adults (Moyle 2002). They spend 1 to 3 years in the marine environment, where they parasitize a wide variety of ocean fishes, including Pacific salmon, flatfish, rockfish, and pollock. For more species information see Close et al. 2010; Stillwater Sciences 2009a; and PacifiCorp 2004a.

Major factors believed to be affecting their populations include barriers to upstream migration at dams, dewatering of larval habitat through flow regulation, stranding due to rapid downramping, reducing larval habitat by increasing water velocity and/or reducing sediment deposition areas, and mortality due to exposure to contaminants in the larval stage (Close et al. 2002, as cited in Hamilton et al. 2011).

#### Green Sturgeon

Green sturgeon (*Acipenser medirostris* Ayres) are an anadromous species that occurs in coastal marine waters from Mexico to the Bering Sea. NOAA Fisheries Service has identified two distinct population segments (DPSs): the Northern Green Sturgeon DPS, which includes populations spawning in coastal watersheds from the Eel River north, which is not listed as threatened or endangered but is on NOAA Fisheries Service' Species of Concern list, and the Southern Green Sturgeon DPS, encompassing coastal or Central Valley populations spawning in watersheds south of the Eel River, which is listed as threatened under the federal ESA (NOAA Fisheries Service 2006a). Although the Southern DPS is considered a separate population from the Northern DPS based on genetic data and spawning locations, their ranges outside of the spawning season tend to

overlap (CDFG 2002b; Israel et al. 2004; Moser and Lindley 2007). The Klamath Basin may support most of the spawning population of green sturgeon (Adams et al. 2002). Although Southern DPS green sturgeon may enter west coast estuaries to feed in the summer and fall, but there has been no evidence of them entering the Klamath River estuary (Reclamation 2010). Northern DPS green sturgeon in the Klamath River sampled during their spawning migration ranged in age from 16 to 40 years (Van Eenennaam et al. 2006). It is believed that in general green sturgeon have a life span of at least 50 years, and spawn every 4 years on average after around age-16, for a total of around eight spawning efforts in a lifetime (Klimley et al 2007). Green sturgeon enter the Klamath River to spawn from March through July. Green sturgeon spawn primarily in the lower 67 miles of the mainstem Klamath River (downstream of Ishi Pishi Falls), in the Trinity River, and occasionally in the lower Salmon River (Klamath River Basin Fisheries Task Force [KRBFTF] 1991; Adams et al. 2002; Benson et al. 2007). Most green sturgeon spawning occurs from the middle of April to the middle of June (NRC 2004). After spawning, around 25 percent of green sturgeon migrate directly back to the ocean (Benson et al. 2007), and the remainder hold in mainstem pools in the Klamath River from river mile (RM) 13 to 65 through November. During the onset of fall rainstorms and increased river flow, adult sturgeon move downstream and leave the river system (Benson et al. 2007). Juvenile green sturgeon may rear for 1 to 3 years in the Klamath River system before they migrate to the estuary and ocean (NRC 2004; FERC 2007; CALFED 2007), usually during summer and fall (Emmett et al. 1991, as cited in CALFED 2007; CH2M Hill 1985; Hardy and Addley 2001).

## **Resident Riverine Fish Species**

### Rainbow and Redband Trout

Rainbow trout (*Oncorhynchus mykiss*) exhibit a wide range of life-history strategies, including anadromous forms (steelhead, described above) and resident forms, described here. The Klamath Basin has two subspecies of rainbow trout. Behnke (1992) identifies the inland form as the Upper Klamath redband trout, *Oncorhynchus mykiss newberrii*, but considers steelhead and resident rainbow trout downstream of Upper Klamath Lake to be primarily coastal rainbow trout, *Oncorhynchus mykiss irideus*. Since construction of Copco 1 Dam and Iron Gate Dam, resident trout upstream of Iron Gate Dam are considered redband trout, and resident trout downstream of Iron Gate Dam are considered coastal rainbow trout (FERC 2007). Behnke (2002) indicates that two distinct groups of redband trout may be in the upper basin: one that is adapted to lakes and another that is adapted to streams. The area upstream of Iron Gate Dam, and particularly Upper Klamath Lake, support populations of redband trout. These fish support a substantial recreational fishery.

The Upper Klamath Lake Basin supports the largest and most functional adfluvial redband trout population of Oregon's interior basins (Hamilton et al. 2011). Adfluvial adult redband trout migrate from lake habitats into tributaries to spawn. Peak spawning occurs in December and January, but redband trout in Spring Creek have been documented to spawn nearly year-round, in all months from October through August. Their progeny typically spend one year rearing in tributaries before migrating back to the

lake. In the Hydroelectric Reach, most redband trout spawning is thought to occur in Spencer and Shovel Creeks. Redband trout need to migrate among habitats, mainstem, tributaries, and reservoirs to meet their life-history requirements. Redband trout are not susceptible to *C. shasta* or other diseases potentially brought upstream by anadromous fishes (Hamilton et al. 2011). For more species information, see USFWS (1998); USFWS (2000); Behnke (2002); Moyle (2002); NRC (2004); PacifiCorp (2004a); Starcevich et al. (2006); Messmer and Smith (2007); and Stillwater Sciences (2009a).

#### Resident Lampreys

In addition to the anadromous Pacific lamprey, described above, at least five or six resident species are present in the Klamath Basin (PacifiCorp 2006; Hamilton et al. 2011):

- Pit-Klamath brook lamprey (*Entosphenus lethophagus*)
- Modoc brook lamprey (*Entosphenus folletti*)
- Western brook lamprey (*Lampetra richardsoni*)
- Klamath River lamprey (*Entosphenus similis*)
- Miller Lake lamprey (*Entosphenus minima*)
- “Klamath Lake lamprey,” an undescribed, parasitic species

All lamprey species have a similar early life history where ammocoetes drift downstream to areas of low velocity with silt or sand substrate and proceed to burrow into the stream bottom and live as filter feeders (USFWS 2004). After they transform into adults, the non-parasitic species do not feed, while the parasitic species feed on a variety of fish species (FERC 2007).

Klamath River lamprey are found both upstream and downstream of Iron Gate Dam, from Spencer Creek downstream, and are common in the lower Klamath River and the low-gradient tributaries there (NRC 2004). They are also found in the Trinity River, and in the Link River of the Upper Klamath Basin (Lorion et al. 2000, as cited by Close et al. 2010). “Klamath Lake lamprey,” an as yet undescribed species, reside in Upper Klamath Lake and migrate upstream in the Sprague River to spawn (Close et al. 2010). Klamath Lake lamprey ammocoetes are reported to metamorphose in the fall, spend 12 to 15 months in Upper Klamath Lake parasitizing fish, and then spawn in the spring in the Sprague River (FERC 2007).

#### Cyprinids

The blue chub (*Gila coerulea*) and tui chub (*Gila bicolor*) are both found in the Klamath Basin. These species prefer habitat with quiet water, well-developed beds of aquatic plants, and fine sediment or sand bottoms. Although chubs can withstand a variety of conditions including cold, clear lake water, and can also tolerate low dissolved oxygen levels, they are most often found in habitats with summer water temperatures higher than 20°C. These fish are omnivores and can play an important role in nutrient cycling. Chub spawning takes place from April through July, in shallow rocky areas in temperatures of 15 to 18°C (Moyle 2002).

### Sculpin

Several sculpin (*Cottidae*) species are found in coastal streams and rivers from Alaska to southern California. At least 7 species of sculpin are known to occur in the Klamath River or its estuary, including Pacific staghorn, prickly, slender, sharpnose, coastrange, marbled, and Klamath Lake sculpin. Mainstem river habitat may be important to sculpin populations as it can provide an important migration corridor (White and Harvey 1999). Pacific staghorn sculpin are found predominantly in brackish waters of the estuary. Coastal populations of prickly and coastrange sculpin are generally assumed to be estuary-dependent for part of their early life history (White and Harvey 1999). The marbled sculpin (*Cottus klamathensis*) is a relatively wide-ranging species found in a variety of habitats in northern California and southern Oregon (Daniels and Moyle 1984). Marbled sculpin are found mainly in low gradient, spring-fed streams and rivers where the water temperature is less than 20°C in the summer and in habitat with fine substrate that can support beds of aquatic plants. They are typically found in 60 to 70 cm of water and are in velocities around 23 cm/sec (Moyle 2002).

### Smallscale sucker

The Klamath smallscale sucker (*Catostomus rimiculus*) is common and widely distributed in the Klamath River and its tributaries below the city of Klamath Falls, Oregon, and in the Rogue River (Moyle 2002). They tend to inhabit deep, quiet pools in mainstem rivers and slower-moving reaches in tributaries; however, they can be found in faster-flowing habitats when feeding or breeding (Moyle 2002). McGinnis (1984) reported that this species spawns in small tributaries to the Klamath and Trinity Rivers. Spawning in tributaries to Copco Reservoir has been observed from mid-March to late April (Knudsen and Mills 1980, as cited in Moyle 2002). Juveniles are most commonly found in the streams that are used for spawning. This species does not achieve a large size and is relatively long-lived. Fish measuring 45 cm have been aged through scale analysis as being 15 years old (Scoppetone 1988, as cited in Moyle (2002). Moyle (2002) speculated that dams and diversions have benefitted this species by increasing the availability of its preferred warmer, low-velocity habitat.

Electrofishing by PacifiCorp and Oregon Department of Fish and Wildlife (ODFW) in the J.C. Boyle Peaking Reach revealed the existence of a good population of smallscale suckers in moderate velocity habitat—smallscale sucker dominated the fish assemblage in most samples (W. Tinniswood, 2011, pers. comm.). The dams have increased reservoir habitat that does not appear to be conducive to a riverine sucker species such as smallscale suckers. The J.C. Boyle Dam blocks the migration of suckers to spawning habitat in Spencer Creek. Spawning now occurs in the mainstem Klamath River where smallscale suckers are exposed to flow fluctuations that can displace their broadcast eggs or dessicated them during power peaking (Dunsmoor 2006). Electrofishing in Jenny Creek revealed adult smallscale suckers occupying deep, moderate-velocity habitat among boulders (W. Tinniswood, 2011, pers. comm.). The reservoirs themselves do not appear to provide habitat for smallscale sucker.

## **Non-native Fish Species**

### Goldfish

Goldfish (*Carassius auratus*) are abundant in J.C. Boyle Reservoir and Keno Impoundment; in September 2010, they were the most abundant species captured during ODFW electrofishing surveys.

### Yellow Perch

Yellow perch (*Perca flavescens*) prefer weedy rivers and shallow lakes. They are found in reservoirs and ponds along the Klamath River. Optimal temperature for growth is 22–27°C but yellow perch can survive in temperatures up to 30–32°C. They can survive low levels of dissolved oxygen (less than 1 milligram per liter [mg/L]) but are most abundant in areas with high water quality, as they are visual feeders. Larval and juvenile yellow perch feed on zooplankton; adults are opportunistic predators that may feed on larger invertebrates and small fish (Knight et al. 1984). The preferred habitat of the yellow perch includes large beds of aquatic plants for spawning and foraging. Their spawning takes place in 7 to 19°C water in April and May and usually occurs in their second year (Moyle 2002).

### Bass and Sunfish

Several species of bass (*Micropterus* spp.) and sunfish (*Lepomis* spp.) have been introduced into the Klamath Basin, including largemouth bass, spotted bass, white and black crappie, bluegill, pumpkinseed and green sunfish. Largemouth bass and sunfish (*Centrarchidae*) prefer lakes, ponds, or low-velocity habitat in rivers. They prefer habitats with aquatic vegetation and will spawn in a variety of substrates. They prefer water temperatures above 27°C. Juvenile and adult largemouth bass tend to feed on larger invertebrates and fish (Moyle 2002). Smaller members of the family, such as sunfish, are opportunistic feeders and eat a variety of aquatic insects, fish eggs, and planktonic crustaceans (Moyle 2002).

### Sacramento Perch

Sacramento Perch (*Archoplites interruptus*) occur in J.C. Boyle Reservoir and Keno Impoundment. The species is native to the Sacramento-San Joaquin watershed of California's Central Valley, from which they were extirpated.

### Catfish

Several species of catfish have been introduced into the Klamath Basin, including black, brown, and channel catfish, and yellow bullhead (Logan and Markle 1993; NRC 2004). Catfish prefer slow moving, warm water habitat. Brown bullhead (*Ameiurus nebulosus*) can tolerate a wide range of salinities and live at temperatures of 0 to 37°C, but their optimum temperature range is 20 to 33°C. Brown bullhead are most active at night and form feeding aggregations. Catfish are opportunistic omnivores and scavenge off the bottom of their habitat (Moyle 2002).

### Trout

Brook trout (*Salvelinus fontinalis*) is an introduced species in the Upper Klamath Basin (FERC 2007) found in clear, cold lake and stream habitats. They prefer temperatures

between 14 and 19°C but can survive in temperatures ranging from 1 to 26°C. Brook trout feed predominantly on terrestrial insects and aquatic insect larvae, though they may also opportunistically feed on other types of prey such as crustaceans, mollusks, and other small fish. Brook trout spawn in the fall and prefer habitats with small-sized gravel and nearby cover (Moyle 2002).

Brown trout (*Salmo trutta*) has also been introduced to the Klamath River and are found in both the Upper and Lower Basin. Brown trout prefer clear, cold water and can utilize both lake and stream habitats. Like brook trout, they spawn in the fall in streams with areas of clean gravel. Brown trout become piscivorous (fish eaters) once they reach a size where their gape can accommodate small fish available as prey.

#### Kokanee

Kokanee are landlocked sockeye salmon (*Oncorhynchus nerka*) that have been found in Upper Klamath Lake and Fourmile Creek.

#### American Shad

American shad (*Alosa sapidissima*) are an introduced, anadromous fish species that enjoys some popularity as a sport fish.

#### Fathead Minnow

Fathead minnow (*Pimephales promelas*) are an introduced bait fish widely distributed in the Upper Klamath Basin; however, it is thought that their introduction into the upper Klamath lakes may be a result of their use for pollution bioassays (Simon and Markle 1997, Moyle 2002).

#### **Estuarine Species**

The estuary is the mixing zone for freshwater and ocean water. The balance of fresh and saltwater changes over the course of the day with tides and is also strongly influenced by river flows. Because of this, both marine and freshwater species can often be found in different portions of the estuary at different times. All anadromous fish pass through the estuary during their migrations from freshwater to the sea and back again, and juvenile salmonids may rear in the estuary for varying periods of time, prior to moving into the ocean. CDFG surveys in the freshwater portion of the estuary commonly find Klamath speckled dace, Klamath smallscale sucker, prickly sculpin, and Pacific staghorn sculpin. Other fairly common species include northern anchovy, saddleback gunnel, and bay pipefish. Other species in the estuary include federally listed eulachon, state listed longfin smelt (described under listed species), silversides, surf smelt, stickleback, and several gobies. Impacts to the estuarine species were assessed based on effects on essential fish habitat for groundfish and pelagic fish, as described in subsequent sections.

#### **Freshwater Mollusks**

Four species of native freshwater mussels have been observed within the Klamath Basin (FERC 2007; Westover 2010). PacifiCorp surveys in 2002 and 2003 found Oregon floater (*Anodonta oregonensis*), California floater (*A. californiensis*) and western ridged mussel (*Gonidia angulata*) along Klamath River reaches from the Keno Impoundment/Lake Ewauna to the confluence of the Klamath and Shasta Rivers.

Westover (2010) found western pearlshell mussel (*Margaritifera falcata*) in addition to these species along the Klamath River from Iron Gate Dam to the confluence of the Klamath and Trinity Rivers.

*Anodonta* spp. are habitat generalists, more tolerant of lentic conditions than other native species (Nedeau et al. 2005). *Anodonta* spp. are also more tolerant of siltier substrates, as their thin shells allow individuals to “float,” or rest on top of silt-dominated streambeds (these species are commonly referred to as “floaters”). *G. angulata* is the largest and most common type of freshwater mussel found within the Klamath Basin, although little is known about their life history or habitat preferences (Nedeau et al. 2005). *G. angulata* is known to prefer cold, clean water, but can tolerate seasonal turbidity, and can be found in aggrading, or depositional areas as it can partially bury itself within bed sediments without affecting filter feeding (Vannote and Minshall 1982; Westover 2010). *M. falcata* has also been observed within the Klamath Basin downstream of Iron Gate Dam, though in lesser abundance than other species (Westover 2010). *M. falcata* occupies low shear stress habitats (e.g., pools and near banks) and interstices within bedrock and cobble (Howard and Cuffey 2003).

Adult freshwater mussels are generally found wedged into gravel, rock substrate or partially buried in finer substrates, using a muscular foot to maintain position. Freshwater mussels filter feed on plankton and other organic material suspended in the water column.

While life history traits of individual species of freshwater mussels have not been fully studied, the general life cycle is as follows. Eggs within female freshwater mussels are fertilized by sperm that is brought into the body cavity. From April through July thousands of tiny larvae, called glochidia, are released into the water where they must encounter a host fish for attachment within hours, otherwise they perish (Haley et al. 2007). Most juvenile freshwater mussels from these species drop off the fish hosts to settle from June to early August. They may spend an undetermined amount of time buried in the sediment where they grow to the point where they can maintain themselves at or below the substrate surface in conditions that are optimal for filter feeding (Nedeau et al. 2009). Freshwater mussels are fed upon by muskrats, river otters, and sturgeon (Nedeau et al. 2009). They were also a food of cultural significance for the Karuk Tribe (Westover 2010) and The Klamath Tribes.

Seven to eight species of fingernail clams and peaclams (Family: Sphaeriidae) were also found in the Hydroelectric Reach and from Iron Gate Dam to Shasta River during re-licensing surveys. One of the clam species, the montane peaclam (*Pisidium ultramontanum*), has special status as a federal species of concern and a United States Forest Service (USFS) sensitive species. The montane peaclam is generally found on sand-gravel substrates in spring-influenced streams and lakes, and occasionally in large spring pools. The original range included the Klamath and Pit Rivers in Oregon and California, as well as some of the larger lakes (Upper Klamath, Tule, Eagle, and possibly, lower Klamath lakes). On USFS lands they are currently present or suspected in streams and lakes of Lassen and Shasta-Trinity National Forests. Fingernail clams and peaclams are relatively short-lived (1 to 3 years) compared to freshwater mussels (10 to 15 years or

100 plus years for some species). These small clams live on the surface or buried in the substrate in lakes, ponds or streams. They bear small numbers of live young several times throughout the spring and summer (Thorp and Covich 2001).

There are also many species of freshwater snails, some of which are endemic to the Klamath Basin and have restricted ranges, often associated with cold-water springs. Several of these have recently been petitioned for listing. However, based on their restricted distribution outside of any areas that could be affected by the Proposed Action they were considered, but not included in any additional analysis.

### **Benthic Macroinvertebrates**

Benthic macroinvertebrates include immature, aquatic stages of insects such as midges, mayflies, caddisflies, stoneflies, dragonflies, and damselflies. They also include immature and adult stages of aquatic beetles; crayfish, amphipods and isopods (crustaceans); clams and snails; aquatic worms and other major invertebrate groups. Many benthic macroinvertebrates (BMIs) are the primary consumers in riverine food webs, feeding on primary producers—algae, aquatic plants, phytoplankton, bacteria, as well as leaves and other materials from terrestrial plants, and detritus. By converting organic material into biomass available to a wide variety of consumers, these organisms form an important component of the aquatic food web. Some BMIs are secondary consumers, feeding on the primary consumers. Together the BMIs are the primary food source for most fish species, and changes in abundance, distribution, or community structure can negatively affect fish populations. BMIs are also used as general indicators of water quality in indices of biological integrity based upon the richness or diversity of pollution tolerant and resistant species. BMIs are also particularly sensitive to changes in fine and coarse sediment load, which could occur under the Proposed Action and alternatives. Food supply can limit growth of salmonids, and this is especially true at higher temperatures; i.e., as water warms, a fish needs more food to sustain growth (Brett 1971; Elliott 1981; McCullough 1999). Growth is critical to juvenile salmonids because a larger size often confers a survival advantage during the overwintering period, smolt outmigration, or ocean residence. If fish are chronically exposed to warmer temperatures and food availability is low, growth may cease, fish may experience physiological stress, and mortality from disease, parasites, and predation may increase. But in a productive system with high densities of macroinvertebrates or forage fish, a high rate of growth can be sustained at temperatures higher than would be considered optimal under conditions where food is limiting.

Relicensing studies evaluated BMIs from Link River Dam to the Shasta River and on Fall Creek in 2002 and 2003 (FERC 2007). These studies show that macroinvertebrates are abundant, with densities of 4,000 to 8,000 individuals per square meter.

Macroinvertebrate densities in fall of 2002 ranged from a low of 4,000 per square meter below the powerhouse on the Klamath River to 21,000 per square meter below Keno Dam (PacifiCorp 2004b). Abundance of macroinvertebrates in the peaking reach of the Klamath River was as low as 500 per square meter in the spring of 2003. Dominant species in the riverine areas were caddisflies, blackflies, midges, beetles, and mayflies.

The reservoirs had high abundance of invertebrates but low diversity, and were dominated by species tolerant of impaired water quality conditions.

### **Listed Species**

#### **Coho Salmon**

The Southern Oregon/Northern California Coast (SONCC) coho salmon (*O. kisutch*) ESU is listed as federally threatened (NOAA Fisheries Service 1997a). This ESU includes all naturally spawning populations between Punta Gorda, California and Cape Blanco, Oregon, which encompasses the Trinity and Klamath Basins (NOAA Fisheries Service 1997a). Three artificial propagation programs are considered to be part of the ESU: the Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho salmon programs. NOAA Fisheries Service has determined that these artificially propagated stocks are no more than moderately diverged from the local natural populations. In addition, coho salmon in the Klamath Basin have been listed by the California Fish and Game Commission as threatened under the California Endangered Species Act (CESA) (CDFG 2002a).

Williams et al. (2006) described nine historical coho salmon populations within the Klamath Basin, including the upper Klamath River, Shasta River, Scott River, Salmon River, mid-Klamath River, lower Klamath River, and three population units within the Trinity River watershed (upper Trinity River, lower Trinity River, and South Fork Trinity River).

Coho salmon are currently widely distributed in the Klamath River downstream of Iron Gate Dam (RM 190), which blocks the upstream migration of coho salmon to historically available habitat in the upper watershed. Before the construction of the dams, coho salmon were apparently common and widely distributed throughout the watershed, probably in both mainstem and tributary reaches up to and including Spencer Creek at RM 228 (NRC 2004, as cited in NOAA Fisheries Service 2007; Hamilton et al. 2005). Coho salmon utilize the mainstem Klamath River for some or all of their life history stages (spawning, rearing and migration). However, the majority of returning adult coho salmon spawn in the tributaries to the mainstem (Magneson and Gough 2006, NOAA Fisheries Service 2010a).

Coho salmon adults in the Klamath Basin migrate upstream from September through late December, peaking in October and November. Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, 3 to 4 months after spawning (Trihey and Associates 1996; NRC 2004).

Some fry and age-0+ juveniles enter the mainstem in the spring and summer following emergence (Chesney et al. 2009). Large numbers of age-0 juveniles from tributaries in the mid-Klamath River move into the mainstem in the fall (October through November) (Soto et al. 2009; Hillemeier et al. 2009). Juvenile coho salmon have been observed to move into non-natal rearing streams, off-channel ponds, the lower Klamath River, and the estuary for overwintering (Soto et al. 2009; Hillemeier et al. 2009). Some proportion of juveniles generally remain in their natal tributaries to rear.

Age 1+ coho salmon migrate from tributaries into the mainstem Klamath River from February through mid-June with a peak in April and May, which often coincides with the descending limb of the spring hydrograph (NRC 2004; Chesney and Yokel 2003; Scheiff et al. 2001). Once in the mainstem, smolts appear to move downstream rather quickly; Wallace (2004) reported that numbers of coho salmon smolts in the Klamath River estuary peaked in May, the same month as peak outmigration from the tributaries.

The major activities identified as responsible for the decline of coho salmon in Oregon and California and/or degradation of their habitat included logging, road building, grazing, mining, urbanization, stream channelization, dams, wetland loss, beaver trapping, artificial propagation, overfishing, water withdrawals, and unscreened diversions for irrigation (NOAA Fisheries Service 1997a). In 2007, NOAA Fisheries Service published a Klamath River Coho Salmon Recovery Plan to comply with Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (not equivalent to recovery plans under ESA), including the following actions identified as high priority for recovery:

- Complete and implement the NOAA Fisheries Service recovery plan for the SONCC coho salmon under the ESA.
- Restore access for coho salmon to the Upper Klamath Basin by providing passage beyond existing mainstem dams.
- Fully implement the Trinity River Restoration Program.
- Provide incentives for private landowners and water users to cooperate in (1) restoring access to tributary streams that are important for coho spawning and rearing; and (2) enhancing mainstem and tributary flows to improve instream habitat conditions.
- Continue to improve the protective measures already in place to address forestry practices and road building/maintenance activities that compromise the quality of coho salmon habitat.
- Implement restorative measures identified through fish disease research results to improve the health of Klamath River coho salmon populations.

### **Eulachon**

Eulachon (*Thaleichthys pacificus*) is an anadromous fish that occurs in the lower portions of certain rivers draining into the northeastern Pacific Ocean, ranging from northern California to the southeastern Bering Sea in Bristol Bay, Alaska (Hubbs 1925; Schultz and DeLacy 1935; McAllister 1963; Scott and Crossman 1973; Willson et al. 2006, as cited in BRT 2010). The southern population of Pacific eulachon consists of populations spawning in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NOAA Fisheries Service 2009a). On March 18, 2010, NOAA Fisheries Service listed the southern DPS of eulachon as threatened under the ESA (NOAA Fisheries Service 2010b). The Klamath River is near the southern limit of the range of eulachon (Hubbs 1925, Schultz and DeLacy 1935, both as cited in BRT 2010). Large spawning aggregations of eulachon historically occurred regularly in the Klamath River (Fry 1979), and occasionally in the Mad River (Moyle et al. 1995; Moyle 2002) and Redwood Creek (Ridenhour and Hofstra 1994; Moyle et al. 1995). CDFG

sampled in the Klamath River from 1989 to 2003 with no eulachon captures (Wallace, pers. comm., 2011). The Yurok Tribe sampled extensively for eulachon in early 2011 and, although they did not capture eulachon from the Klamath River itself, tribal fishermen did recover eulachon from the surf zone at the mouth of the river (M. Belchik, pers. comm. 2011). The Tribe will be sampling for eulachon in the lower Klamath River again next winter.

Historically, eulachon runs in northern California were said to start as early as December and January and peak in abundance during March and April. Historically, large numbers of eulachon migrated upstream in March and April to spawn, but they rarely moved more than 8 miles inland (NRC 2004). Spawning occurs in gravel riffles, with hatching about a month later. The larvae generally move downstream to the estuary following hatching.

### **Southern DPS Green Sturgeon**

The Southern Green Sturgeon DPS is listed as threatened under the federal ESA (NOAA Fisheries Service 2006a). Juvenile and adult Southern Green Sturgeon enter many estuaries along the West Coast during the summer months to forage, but their use of the Klamath River estuary is unknown. The Yurok Tribe has tagged many Green Sturgeon of the Southern DPS with acoustic tags. They have been detected immediately offshore (~1/2 mile) on marine ultrasonic receivers, but there have been no detections within the estuary despite the fact that there are receivers there (M. Belchik, pers. comm., 2011). They are not known to use areas of the Klamath River upstream of the estuary, and they have not been observed to spawn in the Klamath River.

### **Lost River and Shortnose Suckers**

Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers are endemic to the Upper Klamath Basin of southern Oregon and northern California (Moyle 2002). These species are listed as endangered under the ESA (USFWS 1988), and are endangered under CESA, as well as fully protected species under California Fish and Game code section 5515(a)(3)(b)(4) and (6), respectively; thus any take of these species is prohibited. Threats to the population include: the damming of rivers, instream flow diversions, hybridization, competition and predation by exotic species, dredging and draining of marshes, water quality problems associated with timber harvest, the removal of riparian vegetation, livestock grazing, agricultural practices, and low lake elevations, particularly in drought years. Reduction and degradation of lake and stream habitats in the upper Klamath Basin is considered by USFWS to be the most important factor in the decline of both species (USFWS 1993)

The Lost River sucker historically occurred in Upper Klamath Lake (Williams et al. 1985) and its tributaries and the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake (Moyle 1976). Shortnose suckers historically occurred throughout Upper Klamath Lake and its tributaries (Williams et al. 1985; Miller and Smith 1981). The present distribution of both species includes Upper Klamath Lake and its tributaries (Buettner and Scopettone 1990), Clear Lake Reservoir and its tributaries (USFWS 1993), Tule Lake and the Lost River up to Anderson-Rose Dam (USFWS 1993), and the Klamath River downstream to Copco Reservoir (Beak Consultants 1987) and probably to

Iron Gate Reservoir (USFWS 1993). Shortnose sucker occur in Gerber Reservoir and its tributaries, but Lost River sucker do not.

Lost River and shortnose suckers are lake-dwelling, but spawn in tributary streams or springs (USFWS 1988). They spawn from February through May, depending on water depth and stream temperature (Buettner and Scoppettone 1990; Andreasen 1975, USFWS 2008). When spawning occurs over cobble and armored substrate, eggs fall between crevices or are swept downstream (Buettner and Scoppettone 1990). Larval Lost River and shortnose suckers spend relatively little time in tributary streams, migrating back to the lake shortly after emergence, typically in May and early June (Buettner and Scoppettone 1990). Adults return to Upper Klamath Lake soon after spawning. Lake fringe emergent vegetation is the primary habitat used by larval suckers. Juvenile suckers utilize a wide variety of near-shore habitat including emergent vegetation, non-vegetated areas and off-shore habitat (Hamilton et al. 2011). Refugial areas of relatively good water quality are important for fish in Upper Klamath Lake during the summer and early fall, when dissolved oxygen and pH levels can be stressful or lethal in much of the lake (Coleman and McGie 1988). A recovery plan for Lost River and shortnose suckers was completed in 1994. A new recovery plan is currently in development and is expected to be published in 2011 (Sada, pers. comm., 2011), along with proposed critical habitat. More detailed information for this species can be found in USFWS (2008).

### **Bull Trout**

Bull trout (*Salvelinus confluentus*) are listed as threatened under the ESA in 1999 (USFWS 1999), and a recovery plan for the Klamath River Bull Trout DPS was published in 2002 (USFWS 2002). Historically, bull trout occurred throughout the Klamath Basin in Oregon. Currently bull trout are found in two streams in the Upper Klamath Lake watershed (Sun and Threemile creeks), six streams in the Sprague River watershed (Deming, Brownsworth, Leonard, Boulder, Dixon, North Fork Sprague), and one stream in the Sycan River watershed (Long Creek).

The distribution and numbers of bull trout are believed to have declined in the Klamath Basin due to habitat isolation, loss of migratory corridors, poor water quality, and the introduction of nonnative species. The geographic isolation of the Klamath populations places them at greater risk of genetic effects and extirpation (NRC 2004). Bull trout exhibit two basic life-history strategies: resident and migratory. Migratory bull trout live in larger river and lake systems and migrate to small stream headwaters to spawn. In general, migratory fish are larger than resident fish. Research indicates that various types of bull trout interbreed at times, which helped maintain viable populations throughout the fish's range (Rieman and McIntyre 1993).

Bull trout reach sexual maturity in 5 to 7 years and spawn from the end of August through November. Spawning may occur annually for some populations, and every other year for the rest. Bull trout require particularly clean gravel substrates for spawning. High sediment levels suffocate eggs by reducing dissolved oxygen (Rieman and McIntyre 1996). Bull trout eggs incubate over the winter and hatch in the late winter or early spring. Emergence usually requires an incubation period of 120 to 200 days.

Juvenile bull trout migrate upstream from spawning areas to grow and take advantage of cool headwater temperatures. Bull trout less than 1 year old are generally found in areas along stream margins and inside channels. Most migratory juvenile bull trout remain in headwater tributaries for 1 to 3 years before emigrating downstream to larger stream reaches. Emigration usually takes place from June to August (Rieman and McIntyre 1996).

#### **Southern Resident Killer Whale**

The Southern Resident Killer Whale (*Orcinus orca*) DPS is designated as endangered under the ESA (NOAA Fisheries Service 2005). This DPS primarily occurs in the inland waters of Washington State and southern Vancouver Island, particularly during the spring, summer, and fall, although individuals from this population have been observed off coastal California in Monterey Bay, near the Farallon Islands, and off Point Reyes (Heimlich-Boran 1988; Felleman et al. 1991; Olson 1998; Osborne 1999; NOAA Fisheries Service 2005). Southern Resident Killer Whale survival and fecundity are correlated with Chinook salmon abundance (Ward et al. 2009; Ford et al. 2009). Southern Resident Killer Whales could potentially be affected by changes in salmon populations in the Klamath River caused by the Proposed Action (food abundance is one of the elements of their critical habitat, as described in the Critical Habitat Section). Hanson et al. (2010) found that Southern Resident Killer Whale stomach contents included several different ESUs of salmon, including Central Valley fall-run Chinook salmon.

#### **Longfin Smelt**

Longfin smelt (*Spirinchus thaleichthys*) are a state-listed threatened species throughout their range in California (CDFG 2009), but the USFWS denied the petition for federal listing because the population in California (and specifically San Francisco Bay) was not believed to be sufficiently genetically isolated from other populations (USFWS 2009). This species generally has a 2 year lifespan, although 3-year-old fish have been observed (Moyle 2002). They typically live in bays, estuaries and have sometimes been observed in the nearshore ocean from San Francisco Bay to Prince William Sound, Alaska, including the Klamath River. They prefer salinities of 15 to 30 ppt, although they can tolerate salinities from freshwater to full seawater. They prefer temperatures of 16 to 18°C and generally avoid temperatures higher than 20°C. Longfin smelt may occur in the Klamath River throughout the year. They would only be expected to use the estuary and the lowest reaches of the river. Longfin smelt spawning occurs primarily from January to March, but may extend from November into June, in fresh or slightly brackish water over sandy or gravel substrates. Temperatures during spawning in the San Francisco estuary are 7 to 14.5°C. Embryos hatch in 40 days in 7°C water temperature (25 days in 10.6°C water) and are quickly swept downstream by the current to more brackish areas. The importance of ocean rearing is unknown. Little is known about longfin smelt populations in the Klamath River, except that they are presumably small.

### **3.3.3.2 Physical Habitat Descriptions**

#### **Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir**

Aquatic habitat in the Upper Klamath Basin includes both lacustrine and riverine habitats, and also includes large, thermally stable coldwater springs. The upper Klamath River upstream of Iron Gate Dam once supported large populations of anadromous salmon and steelhead by providing spawning and rearing habitat (Hamilton et al. 2005). Further, Butler et al. (2010) documented fish remains from six archaeological sites located upstream of Upper Klamath Lake to provide an independent record of Chinook salmon and steelhead in the Upper Basin.

Upper Klamath Lake is the most prominent feature in this part of the basin, although other lakes and reservoirs are also present. Lake Ewauna, another lake on the Klamath River mainstem, is connected to Upper Klamath Lake via the Link River. The Keno Impoundment/Lake Ewauna is formed by Keno Dam, which regulates water surface elevations in the impoundment to facilitate agricultural diversions. Implementation of the Klamath Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KBRA) would result in the reintroduction of anadromous fish into these lakes and their tributary streams. The KBRA has substantial funding designated to improve water quality above Keno Dam.

Lower Klamath Lake, Tule Lake, Clear Lake and Gerber Reservoir in the Upper Basin could be affected by changes in water management associated with the Proposed Action and alternatives. The KBRA includes provisions for specific water allocations and delivery obligations for the Lower Klamath Lake and Tule Lake National Wildlife Refuges, which will increase availability and reliability of water supplies above historical refuge use in most years (Hetrick et al. 2010). These two refuges contain important habitat for Pacific Flyway waterfowl and waders (see Section 3.5). Tule Lake, Clear Lake, and Gerber Reservoir support populations of shortnose and Lost River suckers (FERC 2007; USFWS 2007a, b; NRC 2008).

Upper Klamath Lake and Lake Ewauna are affected by poor water quality conditions as described in Section 3.2, Water Quality. Each summer these water bodies exhibit high pH, broad daily shifts in dissolved oxygen, and high ammonia (Hamilton et al. 2011). In Upper Klamath Lake several incidents of mass adult mortality of shortnose and Lost River sucker have been associated with low dissolved oxygen levels (Buchanan et al. 2011a). Instances of pH levels above 10 and extended periods of pH levels greater than 9 lasting for several weeks have been associated with large algal blooms occurring in the lake (Kann 2010). On a diel basis, algal photosynthesis can elevate pH levels during the day, with changes exceeding 2 pH units over a 24-hour period. During November–April (non-growing season) pH levels in Upper Klamath Lake are near neutral (Aquatic Scientific Resources 2005).

Fish passage over Link Dam is provided by a ladder. This ladder is designed to modern standards to allow the passage of shortnose and Lost River suckers, salmonids and other migratory fish, including anadromous salmonids and Pacific lamprey, if present. Keno Dam is equipped with a 24-pool weir and orifice type fish ladder, which rises 19 feet over

a distance of 350 feet, designed to pass trout and other resident fish species (FERC 2006). The fishway at Keno Dam currently complies with passage criteria for salmonid fish, but plans are being developed to have the fishway rebuilt to criteria for lamprey and for greater anadromous salmonid runs if the Keno facility is transferred to the government as part of settlement (T. Hepler, Reclamation, pers. comm., as cited in Hamilton et al. 2011). Although suckers have been observed to use the Keno Dam fish ladder, the ladder was not designed for sucker passage and is considered generally inadequate for sucker passage (Reclamation 2002).

The Williamson and Wood Rivers are the largest tributaries to Upper Klamath Lake, with the Williamson River being the largest tributary. The Sprague River is tributary to the Williamson River, and the Sycan River is tributary to the Sprague River (Hamilton et al. 2011). These tributaries currently provide habitat for redband trout, bull trout, shortnose sucker and Lost River sucker, as well as other species. Historically these tributaries provided substantial habitat for Chinook salmon and steelhead (Hamilton et al. 2005, 2011). Substantial flow contributions from springs into these tributaries provide cool summer baseflows with water temperatures and dissolved oxygen (DO) levels generally adequate to support coldwater fish habitat requirements (Hamilton et al. 2011); though these tributaries suffer from some water quality impairments as described in Section 3.2, Water Quality.

In addition to redband trout, shortnose and Lost River sucker, the Upper Basin supports many other fish species. Resident fishes include several species of minnow, sucker, sculpin, and salmonids. At least 18 species have been introduced into the Upper Klamath Basin including several species of minnow, catfish, sunfish, largemouth bass, and spotted bass, as well as yellow perch.

#### **Hydroelectric Reach: J.C. Boyle Reservoir Downstream to Iron Gate Dam**

The hydroelectric reach, from the upstream extent of J.C. Boyle Reservoir to Iron Gate Dam, includes four reservoirs (J.C. Boyle, Copco 1, Copco 2, and Iron Gate) and two riverine reaches. Several coolwater tributaries enter the Klamath River and reservoirs in this reach. The reservoirs are productive and nutrient rich. They tend to be warm during the summer months, with mean daily temperatures sometimes reaching 23°C (FERC 2007). Water quality in the Copco 1 and Iron Gate Reservoirs during the summer is generally quite poor due to warm surface waters and annual blooms of the *Anabaena flos-aquae* and *M. aeruginosa* (see Section 3.2). These algae produce toxins that are harmful to fish and other animals and humans. Tests for the *A. flos-aquae* toxin have not been routinely performed, because adequate testing protocols have not been available (Anderson, pers. comm., 2011). *M. aeruginosa* produces a compound known to cause liver failure. Samples taken from areas frequented by recreational users of the reservoirs contained cell counts up to 4,000 times greater than what the World Health Organization considers a moderate health risk (see Section 3.4). This has resulted in the reservoirs being posted by local health officials during each summer since 2005.

The 22 miles long riverine reach between J.C. Boyle and Copco 1 Reservoirs, is divided into two reaches: a 4-mile long bypass reach, which receives bypass flows from J.C. Boyle Dam, and a 17-mile long “peaking reach,” which receives variable flow from

hydroelectric operations. The downstream 6.2 miles is designated by CDFG as a Wild Trout Area with the whole reach managed for wild trout (FERC 2007) and the reach from the J.C. Boyle Powerhouse to the California-Oregon border is designated as a National Wild and Scenic River. Approximately 100 cfs is released from J.C. Boyle Dam through a minimum flow outlet and the ladder. This is augmented by inflows from Big Springs of about 220 to 250 cfs (FERC 2007, more recent estimates indicate this inflow is about 285 cfs). In the peaking reach, this flow is provided by flows from the powerhouse, which can range from 0 to over 3,000 cfs, depending on water availability (FERC 2007). Depending on water availability, power demands and whitewater boating needs, peaking operations can occur daily, or cycles may extend over several days. The 1.5 mile long Copco 2 Bypass Reach, has flows of about 5 cfs provided below Copco 2 Dam. Both of these riverine reaches provide complex habitat suitable for salmonid spawning and rearing.

A number of tributary streams come into this reach, including Spencer, Shovel, Fall, Spring, and Camp Creeks. These streams provide suitable coldwater spawning and rearing habitat for riverine fish.

The reservoirs currently provide a recreational fishery for non-native fishes including largemouth bass, trout, catfish, crappie, and sunfish (Hamilton et al. 2011). Fishing is popular in Copco 1 and Iron Gate Reservoirs, especially for yellow perch, this area is known locally as the best yellow perch fishery in California (Hamilton et al. 2011). These reservoirs also support the native shortnose and Lost River suckers in small numbers that are believed to be individuals that have migrated down from the upstream reservoirs and are not thought to be self-sustaining populations or to be contributing to populations in upstream areas (Hamilton et al. 2011). Fish collections by Oregon State University in Copco 1 Reservoir during 1998 and 1999 found about 13 percent of all adult fish caught were listed suckers, primarily shortnose sucker. One percent of the adult fish in Iron Gate Reservoir were listed sucker, and those were only shortnose sucker. Riverine sections between reservoirs support populations of speckled dace, marbled sculpin, tui chub, and rainbow and redband trout. This area historically supported anadromous fish populations, including Chinook and coho salmon, steelhead, and Pacific lamprey. These fish can no longer access this area because of the dams.

### **Klamath River from Iron Gate Dam Downstream to Estuary**

The lower Klamath River flows unobstructed for 190 miles downstream of Iron Gate Dam before entering the Pacific Ocean. Downstream of Iron Gate Dam, the Klamath River has a gradient of approximately 0.0025 and four major tributaries enter this reach: the Shasta, Scott, Salmon, and Trinity Rivers.

The river basin downstream of Iron Gate Dam supports anadromous fish, including fall-run and spring-run Chinook salmon, coho salmon, steelhead, green sturgeon, American shad, and Pacific lamprey. Most of the anadromous salmonid species spawn primarily in the tributary streams, although fall-run Chinook salmon and coho salmon do spawn on the mainstem. The mainstem also serves as a migratory corridor and as rearing habitat for juveniles of many salmonid species (FERC 2007). The amount of time spent on the mainstem varies with species, run, temperature and hydrologic conditions in the

mainstem and the tributaries. Pacific lamprey are also found throughout the mainstem Klamath River and its major tributaries downstream of Iron Gate Dam. Green sturgeon (belonging to the Northern Green Sturgeon DPS) spawn and rear in the Klamath River downstream of Ishi Pishi Falls, and in the Salmon and Trinity Rivers. Tributaries to the Klamath River provide hundreds of miles of suitable habitat for anadromous fish. Stocks of anadromous fish stocks have declined substantially from historical levels (NRC 2004, FERC 2007). The ability of the mainstem Klamath River to support the rearing and migration of anadromous species is reduced by periodic high water temperatures during summer, poor water quality (low DO and high pH; see Sections 3.2.3.5 and 3.2.3.6), and disease outbreaks during spring. Habitat quality in the tributaries is also affected by high temperatures. The Shasta and Scott Rivers also are impaired by low flows, high water temperatures, stream diversions, non-native species, and degraded spawning habitat (Hardy and Addley 2001; FERC 2007; North Coast Regional Water Quality Control Board [NCRWQCB] 2010). In the Salmon River, past and present high severity fires and logging roads in the basin contribute to high sediment yields, and continued placer mining has disturbed spawning and holding habitat (NRC 2004).

The Trinity River (RM 42.8) is not expected to be directly affected by conditions in the mainstem Klamath River, but the lower one-quarter to one-half mile of the river may be used by fish as refuge during the drawdown. Fish populations in the Trinity River are expected to be directly affected by the Proposed Action while migrating along the mainstem Klamath River, and indirectly affected by potential changes in salmonid escapement to the basin.

#### **Klamath River Estuary and Pacific Ocean Nearshore**

Wallace (1998) surveyed the Klamath River Estuary, and noted formation of a sand berm at the river mouth each year in the late summer or early fall, raising the water level in the estuary, reducing tidal fluctuation, and restricting saltwater inflow. The surveys found brackish water layer along the bottom of the estuary may be extremely important to rearing juvenile salmonids, as they appeared to be more abundant near the freshwater/saltwater interface. Juvenile Chinook salmon may also use the cooler brackish water layer as a thermal refuge.

The Klamath River Estuary supports a wide array of fish species and may also serve as breeding and foraging habitat for marine and estuarine species. These species include, but are not limited to all of the anadromous fish listed previously, federally threatened Southern DPS green sturgeon, Pacific herring, surf smelt, longfin smelt, eulachon, top smelt, starry flounder and other flatfish, Klamath speckled dace, Klamath smallscale sucker, prickly sculpin, and Pacific staghorn sculpin, northern anchovy, saddleback gunnel, and bay pipefish.

#### ***3.3.3.3 Habitat Attributes Expected to be Affected by the Project***

The action alternatives would affect the physical, chemical, and biological components of habitat throughout the Klamath River watershed, from the tributaries to Upper Klamath Lake downstream to the Pacific Ocean. These effects would result from changes in suspended sediment, bedload sediment, water quality, water temperature, disease and

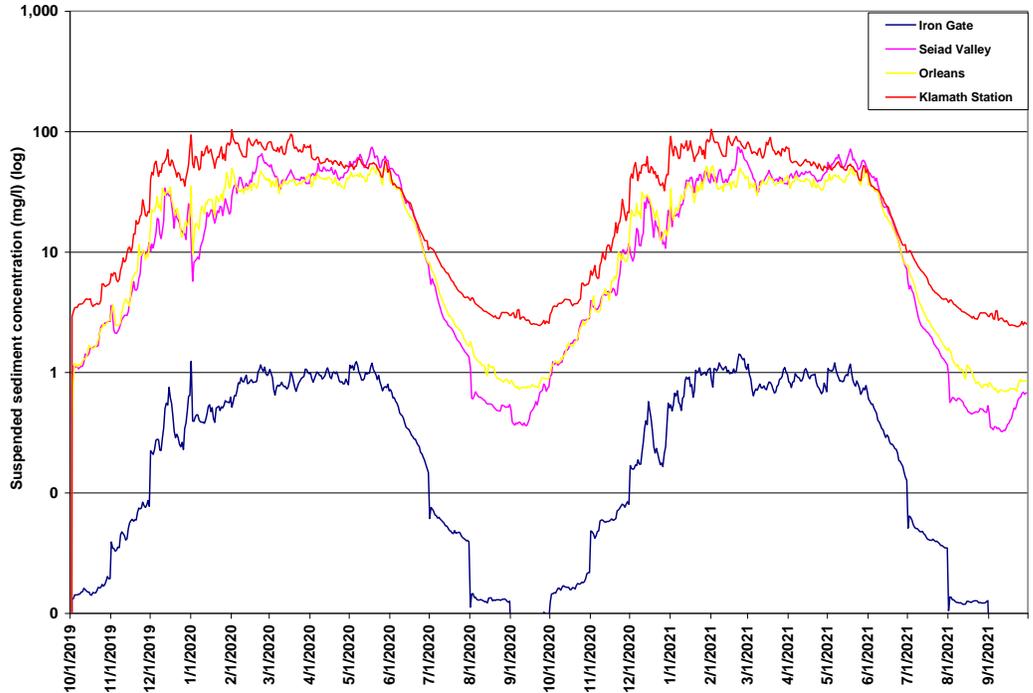
parasites, and flow related habitat. As described in the following sections, these changes would act in both beneficial and harmful ways on species, critical habitat, and EFH. Appendices E and F provide more detailed technical descriptions of suspended sediment and bedload sediment. Changes in water quality are discussed in greater detail in Section 3.2, Water Quality and its associated appendices, and a description of the effects of the action alternatives on algae is found in Section 3.4, Algae. A description of these parameters, water temperature, and disease and parasites under existing conditions is provided in the following sections.

### **Suspended Sediment**

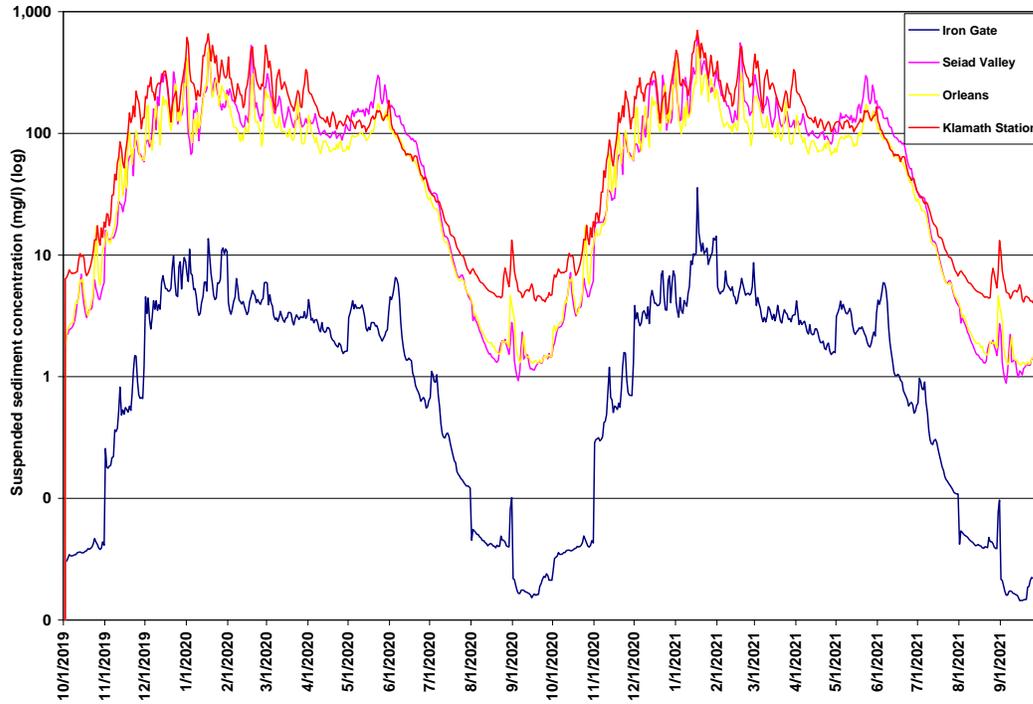
#### **Lower Klamath River: Downstream of Iron Gate Dam**

The downstream transport of suspended sediment can affect species through elevated suspended sediment concentrations (SSCs) that may clog or abrade the gills of fish, or reduce foraging efficiency and as the material settles on the stream bed during declining flows, it can reduce the survival of incubating eggs and developing alevins in salmonid redds by impeding intergravel flow as well as the emergence of fry. SSCs under existing conditions in the Klamath River upstream and downstream of Iron Gate Dam are summarized in Section 3.2.3, Water Quality. In general, the data indicate that suspended sediment downstream of Iron Gate Dam ranges from less than 5 mg/L during summer low flows to greater than 5,000 mg/L during winter high flows (see Section 3.2.3.3). During large winter storms or following landslides in the Klamath Basin, extremely high SSCs have been observed in the Klamath River mainstem and tributaries. Appendix E provides a detailed analysis of the effects of suspended sediment on aquatic species downstream of Iron Gate Dam under existing conditions. To provide a reliable basis for a relative comparison of SSCs to the alternatives, SSCs under existing conditions were calculated using the SRH-1D model (Reclamation 2011) based on hydrology data from 1961 to present. SSCs were developed for two conditions meant to represent the existing range of variability under existing conditions, defined as follows:

- **Normal conditions:** suspended sediment concentrations and durations with a 50 percent exceedance probability for the mainstem Klamath River downstream of Iron Gate Dam (i.e., the probability of these concentrations and durations being equaled or exceeded in any one year is 50 percent). Exceedance probabilities were based on modeling SSC for all water years subsequent to 1961 with facilities in place. To assess “normal conditions” the median (50 percent) suspended sediment concentration and duration from these results was estimated (Figure 3.3-2).
- **Extreme conditions:** suspended sediment concentrations and durations with a 10 percent exceedance probability (i.e., the probability of these concentrations and durations being equaled or exceeded in any 1 year is 10 percent). This represents an extreme condition (Figure 3.3-3).



**Figure 3.3-2. Normal conditions (50 Percent Exceedance Probability) SSCs for Three Locations Downstream of Iron Gate Dam under Existing Conditions, as Predicted Using the SRH-1D Model.**



**Figure 3.3-3. Extreme conditions (10 Percent Exceedance Probability) SSCs for Three Locations Downstream of Iron Gate Dam under Existing Conditions, as Predicted Using the SRH-1D Model.**

Under both normal and extreme conditions, SSCs of the magnitude and duration modeled are expected to cause major stress to migrating adult and juvenile salmonids primarily during winter (Newcombe and Jenson 1996, Appendix E). SSC generally increases in a downstream direction from the contribution of tributaries, and since Iron Gate Dam currently effectively traps most suspended sediment.

### **Klamath River Estuary**

Under existing conditions SSCs within the Klamath River Estuary is relatively high. As described in Section 3.2.4.3.1.2, the lower Klamath River downstream of the Trinity River confluence to the estuary mouth is currently listed as sediment impaired under Section 303(d) of the Clean Water Act, as related to protection of the cold freshwater habitat beneficial use associated with salmonids (NCRWQCB 2010). Modeling in the Klamath River (from Seiad Valley at approximately RM 128 downstream to the Klamath Station at RM 5) under normal conditions indicates that SSCs are generally less than 100 mg/L year-round (Figure 3.3-2), and under extreme conditions are less than 100mg/L in summer and fall but can spike to well over 100 mg/L during winter and spring (Figure 3.3-3).

### **Pacific Ocean Nearshore Environment**

Under existing conditions a “plume” exists within the nearshore environment in the Klamath River vicinity that is subject to strong land runoff effects following winter rainfall events. These effects include low-salinity, high levels of suspended particles, high sedimentation, and low light (and potential exposure to land-derived contaminants). The extent and shape of the plume is variable, and influenced by wind patterns, upwelling effects, shoreline topography (especially Point Saint George), and longshore currents. High SSCs events contribute to the plume, especially during floods. In a recent study of the Eel River nearshore sediment plume, located approximately 80 miles to the south of the Klamath River, *in situ* measurements of plume characteristics indicated no relationship with SSCs, turbulent-kinetic-energy, time from river mouth, wind speed, wave height, or discharge. A relationship apparently did exist between effective settling velocity (bulk mean settling velocity) of plume sediments and wind speed/direction, as well as with tides (Curran et al. 2002).

### **Bedload**

Appendix F describes current habitat conditions and assesses the changes to bedload sediment within the analysis area for existing conditions, and under each Klamath River EIS/EIR alternative. The sections below provide a brief summary of the analysis provided in Appendix F.

### **Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir**

For all practical purposes, the amount of sediment supplied to the Klamath River from the Klamath Basin upstream of Keno Dam is negligible (Reclamation 2011). Upper Klamath Lake, with its large surface area, traps nearly all sediment delivered from upstream tributaries, although some finer material may be transported through the lake during high runoff events. All fluvial sediment supplied to reaches downstream of Iron Gate Dam is delivered to the Klamath River between Keno Dam and Iron Gate Dam. Sources within this reach supply 24,160 tons/year of coarse sediment (1.3 percent of the

cumulative average annual basin wide coarse sediment delivery) (Stillwater Sciences 2010a).

**Hydroelectric Reach: Klamath River from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

The Project reservoirs are the dominant feature in this 38-mile reach, with a 22-mile riverine section between J.C. Boyle Dam and Copco 1 Reservoir and a 1.5-mile riverine reach between Copco 2 Dam and Iron Gate Reservoir. The four Project dams currently store 13.15 million yd<sup>3</sup> of sediment (Reclamation 2011), with Copco 1 Reservoir storing the largest amount of sediment (Table 3.3-2). The sediment stored behind the dams has high water content and 85 percent of its particles are silts and clays (particle size less than 0.063 mm) while 15 percent are sand or coarser (particle size higher than 0.063 mm) (Gathard Engineering Consulting 2006; Stillwater Sciences 2008; Reclamation 2011). As such, most sediment released from behind the dams under the Proposed Action would be silt and clay (less than 0.063 mm) with smaller fractions of sand (0.063 to 2 mm), gravel (2 to 64 mm), and cobble (64 to 256 mm) (Gathard Engineering Consulting 2006; Stillwater Sciences 2010a; Reclamation 2011).

**Table 3.3-2. Estimated Volume of Sediment Currently Stored within Hydroelectric Reach Reservoirs (Reclamation 2011).**

<b>Reservoir</b>	<b>Current Sediment Volume (yd<sup>3</sup>)</b>
J.C. Boyle	1,000,000
Copco 1	7,440,000
Copco 2	0
Iron Gate	4,710,000
<b>Total</b>	<b>13,150,000</b>

**Lower Klamath River: Downstream of Iron Gate Dam**

Downstream of Iron Gate Dam, channel conditions reflect the interruption of sediment flux from upstream by Klamath Hydroelectric Project dams and the eventual re-supply of sediment from tributaries entering the mainstem Klamath River (PacifiCorp 2004a; Reclamation 2011). The reach from Iron Gate Dam to Cottonwood Creek (RM 182.1) is characterized by coarse, cobble-boulder bars immediately downstream of the dam, transitioning to a cobble bed with pool-riffle morphology farther downstream near Cottonwood Creek (Montgomery and Buffington 1997; PacifiCorp 2004a; Stillwater Sciences 2010a). Cottonwood Creek to the Scott River is a confined channel with a cobble-gravel bed and pool-riffle morphology (PacifiCorp 2004a). The median bed material ranges from 45 to 50 mm, but bar substrates become finer in the downstream direction, with median sizes of 49 mm and 25 mm at the upstream and downstream ends, respectively. Downstream of the Scott River, including through the Seiad Valley, the Klamath River is cobble-gravel bedded with pool-riffle morphology (PacifiCorp 2004a). PacifiCorp (2004a) also noted increasing quantities of sand and fine gravel on the bed

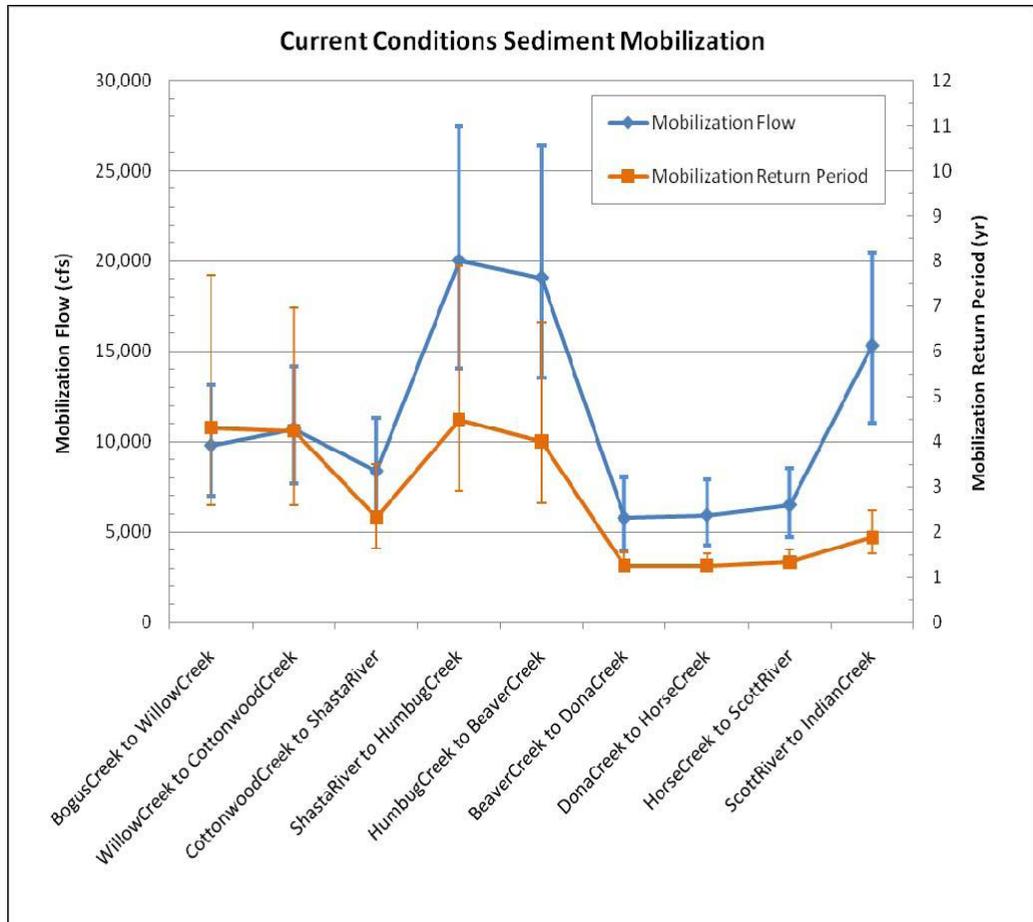
surface with distance downstream, likely reflecting the resupply of finer material from tributaries to the Klamath River.

The Klamath Hydroelectric Project dams trap most of the finer sediment produced in the low sediment yielding, young volcanic terrain upstream of the dams, which results in coarsening of the channel bed downstream of the dams until tributaries resupply the channel with finer sediment. However, most of the supply from the portion of the watershed upstream of J.C. Boyle Reservoir is trapped in Upper Klamath Lake, which is a natural lake. Most ( $\approx 98$  percent) of the sediment supplied to the mainstem Klamath River (Stillwater Sciences 2010a) is delivered from tributaries downstream of Cottonwood Creek, limiting the effects of interrupting upstream sediment supply downstream of around Scott River.

Reclamation (2011) used reach average hydraulic properties and previously collected grain size data to estimate the flow magnitude and return period at which sediment mobilization occurs downstream of Iron Gate Dam. The estimates did not include the reach from Iron Gate Dam to Bogus Creek, for which there were no grain size data. Reclamation (2011) assumed this reach to be fully armored because there has been no sediment supplied to this reach in the past 50 years because the dams capture sediment from upstream. From downstream of Bogus Creek to Willow Creek, flows to mobilize median substrate sizes (D50) ranged from 6,800 to 12,700 cfs, and recur every 2.6 to 7.5 years, on average (Figure 3.3-4).

### **Water Quality**

Section 3.2.3 provides information regarding water quality as it relates to aquatic resources in the area of analysis. As described, therein, many water bodies in the area of analysis are listed under Section 303 (d) of the Clean Water Act for a variety of parameters including temperature, sediment and turbidity, nutrients, dissolved oxygen, pH, ammonia, Chlorophyll-*a*, and microcystin (Table 3.2-8 in Section 3.2., Water Quality). The SSCs, dissolved oxygen, and temperature are evaluated in greater detail in Section 3.3.3.3. Microcystins are also addressed in Section 3.4, Algae.



**Figure 3.3-4. Mobilization Flow and Return Period at which Sediment Mobilization Occurs (Reclamation 2011).**

**Water Temperature**

As described in Section 3.2, Water Quality, the entire Klamath River, including Upper Klamath Lake, Lost River, and the Klamath Straights Drain, has been listed as impaired for water temperature (Oregon Department of Environmental Quality (ODEQ 2002). Temperatures in the Klamath River are of special concern as they are elevated with a greater frequency and they remain elevated for longer periods of time than temperatures in adjacent coastal anadromous streams, and are currently marginal in the lower mainstem for anadromous salmonids (Bartholow 2005). These elevated temperatures are especially detrimental to anadromous species during the warmer portions of the year (ODEQ 2002). Acute thermal effects for salmonids are expected to occur as mean daily water temperatures begin to exceed 20°C (Bartholow 2005). Bartholow (2005) expressed concern that if water temperature trends in the mainstem Klamath River downstream of Iron Gate Dam continue, some stocks may decline to levels insufficient to ensure survival. Elevated temperatures can affect the timing of different life-history events, altering migration patterns, delaying and shortening the spawning season, impairing reproductive success, reducing growth, and result in an ongoing lack of temporal diversity (Hamilton et al. 2011). High water temperatures can contribute to low

dissolved oxygen events by accelerating oxygen-demanding processes, and can facilitate the spread of disease (Wood et al. 2006). Stress associated with high water temperatures can make cold water species more vulnerable to disease and parasites, and have been associated with fish kills in the Klamath River downstream of Iron Gate Dam during low flow periods in late summer (Hardy and Addley 2001).

#### **Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir**

Summer water temperatures are naturally high in Upper Klamath Lake. In the summer, instantaneous maximum water temperatures of 22 to 24°C are common in the upper 3 to 6 feet of Upper Klamath Lake and temperatures can approach a maximum of 30°C near the surface (PacifiCorp 2004a). Although prolonged exposure to these high temperatures could be lethal for some species, these temperatures remain within tolerance criteria for migrating adult anadromous salmonids (Hamilton et al. 2011), and anadromous salmonids successfully navigated through the lake to spawn in the Upper Basin prior to their access being blocked by the Project. In the late summer and early fall, temperatures in Upper Klamath Lake are actually cooler than those downstream of Iron Gate Dam in the late summer and early fall when fall-run Chinook salmon are migrating. In addition, thermal refugia are available where fish can moderate the temperatures they are exposed to. Upper Klamath Lake supports a population of redband trout that move into cooler tributary habitats in the summer, but which have high growth rates while in the lake. Those in the lake over the summer can find thermal refuge in Pelican Bay, which is fed by springs and remains cool (Dunsmoor and Huntington 2006). Wetlands surround this bay and would be expected to provide juvenile salmonids with excellent rearing habitat (Dunsmoor and Huntington 2006).

Both Upper Klamath Lake and the Keno Impoundment/Lake Ewauna are relatively shallow; temperatures in Upper Klamath Lake, the Keno Impoundment/Lake Ewauna, and J.C. Boyle Reservoir are generally warm during the late spring through early fall (see Section 3.2.3.2). Under existing conditions, water temperatures are suitable for migrating salmonids from mid-September to mid-June in Upper Klamath Lake and Keno Impoundment (Dunsmoor and Huntington 2006).

The Keno Impoundment/Lake Ewauna has generally poor water quality in the summer, with instantaneous maximum water temperatures exceeding 25°C and low dissolved oxygen (Hamilton et al. 2011). These warm temperatures are also present downstream of Keno Dam. However, from November through mid-June, the reach from Link River Dam to Keno Dam is cooler (below 20°C) and meets criteria for migrating adult anadromous salmonids (Hamilton et al. 2011). Temperatures in the Link River and the Keno Impoundment/Lake Ewauna tend to increase in the summer; maximum water temperatures (22 to 25°C) are still within the preferred range for warm- and some cool-water species found in the Upper Klamath Basin (yellow perch, catfish, sunfish, largemouth bass, and spotted bass), but temperatures above 22 to 25°C are potentially lethal to anadromous salmonids.

### **Hydroelectric Reach: Klamath River from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

Water temperatures through the Hydroelectric Reach are generally warm in the reservoirs from late spring through early fall, but tributaries are generally cool (see Section 3.2.3.2). In addition, numerous cold-water springs contribute flows to both Copco 1 and Iron Gate Reservoirs. Average monthly water temperatures within reservoirs from 2001 to 2004 ranged from just over 5°C in November to more than 22°C in June through August (FERC 2007), with thermal stratification in Copco 1 and Iron Gate reservoirs resulting in relatively warm discharge waters during summer months. Water temperatures at the downstream end of the J.C. Boyle Bypass Reach and in the Klamath River upstream of Shovel Creek are consistently cooler than other sites sampled between Link Dam and the Shasta River (PacifiCorp 2004b) (see Section 3.2.3.2). Temperatures in the J.C. Boyle Bypass Reach are cooled by the contribution of 200 to 250 cfs of groundwater within the reach. The cool water input from the bypass reach during the summer results in a relatively lower daily water temperature range in the Klamath River in the J.C. Boyle Peaking Reach (FERC 2007).

Temperature data for tributary reaches are based on a limited study period as described in PacifiCorp (2004a). Fall Creek, which flows into Iron Gate Reservoir, is generally cold year-round and does not exceed 14°C degrees during the summer (PacifiCorp 2004a). Temperatures in Jenny Creek, which also flows into Iron Gate Reservoir, vary seasonally, ranging from less than 10°C in the spring to more than 22°C in July and August (PacifiCorp 2004a). Temperatures in Shovel Creek are generally low year-round and do not exceed 15°C in the summer (PacifiCorp 2004a). Spencer Creek temperatures are low during spring (<15°C) and are generally below 18°C, but can exceed 20°C for short durations (PacifiCorp 2004a).

Copco 1 and Iron Gate Reservoirs reach maximum temperatures exceeding 20°C near their surfaces during the summer while maintaining average temperatures near 8°C or 10°C when stratified (PacifiCorp 2004a). These cooler water temperatures at a depth >6–8 m below the surface (see Appendix C, Section C.1.1.4) are a result of 4°C water entering Copco 1 and Iron Gate Reservoirs from upstream areas during the winter and the relatively shallow outlets of both reservoirs (PacifiCorp 2004a). During reservoir stratification, dissolved oxygen in Iron Gate and Copco 1 in deeper waters decreases and can reach minimum values close to 0 mg/L by July near the reservoir bottoms (see Appendix C, Section C.4.1.4). Although temperatures are increasing in the summer months, temperatures documented in these reaches are all within the tolerance ranges of the species observed there (see Section 3.2.3.2), but would be considered stressful for cold water species.

### **Lower Klamath River: Downstream of Iron Gate Dam**

Water temperatures in spring in the Lower Klamath Basin downstream of Iron Gate Dam can be slightly cooler from reservoir releases than those upstream of Iron Gate Dam (see Section 3.2.3.2), with this difference diminishing downstream of Iron Gate Dam with no noticeable difference just upstream of the Salmon River confluence. Summer weather conditions, however, can be severe from June through September, and rising ambient air

temperatures can lead to increased water temperatures (Hamilton et al. 2011). Downstream of Iron Gate Dam, mean monthly temperatures in the river are 3 to 6°C in January and 20 to 22.5 °C in July and August (Bartholow 2005). Substantial losses of juvenile salmonids have occurred during their migration through the lower Klamath River, and were especially severe during low-water years with periods of sustained high water temperatures, which may cause them to crowd into thermal refugia and may reduce the resistance of these fish to disease and other stressors (Scheiff et al. 2001). Summary statistics compiled by the United States Environmental Protection Agency indicate that water temperatures at locations between Iron Gate Dam and the Klamath River's confluence with the Scott River range from about 16 to 22°C in June, and from 16 to 26°C in July (FERC 2007). The Klamath Basin downstream of Iron Gate Dam (i.e., the Lower Klamath Basin) supports a variety of species of anadromous fish including fall and spring Chinook salmon, coho, steelhead, green sturgeon, and Pacific lamprey. From May through September (peaking in June–August) summer temperatures begin to warm to stressful levels for cold water species such as salmon, steelhead, and Pacific lamprey.

### **Klamath River Estuary and Pacific Ocean Nearshore Environment**

Water temperatures in the estuary range from 5 to 12 °C from December through April (Hiner 2006). Warmer air temperatures and lower flows in summer and fall months result in increased water temperatures ranging from 20 to 24°C (Hiner 2006). Under summer low-flow conditions, water temperatures in the Klamath Estuary exceed those for optimal growth as well as critical thermal maxima for Chinook salmon, coho salmon, and steelhead (Stillwater Sciences 2009a). Input of cool ocean water provides cooler areas for fish and fog along the coast minimizes this effect much of the time.

### **Disease and Parasites**

Fish diseases, specifically the myxozoan parasites *Ceratomyxa shasta* (*C. shasta*) and *Parvicapsula minibicornis*, periodically result in substantial mortality for Klamath River salmonids, (though steelhead are generally resistant to *C. shasta*). Additional diseases that may affect fish in the Klamath Basin include *Ichthyophthirius multifis* (Ich) and *Flavobacterium columnare* (“columnaris disease”). These parasites and diseases occur throughout the watershed, but appear to cause the most severe mortality in the Lower Klamath Basin where *C. shasta* has been observed to result in high rates of mortality in salmon. Ich and columnaris occur episodically, occasionally resulting in substantial mortality (e.g., the 2002 fish kill of juvenile and adult Chinook salmon). The effects of Ich and columnaris are generally not as harmful as the myxozoan parasites, although impacts on juvenile salmonids and other species have not been well studied.

Both *P. minibicornis* and *C. shasta* spend part of their life cycle in an invertebrate host and another part in a fish host. Transmission of these parasites is limited to areas where the invertebrate host is present. In the Klamath River, their invertebrate host is the annelid polychaete worm *Manayunkia speciosa* (Bartholomew et al. 1997, 2007). Once the polychaetes are infected, they release *C. shasta* actinospores into the water column. Actinospores are generally released when temperatures rise above 10°C and remain viable from 3 to 7 days at temperatures from 11 to 18°C, with temperatures outside that range resulting in a shorter period of viability (Foott et al. 2007). The longer the period of viability, the wider the distribution of the actinospores, raises exposure rate of salmon

over a larger area of the river (Bjork and Bartholomew 2010). Actinospore abundance, a primary determinant of infectious dose, is controlled by the number of infected polychaetes and the prevalence and severity of infection within their population.

Salmon become infected when the actinospores enter the gills, eventually reaching the intestines where the parasite replicates and matures to the myxospore stage. Myxospores are shed by the dying and dead salmon, and the cycle continues with infection of polychaete worms by the myxospores (Bartholomew and Foott 2010). The polychaete host for the parasite is present in a variety of habitat types, including runs, pools, riffles, edge-water, and reservoir inflow zones, as well as sand, gravel, boulders, bedrock, aquatic vegetation, and is frequently present with a periphyton species: *Cladophora* (Bartholomew and Foott 2010). Slow-flowing and more stable habitats (e.g., pools with sand) may support higher densities of polychaetes, (Bartholomew and Foott 2010), especially if instream flows remain constant.

Bartholomew (1998) noted that native populations of salmonids in waters where *C. shasta* is endemic generally develop a high degree of resistance to the disease. Stocking et al. (2006) conducted studies of the seasonal and spatial distribution of *C. shasta* in the Klamath River. The study included the exposure of fall Chinook salmon (*Oncorhynchus tshawytscha*; Iron Gate Hatchery strain). The study found the polychaete host, *M. speciosa*, from Upper Klamath Lake to the mouth of the river. Although infection rates were high in non-native, non-resistant, rainbow trout, used as sentinel fish in the upper Klamath River upstream of Iron Gate Dam and below the Williamson River, mortality rates were very low (Stocking et al. 2006). Chinook salmon at this location did not become infected. Minimal mortality in both was likely due to low levels of parasites in this area and a predominance of Type 0 genotype of *C. shasta* (see below). Because the parasites are endemic to the watershed, the native salmonid populations have some level of resistance to the disease. However, an altered river channel below Iron Gate Dam, where the bed has been atypically stable, has provided favorable habitat for the polychaete worm host, likely increasing the parasite load to which the fish are exposed. High parasite loads are believed to lead to higher rates of mortality.

Susceptibility to *C. shasta* is also influenced by the genetic type of *C. shasta* fish encounters. Atkinson and Bartholomew (2010) conducted an analysis of the genotypes of *C. shasta* and the association of these genotypes with different salmonid species, including Chinook and coho salmon, steelhead, rainbow trout, and redband trout. In the Williamson River, although parasite densities had been found to be high, Chinook salmon were resistant to infection because the genotype specific to Chinook salmon was absent. In a genetic analysis, the *C. shasta* genotypes were characterized as Type 0, Type I, Type II and Type III (Table 3.3-3):

**Table 3.3-3. *C. shasta* Genotypes in the Klamath Basin.**

<b><i>C. shasta</i> Genotype</b>	<b>Distribution</b>	<b>Affected Species</b>	<b>Notes</b>
<b>Type 0</b>	Upper and Lower Klamath Basin	native steelhead, rainbow, and redband trout	Usually occurs in low densities, is not very virulent, and causes little or no mortality
<b>Type I</b>	Lower Klamath Basin	Chinook salmon	If the Type I genotype were carried into the Upper Basin, only Chinook salmon would be affected
<b>Type II</b>	Klamath Lake, Upper and Lower Klamath Basin	coho salmon and non-native rainbow trout	The “biotype” found in the Upper Basin does not appear to affect coho salmon, and risks to native rainbow/redband trout are low <sup>1</sup>
<b>Type III</b>	Assumed widespread in Klamath Basin based on presence in fish	all salmonid species	Prevalence of this genotype is low and it infects fish but does not appear to cause mortality

<sup>1</sup>(J. Bartholomew, pers. comm.)

### **Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir**

Fish in the upper Klamath River are exposed to disease and parasites. All of the diseases and parasites described above can occur here. *C. shasta* and *P. minibicornis* are both known to occur in the Upper Basin, and *C. shasta* density is reported to be as high in the Williamson River as it is in the area downstream of Iron Gate Dam. In this section of the river, however, *C. shasta* does not have the same serious effects as it does downstream of Iron Gate Dam, because of the genotype of the parasite and the higher resistance of the redband trout to the disease. Historically *C. shasta* and *P. minibicornis* occurred in the Upper Basin and resident fish above the dams evolved with these parasites.

Despite the fact that Klamath River fish disease science has advanced greatly in the past five years, no recent information indicates a conflict with the finding that the movement of anadromous fish above Iron Gate Dam presents a relatively low risk of introducing pathogens to resident fish (Administrative Law Judge 2006, USFWS/NOAA Fisheries Service Issue 2(B)).

### **Hydroelectric Reach: Klamath River from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

As described above, Stocking et al. (2006) found the polychaete host for *C. shasta* and *P. minibicornis* throughout the mainstem Klamath River, including the reach from J.C. Boyle Reservoir to Iron Gate Dam (the Hydroelectric Reach). In J.C. Boyle Reservoir, densities of polychaetes increased with distance from the reservoir inflow. Stocking and Bartholomew (2007) noted that the ability of some polychaete populations to persist through disturbances (e.g., large flow events) indicates that the lotic populations are influenced by the stability of the microhabitat they occupy.

### **Lower Klamath River: Downstream of Iron Gate Dam**

In the lower Klamath River, the polychaete host for *C. shasta* and *P. minibicornis* is aggregated into small, patchy populations mostly concentrated between the Interstate 5 bridge and the Trinity River confluence, and especially above the Scott River (Stocking

and Bartholomew 2007). The reach of the Klamath River from the Shasta River to Seiad/Indian Creek is known to be a highly infectious zone with high actinospores exposure, particularly from May through August (Beeman et al. 2008). This portion of the river contains areas of dense populations of polychaetes within low-velocity habitats with *Cladophora* (a type of green algae), sand-silt, and fine benthic organic material in the substrate (Stocking et al. 2007). High parasite prevalence in the lower Klamath River is considered to be a combined effect of high spore input from heavily infected, spawned adult salmon that congregate downstream of Iron Gate Dam and Iron Gate Hatchery and the proximity to dense populations of polychaetes (Bartholomew et al. 2007). The highest rates of infection occur in the lower Klamath River downstream of Iron Gate Dam (Stocking and Bartholomew 2007; Bartholomew and Foott 2010).

Despite potential resistance to the disease in native populations, fish (particularly juvenile fish, and more so at higher water temperatures) exposed to high levels of the parasite may be more susceptible to disease. Chinook and coho salmon migrating downstream have been found to have infection rates as high as 90 percent and 50 percent, respectively (Bartholomew and Foott 2010). The number of juvenile salmonids that become infected is estimated to be 10 to 70 percent annually based on surveys of fish captured in the river (True et al. 2010). High infection rates are apparently resulting in high mortality of outmigrating smolts. Studies of outmigrating coho salmon smolts by Beeman et al. (2008) estimated that disease-related mortality rates were between 35 and 70 percent in the Klamath River near Iron Gate Dam. Their studies suggested that higher spring discharge increased smolt survival (Beeman et al. 2008). In 2008, mortality rates were as high as 85 percent in May (7-day exposure for age 1+ coho smolts), and 96 percent (age 0+ coho smolts) and 84 percent (0+ Chinook smolts) in June (3-day exposure). In May 2004, the USFWS, the Yurok Tribe and the Karuk Tribe, reported high levels of mortality and disease infections among naturally produced juvenile Chinook salmon captured in downstream migrant traps fished in the Klamath River (Klamath Fish Health Assessment Team [KFHAT] 2005). The symptoms observed included bloated abdominal cavities, pale gills, bloody vents, and pop-eye. Infected fish also exhibited lethargic behavior, poor swimming ability and increased vulnerability to handling stress. The primary cause of the disease was found to be *C. Shasta*, with *P. minibicornis* observed as well. The 2004 mortality event was not quantified, because of limited resources and other problems associated with sampling small fish in a large river system. Other recent fish kills include the June 2000 and June 1998 fish kills. CDFG (2000) estimated 10,000 to 300,000 individuals, mostly young-of-year killed in the June 2000 event, believed to be infected with *C. shasta* and columnaris.

Ich and columnaris have occasionally had a substantial impact on adult salmon downstream of Iron Gate Dam as well, particularly when habitat conditions include exceptionally low flows, high water temperatures, and high densities of fish (such as adult Chinook salmon migrating upstream in the fall and holding at high densities in pools). In 2002, these habitat factors were present, and an outbreak of disease occurred, with more than 33,000 adult salmon and steelhead losses. Most of the fish affected by the 2002 fish die-off were fall-run Chinook salmon in the lower 36 miles of the Klamath River (CDFG 2004). Although losses of adult salmonids can be substantial when events

such as the 2002 fish die-off occur, the combination of factors that leads to adult infection by Ich and columnaris disease may not be as frequent as the annual exposure of juvenile salmonids to *C. shasta* and *P. minibicornis*, as many juveniles must migrate each spring downstream past established populations of the invertebrate polychaete worm host.

### **Klamath River Estuary and Pacific Ocean Nearshore**

While disease and parasites occur in the Klamath Estuary and Pacific Ocean, these areas are not known to be important source areas for these stressors. Juvenile salmonids that are weakened by disease or parasites upstream may succumb to those diseases once they enter the estuary or ocean as a result of the additional stress created by adapting to the saline environment.

### **Algal Toxins**

Algae produced in Upper Klamath Lake and the reservoirs in the Klamath Hydropower Reach (Copco 1 and Iron Gate Reservoirs) may be deleterious to the health of aquatic organisms in Upper Klamath Lake and the Klamath River. Some cyanobacteria species, such as *M. aeruginosa*, produce toxins that can cause irritation, sickness, or in extreme cases, death to exposed organisms (see Section 3.2.3.7 and Appendix C, Section C.6). While direct links to fish health are still somewhat unclear, recently collected data from the Klamath Basin indicates that algal toxins are bioaccumulating in fish tissue at concentrations that may be detrimental to the affected species.

In Upper Klamath Lake, a preliminary study of the presence, concentration, and dynamics of microcystin as related to Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) exposure is currently ongoing. United States Geological Survey (USGS) collected water samples at multiple lake sites from July to October 2007 and June through September 2008 and found evidence of gastro-intestinal lesions in juvenile suckers that had ingested chironomid larvae, which had in turn ingested *A. flos-aquae* and colonies of *M. aeruginosa*. The lesions were observed when liver necrosis was either present or absent suggesting that the gastro-intestinal tract was the first point of toxin contact. The authors indicated that the totality of the evidence suggests that the fish were exposed to algal toxins, and that the route of exposure to toxins was an oral route through the food chain, rather than exposure to dissolved toxins at the gills (VanderKooi et al. 2010).

In the Klamath River downstream of Iron Gate Dam, preliminary results from salmonid tissue samples collected by the Karuk Tribe in 2010 show that three of seven Chinook salmon livers collected near Happy Camp had detectable levels of microcystin (Kann et al. 2011). During the period the Chinook salmon were collected, the 2010 longitudinal microcystin sampling showed very high microcystin levels being exported directly from Iron Gate Reservoir and then transported downstream to areas where Chinook salmon were migrating upstream (Kann and Johnson 2010). In addition, data from 2007 indicate microcystin bioaccumulation in juvenile salmonids reared in Iron Gate Hatchery (Kann 2008). Trace concentrations of microcystin were also found in Klamath River steelhead livers in 2005 (Fetcho 2006).

### **Aquatic Habitat**

One of factors that influence habitat availability for aquatic species is instream flow. Reclamation manages Upper Klamath Lake to meet the requirements of biological opinions from the USFWS (2008) and NOAA Fisheries Service (2010a) and its contract requirements for the Reclamation's Klamath Project (Reclamation 2010). If implemented, the Proposed Action would result in changes in the operations of Upper Klamath Lake (see Section 2.4.3.9). These changes would affect reservoir elevations in Upper Klamath Lake, and river flows in downstream reaches. These hydrologic changes would result in changes to instream habitat. Studies to determine how fish habitat changes with flow have been conducted in areas of the Klamath River, including two reaches between J.C. Boyle Reservoir and Iron Gate Dam, for selected life stages of rainbow trout (Bureau of Land Management 2002) and seven locations between Iron Gate Dam and the estuary for selected life stages of Chinook salmon, coho salmon, and steelhead (Hardy et al. 2006).

The following sections describe the amount of flow-related habitat in various portions of the basin for the species for which information exists. Where specific information is not available for a species or area, the Lead Agencies used hydrologic changes, species habitat requirements, and comparisons with those species for which the Lead Agencies does have specific information to qualitatively assess changes in flow-related habitat. This information was used to evaluate how the Proposed Action and alternatives might result in changes to the amount of flow-related habitat. The Lead Agencies determined that the hydrologic record of the past decade was insufficient for describing the amount of habitat available under existing conditions because of management actions made over the past eight years to protect listed fish species (minimum lake elevations; minimum flows downstream of Iron Gate Dam). These changes are described in biological opinions from USFWS (2008) and NOAA Fisheries Service (2002, 2010a). The flows under existing conditions and with the various alternatives are described in Section 3.6, Flood Hydrology.

#### **Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir**

This area was not evaluated for flow-related habitat, as no known flow-related habitat relationships exist for the Klamath or Link Rivers in this area. Some changes in flow-related habitat in tributaries to Upper Klamath Lake may occur; however, the location and magnitude of these changes are unknown at this time.

Water surface elevations in Upper Klamath Lake are expected to vary as a result of implementation of the Proposed Action and alternatives. The USFWS biological opinion (2008) provides information on the amount of habitat provided for Lost River and shortnose suckers at different lake elevations, with higher elevations providing increased habitat for all life stages of sucker. It requires that Reclamation maintain the lake at minimum elevations from February through October each year to protect shortnose and Lost River suckers.

Under existing conditions (as indicated by the hydrologic modeling for the No Action/No Project Alternative), lake elevations are maintained at elevations ranging from about 4,138 to 4,142.2 feet in drier conditions (90 percent exceedance) and 4,139.8 to

4,143.3 feet under wetter conditions (20 percent exceedance). Lake elevations increase during the fall and winter, peak in April or May, and then decline until October.

### **Hydroelectric Reach: Klamath River from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

Under its existing license, PacifiCorp operates the J.C. Boyle Powerhouse in peaking mode, meaning that water is run through the powerhouse to generate electricity cyclically depending on water availability and power demand. Flows through the reach downstream of Copco 2 Dam are only about 5 cfs unless spill is occurring as a result of high runoff or project maintenance (PacifiCorp 2004a). Based on an Indicators of Hydrologic Alteration (IHA) Analyses (Richter et al. 1996) of flows within the reach downstream of J.C. Boyle Powerhouse, Huntington (2004) found a high rate of deviation from conditions that would be expected without the project influencing conditions. Substantial changes in flow (350 to 3,000 cfs) can occur within the course of a single day in the 17-mile long J.C. Boyle Peaking Reach (the reach of the Klamath River between J.C. Boyle Powerhouse and Copco 1 Reservoir). These flow fluctuations can result in temperature fluctuations in this reach ranging 5–15°C during the summer months (ODEQ 2010). These extreme flow fluctuations may also result in stranding of fish and invertebrates (Dunsmoor 2006, as cited in FERC 2007), reductions in aquatic invertebrate production (City of Klamath Falls 1986, as cited in Hamilton et al. 2011), displacement of fish, and higher energetic costs to fish to maintain their position (FERC 2007). In the Trial-type Hearing for the relicensing of the Klamath Hydroelectric Project (Administrative Law Judge 2006), it was found that this reach had lower macroinvertebrate drift rates, indicating a reduced food base for fish.

### **Lower Klamath River: Downstream of Iron Gate Dam**

The Biological Opinion issued in 2010 by NOAA Fisheries Service for the protection of coho salmon changed the flow requirements immediately downstream of Iron Gate Dam from those contained in the annual license. These changes to operations increased minimum flows downstream of Iron Gate Dam, set ramping rates to match those of Upper Klamath Lake inflows, and set target water surface elevations for Upper Klamath Lake. The revised ramp-down rates are defined as follows.

- When flows at Iron Gate Dam are 3,000 cfs or above, Iron Gate Dam ramp-down rates will follow the rate of decline to inflows to Upper Klamath Lake combined with accretions between Keno Dam and Iron Gate Dam.
- When flows at Iron Gate Dam are between 1,750 cfs and 3,000 cfs, Iron Gate Dam ramp down rates will be 300 cfs or less per 24-hour period and no more than 125 cfs per 4 hour period.
- When flows at Iron Gate Dam are 1,750 cfs or less, Iron Gate Dam ramp down rates will be 150 cfs or less per 24 hour period and no more than 50 cfs per two hour period.

Because Upper Klamath Lake has limited storage capacity, Reclamation operates the lake on an annual refill basis. The proposed minimum lake levels (measured as feet above mean sea level at Iron Gate Dam) limit the drawdown of Upper Klamath Lake over the

course of the summer. The minimum flows downstream of Iron Gate Dam, and the proposed minimum lake elevations and refill targets for Upper Klamath Lake are provided below (Table 3.3-4):

**Table 3.3-4. 2010 Biological Opinion Proposed Flows and Lake Elevations.**

Month	Klamath River	Upper Klamath Lake	
	Proposed Minimum Flows below Iron Gate Dam (cfs)	Proposed Minimum Lake Elevations (msl) <sup>1</sup>	Proposed Lake Refill Target Elevations (msl) <sup>1</sup>
October	1,000	--	4139.1
November	1,300	--	4139.9
December	1,260	--	4140.8
January	1,130	--	4141.7
February	1,275	4141.5	4142.5
March	1,325	4142.2	4143.0
April	1,175	4142.2	--
May	1,025	4141.6	--
June	805	4140.5	--
July	880	4139.3	--
August	1,000	4138.1	--
September	1,000	4137.5	--

<sup>1</sup> "msl" defined as feet above mean sea level

There are no provisions for flow through or minimum stream flow for the Hydroelectric Reach in the Biological Opinion with the exception of the minimum flow requirements below Iron Gate Dam described above.

### **Klamath River Estuary and Pacific Ocean**

Flow-related habitat has not been described for the Klamath River estuary.

### **Critical Habitat**

The ESA requires that USFWS and NOAA Fisheries Service designate critical habitat<sup>2</sup> for the listed species they manage. Critical habitat has been designated for three species within the area of analysis: coho salmon, green sturgeon, and bull trout, and has been proposed for an additional two: shortnose and Lost River suckers. An endangered population of killer whales that includes Klamath River salmon in its diet is also discussed here.

<sup>2</sup> The ESA defines critical habitat as "the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed that are determined by the Secretary to be essential for the conservation of the species."

### Coho Salmon

Critical habitat for the SONCC Coho ESU was designated on May 5, 1999 and includes all river reaches accessible to listed coho salmon between Cape Blanco, Oregon and Punta Gorda, California, and includes water, substrate, and adjacent riparian zones of estuarine and riverine reaches, including off-channel habitat. "Accessible reaches" are defined as those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Specifically, in the Klamath Basin, all river reaches downstream of Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River are designated as critical habitat (NOAA Fisheries Service 1999b).

Essential features of critical habitat considered essential for the conservation of the SONCC ESU (NOAA Fisheries Service 1997b) include (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions. Primary Constituent Elements (PCEs) for SONCC coho salmon are described in NOAA Fisheries Service (1999b) as follows: "In addition to these factors, NMFS also focuses on the known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation."

### Shortnose Sucker and Lost River Sucker

The USFWS proposed critical habitat for the shortnose sucker and Lost River sucker of approximately 182,400 hectares and 170,000 hectares, respectively, of stream, lake, and shoreline areas, but critical habitat has not yet been formally designated. The proposed designation includes six habitat units across the range of the two species: (1) Clear Lake and Watershed; (2) Tule Lake; (3) Klamath River; (4) Upper Klamath Lake and Watershed [excluding Williamson and Sprague rivers]; (5) Williamson and Sprague Rivers; and (6) Gerber Reservoir and watershed (USFWS 1994). Proposed critical habitat for the Lost River sucker includes all of the above habitat units except Gerber Reservoir and watershed. The PCEs identified in the critical habitat proposal are as follows: (1) water of sufficient quantity and suitable quality; (2) sufficient physical habitat, including water quality refuge areas and habitat for spawning, feeding, rearing, and travel corridors; and (3) a sufficient biological environment, including adequate food levels, and patterns for predation, parasitism, and competition that are compatible with recovery (USFWS 1994). A Recovery Plan was written for both species (USFWS 1994), but did not include critical habitat. A new draft recovery plan and proposed critical habitat is currently being developed and expected to be released in 2011 (L. Sada, pers. comm., 2011).

Predominate threats to these suckers are lack of spawning habitat, continued loss of habitat, lake elevation fluctuations that reduce access to vegetative habitat, water diversions, competition and predation by introduced species, hybridization with other sucker species, isolation of remaining habitats, and drought (USFWS 1988). Decreases in water quality resulting from timber harvest, dredging activities, removal of riparian vegetation, and livestock grazing may also cause problems for these species (USFWS 1988).

### Green Sturgeon

In 2009, NOAA Fisheries Service designated critical habitat for the Southern DPS of green sturgeon, which encompasses all coastal marine waters of the United States less than 60 fathoms deep (approximately 110 m) from Monterey Bay, California north to Cape Flattery, Washington. The estuary portion of the Eel and Klamath/Trinity Rivers was specifically excluded from the critical habitat designation (NOAA Fisheries Service 2009b).

### Bull Trout

Critical habitat designations for bull trout were finalized in 2005, but were then remanded in 2009 and republished in 2010. The final 2010 rule designates 277 miles of stream shoreline and 9,329 acres of reservoirs or lakes as critical habitat within the Klamath River Recovery Unit. This habitat includes Agency Lake and its tributaries and an assortment of headwater streams. A map of designated critical habitat is available from the USFWS

([http://www.fws.gov/oregonfwo/Species/Data/BullTrout/Maps/final\\_krb.pdf](http://www.fws.gov/oregonfwo/Species/Data/BullTrout/Maps/final_krb.pdf)). Critical habitat areas have at least one PCE essential to the conservation of bull trout. These features are the PCEs laid out in the appropriate quantity and spatial arrangement for conservation of the species. These include: (1) Space for individual and population growth and for normal behavior; (2) Food, water, air, light, minerals, or other nutritional or physiological requirements; (3) Cover or shelter; (4) Sites for breeding, reproduction, or rearing (or development) of offspring; and (5) Habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of a species.

### Eulachon

NOAA Fisheries Service proposed critical habitat for eulachon on January 5, 2011 (NOAA Fisheries Service 2011). The proposed critical habitat designation for the Southern Eulachon DPS included 12 areas comprising freshwater streams, rivers, and estuaries along the coast of Washington, Oregon, and California. The proposed designation does not include the Klamath River.

### Southern Resident Killer Whale

In November 2006, NOAA Fisheries Service designated critical habitat for Southern Resident Killer Whales (NOAA Fisheries Service 2006b). Critical habitat includes all waters relative to a contiguous shoreline-delimited by the line at a 20-foot depth relative to extreme high water within three designated areas: (1) the Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca. Coastal and offshore areas have not been designated as critical habitat, though they are recognized as important for the Southern Resident Killer Whales and NOAA Fisheries Service anticipates additional information on coastal habitat use from research projects in the coming years (NOAA Fisheries Service 2006b).

Based on the natural history of the Southern Residents and their habitat needs, the following physical or biological features were identified as essential to conservation: (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as

well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging (71 FR 69054). There is the potential for Southern Resident Killer Whales to feed on Klamath River salmonids during the period from about September through May when they spend more time in outer coastal waters and may range from central California to northern British Columbia (Hanson et al. 2010). Southern Resident Killer Whales would not be expected to be affected by any of the alternatives, apart from their effects on salmon production.

### **Essential Fish Habitat**

EFH is designated for commercially fished species under the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (Magnuson-Stevens Act). The Magnuson-Stevens Act requires federal fishery management plans, developed by NOAA Fisheries Service and the Pacific Southwest Fisheries Management Council, to describe the habitat essential to the fish being managed and to describe threats to that habitat from both fishing and nonfishing activities. To protect EFH, federal agencies are required to consult with the NOAA Fisheries Service on activities that may adversely affect EFH.

EFH has been designated for 3 species of salmon, 83 groundfish species, and 5 pelagic species. Descriptions of EFH within the area of analysis are provided below.

### **Chinook and Coho Salmon**

Coho salmon are also managed under the Magnuson-Stevens Act, under the authority of which EFH for coho salmon is described in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan (50 CFR 660.412). EFH for Chinook salmon is also described in the same management plan, and is identical to that for coho salmon in the Klamath basin. EFH has been designated for the mainstem Klamath River and its tributaries from its mouth to Iron Gate Dam, and upstream to Lewiston Dam on the Trinity River. EFH includes the water quality and quantity necessary for successful adult migration and holding, spawning, egg-to-fry survival, fry rearing, smolt migration, and estuarine rearing of juvenile coho and Chinook salmon.

Although specific Habitat Areas of Particular Concern have not been established for coho or Chinook salmon in the Klamath Basin, the Preliminary Draft of the Pacific Coast Salmon EFH Review recommend designating complex channels and floodplain habitats: meandering, island-braided, pool-riffle and forced pool riffle habitats; thermal refugia; spawning habitat; estuaries; and marine and estuarine submerged aquatic vegetation (NOAA Fisheries Service 2010a).

### **Groundfish**

NOAA Fisheries Service defined EFH to include those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 USC 1802 (10)). EFH for Pacific Coast groundfish includes all waters and substrate within areas with a depth less than or equal to 3,500 m (1,914 fm) shoreward to the mean higher high water level or the upriver extent of saltwater intrusion (defined as upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow). The Klamath River Estuary, which extends from the river's mouth upstream to near the

confluence with Ah Pah Creek, is included in the Pacific groundfish EFH (50 CFR § 660.395).

#### Pelagic Fish

EFH for coastal pelagic species, including finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, and jack mackerel) and market squid occurs from the shorelines of California, Oregon, and Washington westward to the exclusive economic zone and above the thermocline where sea surface temperatures range from 10 to 26°C. During colder winters, the northern extent of EFH for coastal pelagic species may be as far south as Cape Mendocino, and during warm summers it may extend into Alaska's Aleutian Islands. In each of these seasonal examples the Klamath Estuary and coastline would be included as EFH for these species.

### **3.3.4 Environmental Consequences**

#### **3.3.4.1 Effects Determination Methods**

This section provides a brief overview of the methods used in the evaluation of important factors to aquatic resources. More complete descriptions are provided in the Methods and Criteria Technical Memorandum (Reclamation 2011), Appendix E for suspended sediment, and Appendix F for bedload sediment.

#### **Suspended Sediment**

As described in Appendix E, the potential effects of suspended sediment on anadromous fish species for the Proposed Action and alternatives were assessed using SRH-1D (Huang and Greimann 2010, as summarized in Greimann et al. 2010). The SRH-1D model provides an estimate of SSCs at different points on the river on a daily average estimate. This information is used to assess the impacts of SSCs on fish based on the concentration and duration of exposure using Newcombe and Jensen's (1996) approach. Duration of exposure is based on the time a species and lifestage would be exposed to elevated SSCs. These effects are compared to those that fish would be expected to encounter under baseline conditions. Estimated existing conditions were also simulated using the SRH-1D model, to provide a comparison of what SSCs would be with and without dam removal in the years 2020 and 2021 (No Action/No Project Alternative). This approach is similar to that used in Stillwater Sciences (2008, 2009a, 2009b).

Daily durations of SSC concentrations were modeled assuming the Proposed Action occurred within each of the 48 years in the available hydrology record since 1961. The results of modeling all potential years were summarized for each life-stage of each species assessed. Because the suspended sediment varies with hydrology, and in order to account for (and compare) the range of results and impacts that might occur under each alternative, two scenarios were analyzed for the Proposed Action, and for action alternatives, with the goal of predicting the potential impacts to fish that has either a 50% (likely to occur) or 10% (unlikely, or worst case) probability of occurring, defined as follows:

**For Existing Conditions and the No Action/No Project Alternative:**

- **Normal conditions:** suspended sediment concentrations and durations with a 50 percent exceedance probability for the mainstem Klamath River downstream of Iron Gate Dam (i.e., the probability of these concentrations and durations being equaled or exceeded for each assessed species and life-stage in any one year is 50 percent). Exceedance probabilities were based on modeling SSC using hydrologic data from all water years subsequent to 1961 with facilities in place. To assess “normal conditions” the median (50 percent) suspended sediment concentration and duration from these results was estimated.
- **Extreme conditions:** suspended sediment concentrations and durations with a 10 percent exceedance probability (i.e., the probability of these concentrations and durations being equaled or exceeded for each assessed species and life-stage in any 1 year is 10 percent).

**For the Proposed Action– Full Facilities Removal of Four Dams:**

- **Most likely scenario:** suspended sediment concentrations and durations with a 50 percent exceedance probability for the mainstem Klamath River downstream of Iron Gate Dam (i.e., the probability of these concentrations and durations being equaled or exceeded for each assessed species and life-stage in any one year is 50 percent). Exceedance probabilities were based on the results of modeling suspended sediment in the Klamath River downstream of Iron Gate Dam in all water years observed since 1961 with facility removal. To assess the “most likely scenario” the median (50 percent exposure concentration) was estimated.
- **Worst-case scenario:** suspended sediment concentrations and durations with a 10 percent exceedance probability (i.e., the probability of these concentrations and durations being equaled or exceeded for each assessed species and life-stage in any 1 year is 10 percent).

**Bedload Sediment**

As described in Appendix F, the analysis of potential changes to bedload sediment also relied upon output from the SRH-1D model (Huang and Greimann 2010). The changes in bedload were evaluated for a range of hydrologic conditions for short-term (2-year) and long-term (5-, 10-, 25-, 50-year) changes using a range of flows taken from historical hydrology. A long-term simulation was not conducted for the Klamath River upstream of Iron Gate Dam under the assumption that the bedload sediment conditions at the end of 2 years are representative and would persist through time, allowing for mild fluctuations as a function of hydrology (Reclamation 2011; D. Varyu, pers. comm., January 4, 2011).

The effects determination used results from the analysis and knowledge of habitat requirements of affected fish species to determine how changes in bed elevation and substrate composition would affect aquatic resources (e.g., pool habitat, spawning gravel, benthic habitat). Changes in substrate composition occurring as a result of dam removal that decreased habitat suitability were assumed to be deleterious to salmonids. Bedload

transport in the area upstream of the influence of J.C. Boyle Reservoir are not anticipated to be affected by dam removal and are not expected to be substantially affected by the Proposed Action, and are not evaluated further in this document. Link and Keno Dams would remain in place and would continue to affect hydrology and sediment transport in much the way they do currently.

### **Water Quality**

The potential short- and long-term water quality-related effects on fish were based on water quality effects determinations (see Section 3.2, Water Quality) for parameters to which fish are most sensitive (i.e., water temperature, sediment and turbidity, dissolved oxygen, pH, ammonia toxicity), as well as effects determinations for state and approved tribal designated beneficial uses that are directly related to fish (see Table 3.2-3). Potential effects of sediment toxins on fish were evaluated using the results of multiple screening level comparisons of sediment contaminant levels identified in reservoir sediments. These water quality methods are described in greater detail in Section 3.2, Water Quality.

### **Water Temperature**

Potential impacts of water temperature on species within each analysis area were evaluated using available modeled water temperatures (PacifiCorp 2004c; Dunsmoor and Huntington 2006; FERC 2007). Because model results were not developed for all of the alternatives, this evaluation assumes that the Partial Facilities Removal Alternative would result in temperatures similar to those that would occur under the Proposed Action. It is assumed that the Fish Passage at Four Dams Alternative would result in similar temperatures to the No Action/No Project Alternative. The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative was assumed to result in temperatures intermediate to the Proposed Action and No Action/No Project Alternative. Because the remaining reservoirs are small relative to Copco 1 and Iron Gate Reservoirs, with correspondingly lower amounts of thermal heating and residence time, the temperatures under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would likely be more similar to those under the Proposed Action than they would be to the No Action/No Project Alternative. Water temperature data were compared to the thermal tolerances of focal species and associated life stages as determined from the literature to determine relative suitability for these species under the various alternatives.

Neither implementation of total maximum daily loads (TMDLs) nor climate change was incorporated into the existing models. For purposes of the analysis it was assumed that TMDL objectives would be met within the analysis period (see Section 3.2, Water Quality) and that climate change would result in 2.5 to 3.0°C warming by the end of the analysis period (Snyder et al. 2004; Bartholow 2005; Stillwater Sciences 2009a).

### **Fish Disease and Parasites**

Fish diseases, specifically *C. shasta* and *P. minibicornis*, can contribute to reduced survival and have periodically contributed to substantial mortality for Klamath River salmonids. Generally, Klamath River steelhead are resistant to *C. shasta* (Administrative Law Judge 2006). Environmental variables such as temperature, flow, and nutrients are

thought to affect the abundance of *P. minibicornis* and *C. shasta*; therefore, differences in river habitat conditions that could occur under the Proposed Action and alternatives could affect the abundance of these parasites and their infection rates in Klamath Basin fish. Bartholomew and Foott (2010) prepared a compilation of available information regarding Myxozoan disease relative to the Klamath River and, in their analysis they considered several factors that could, if co-occurring, lead to high infections rates of fish:

- Physical habitat components that support the invertebrate host species (pools, eddies, sediment)
- Microhabitats with low velocity and stable flows
- Close proximity to spawning areas
- Temperatures higher than 15°C

### **Aquatic Habitat**

Changes to habitat area were assessed for each life stage qualitatively, using knowledge of habitat requirements and expected changes under the alternatives. Quantitative descriptions of the relationship between fish habitat and flow are available for the current channel configuration at some locations (Bureau of Land Management 2002; Hardy et al. 2006). However, extrapolation of these relationships to describe the habitat changes that would be anticipated under each of the proposed alternatives would not provide an appropriate method to assess the effects of the project alternatives because the channel configuration itself is anticipated to change as a result of alterations to sediment supply and the temporal resolution (mean monthly or biweekly time steps) of modeled flows would not accurately represent daily flow conditions. Qualitative analyses relied on data evaluated for other affected factors (water temperature and fish passage) and expected changes in geomorphic processes, such as short- and long-term changes in sediment transport and deposition, to determine increases or decreases in habitat relative to existing conditions for the different species and life stages in the various reaches.

### **Critical Habitat**

NOAA Fisheries Service has designated critical habitat for coho salmon and Southern Resident Killer Whales, and the USFWS has designated critical habitat for bull trout. Within critical habitat, NOAA Fisheries Service has determined that the PCEs essential for the conservation of these species are those sites and habitat components that support one or more life stage, as described in Section 3.3.3.3. Critical habitat for Southern Resident Killer Whales does not extend into coastal or offshore habitats (71 FR 69054). The effects of each alternative on critical habitat were based on evaluation of the physical, chemical and biological changes that were expected to occur to designated critical habitat within the area of analysis and how those changes would affect the PCEs for that critical habitat in the short and long term.

### **Essential Fish Habitat**

The effects of each alternative on EFH were based on evaluation of the physical, chemical and biological changes that were expected to occur to EFH within the area of analysis and whether those changes would have beneficial effects on this habitat in terms of its quantity and quality in the short and long term.

### **Freshwater Mussels**

Increased levels of fine sediment, both suspended in the water column and along the channel bed, can inhibit the growth, production, and abundance of freshwater mussels and clams. Therefore, the analysis of impacts associated with dam removal focused on short- and long-term changes in SSCs (Aldridge et al. 1987, as cited in Henley et al. 2000) and stream substrate texture (Howard and Cuffey 2003; Vannote and Minshall 1982). The evaluation focuses on freshwater mussels because of the lack of information regarding the effects of SSCs and sediment transport on clams. Suspended sediment impacts on freshwater mussel species were evaluated using output from the SRH-1D (Huang and Greimann 2010) sediment transport model as discussed above for suspended and bedload sediment.

Aldridge et al. (1987, as cited in Henley et al. 2000) showed that exposure to SSCs of 600-750 mg/L led to reduced survival of freshwater mussels found in the eastern United States. No duration of exposure was cited in the study. No comparable data are available for the species in the Klamath River. Using 600 mg/L as the minimum SSCs that would be detrimental to freshwater mussels, alternatives were compared to each other by determining the number of days during which this criterion threshold would be exceeded.

Analysis of impacts due to changes in bedload transport on the four species of freshwater mussels considered modeled changes in median sediment size, under the Proposed Action and each project alternative. The effects of changes in water quality on freshwater mussels were evaluated in the same manner as described for fish. The analysis presented here, focuses on effect on freshwater mussels because of their longer lifespan and a lack of information on the effects of water quality on clams.

### **Benthic Macroinvertebrates**

Suspended sediment and turbidity can cause stress to benthic macroinvertebrates through impaired respiration, reduced feeding, growth, and reproductive abilities, and reduced primary production (Lemly 1982; Vuori and Joensuu 1996). Therefore, potential short-term and long-term effects of the Proposed Action and alternatives on benthic macroinvertebrates were evaluated for both short- and long-term changes in SSCs and bedload sediment. Suspended sediment impacts on benthic macroinvertebrates were evaluated using output from the SRH-1D (Huang and Greimann 2010) sediment transport model as discussed above for suspended and bedload sediment.

Changes in substrate size or embeddedness may influence the distribution, abundance, and community structure of benthic macroinvertebrates (Bjornn et al. 1977; McClelland and Brusven 1980; Ryan 1991). Bed texture changes that would occur under the Proposed Action and alternatives were qualitatively evaluated to determine whether changes in substrate composition would decrease macroinvertebrate abundance or alter the community composition to the extent that these communities could no longer support sufficient fish populations in the Klamath system.

The effects of changes in water quality, Biochemical Oxygen Demand/Immediate Oxygen Demand, and toxicity effects on BMIs were based on water quality determinations (see Section 3.2, Water Quality) and evaluated in the same manner as

described for fish and mollusks. Potential toxicity to BMIs was also evaluated using the results of bioassays.

#### **3.3.4.2 Significance Criteria**

The Proposed Action and alternatives could affect aquatic resources directly or indirectly through a variety of mechanisms, as described in the preceding section. These effects could be additive or offsetting. For purposes of this evaluation, the Lead Agencies considered the total effect of the factors described above on native fish populations and their habitat. These impacts could vary substantially in intensity, geographic extent, and duration. The intensity of an impact refers to how severely it affects an organism. This severity can range from sublethal behavioral adaptations such as avoidance of a specific condition, to mortality. The geographic extent refers to how much of the species' potential habitat and what proportion of the total population is expected to be affected. The temporal duration refers to how long the effect is anticipated to persist (hours, days, months, or years). The Lead Agencies considered effects in the short term (less than 2 years) and the long term (more than 2 years), but either short- or long-term impacts could be significant.

For the purposes of this EIS/EIR, the following determinations were considered:

- No change from existing conditions: Effect would not result in alterations to existing conditions.
- Significant: As defined below.
- Less-than-significant: Effect influences an aquatics species, but does not result in a significant effect.
- Beneficial: Results in a substantial increase in the abundance of a year class in the short or long term.

For the purposes of this EIS/EIR, effects would be significant if they would result in the following:

Short term:

- Substantially reduce the abundance of a year class in the short term.
- Substantially decrease the habitat quality or availability for a native species over a large proportion of the habitat available to it in the short term.
- Substantially decrease the quality or availability of a large proportion of critical habitat under the ESA or EFH under the Magnuson-Stevens Fishery Conservation and Management Act in the short term.

Long term:

- Substantially reduce the population of a native species for more than two generations after removal of all dams (if removed all at once) or after the last dam (if removed sequentially).
- Substantially decrease the habitat quality or availability for a native species or community in the long term.

- Substantially decrease the habitat quality or availability for a native species over a large proportion of the habitat available to it in the long term.
- Substantially decrease the habitat quality or availability of a large proportion of critical habitat under the ESA or EFH under the Magnuson-Stevens Fishery Conservation and Management Act in the long term.
- Continue or worsen conditions that are currently causing a species to decline in the long term.
- Eliminate a year class of salmon or steelhead, thereby jeopardizing the long-term viability within the Klamath Basin. Because of the fixed, 3-year timing of the coho salmon life cycle, which has little to no plasticity, this criterion was added for the protection of coho salmon in particular and could result in a jeopardy decision.

#### **3.3.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

Under this alternative, none of the actions under consideration would be implemented. The Klamath Hydroelectric Project would continue current operations under the terms of an annual license until a long-term license is finalized. Annual licenses would not include actions associated with the KHSA and KBRA. Several Interim Measures (IMs) from the KHSA would be implemented through other PacifiCorp's Habitat Conservation Plan or other means; these measures are included in the No Action/No Project Alternative. Some KBRA actions have already been initiated and would continue under the No Action/No Project Alternative. These include the Williamson River Delta Project, the Agency Lake and Barnes Ranch Project, fish habitat restoration work, and ongoing climate change assessments. The TMDLs would be implemented under all alternatives as they are an unrelated regulatory action; however, TMDL goals would likely be met at a later date than under alternatives with KBRA. Hydroelectric operations would continue as they have been, providing peaking power generation during the summer as demand requires and conditions allow.

##### **Key Ecological Attributes**

###### **Suspended Sediment**

Suspended sediment effects under the No Action/No Project Alternative are described in detail in Appendix E, and summarized here. Under the No Action/No Project Alternative, suspended sediment would be the same as under existing conditions. Most suspended sediment is supplied by tributaries; Iron Gate Dam currently interrupts both fine and coarse sediment transport, so suspended sediment generally increase in a downstream direction. The lower Klamath River downstream of the Trinity River confluence (RM 40.0) to the estuary mouth is listed as sediment impaired under Section 303(d) of the Clean Water Act (see Section 3.2.2). Under both normal and extreme conditions, the magnitude and duration of the SSCs modeled for the No Action/No Project Alternative are expected to cause major stress to migrating adult and juvenile salmonids primarily during winter (Newcombe and Jenson 1996; Appendix E).

### Bedload Sediment

Bedload sediment effects under the No Action/No Project Alternative are described in detail in Appendix F, and summarized here.

#### **Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

Under the No Action/No Project Alternative, the Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Reclamation (2011) estimates that the four subject reservoirs would store 2.35 million yd<sup>3</sup> of fine and coarse sediment by 2061. As reservoir water storage capacities decreased (i.e., as they filled with sediment), sediment trapping efficiency could also decrease, allowing sediment to pass through reservoirs. The No Action/No Project Alternative would have no effects associated with bedload sediment relative to existing conditions for any aquatic species in this reach.

**Lower Klamath River: Downstream of Iron Gate Dam** Under the No Action/No Project Alternative, the channel directly downstream of Iron Gate Dam would continue to coarsen over time due to retention of fine and coarse sediment supply from sources upstream of Iron Gate Dam (Reclamation 2011), but this effect would gradually decrease in the downstream direction as coarse sediment was resupplied by tributary inputs (Hetrick et al. 2009), and would be substantially reduced at the Cottonwood Creek confluence (PacifiCorp 2004b). The coarser bed material is mobilized at higher flows that occur less frequently, resulting in channel features that are more stable. This impact would be limited to the area upstream of Cottonwood Creek. Under the No Action/No Project Alternative, rearing habitat would be expected to remain similar to existing conditions.

**Klamath River Estuary** The No Action/No Project Alternative would not change bedload transport to the estuary or Pacific Ocean, relative to existing conditions.

### Water Quality

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** As described in Section 3.2, Water Quality, long-term dissolved oxygen levels under the No Action/No Project Alternative would continue to exhibit seasonal variability. These dissolved oxygen levels would not consistently meet Oregon and California Basin Plan water quality objectives for dissolved oxygen, and would not consistently support designated beneficial uses in Oregon for cold-water aquatic life, cool-water aquatic life, warm-water aquatic life, and spawning and in California for cold freshwater habitat, warm freshwater habitat, and spawning habitat beneficial uses.

Klamath TMDL model results for riverine conditions between Link River Dam and the upstream end of J.C. Boyle Reservoir predict that dissolved oxygen concentrations will meet the 6.5 mg/L objective year round and achieve the modeled natural conditions baseline during the warm summer and fall months (see Section 3.2.4.3.1.4 Upper Klamath Basin). Thus, full attainment of the Oregon TMDLs would eventually be beneficial for dissolved oxygen in this reach. Under full TMDL compliant conditions, the California 85 percent saturation objective (based on natural receiving water

temperatures) is also met at state line under the No Action/No Project Alternative (see Section 3.2.4.3.1.4). Thus, full attainment of the Oregon and California TMDLs would eventually be beneficial for dissolved oxygen in the Hydroelectric Reach. Full attainment could require decades to achieve and it is highly dependent on improvements in dissolved oxygen in Upper Klamath Lake and the upstream reach from Link River Dam to J.C. Boyle Dam (particularly Keno Impoundment and Lake Ewauna).

The overall anticipated effect on dissolved oxygen in the Upper Klamath Basin under the No Action/No Project Alternative would be an increasing trend toward compliance with water quality objectives and support of designated beneficial uses, but may not meet minimum dissolved oxygen objectives for California at the downstream end of the Hydroelectric Reach during the late summer/early fall months.

Restoration activities such as floodplain rehabilitation, riparian vegetation planting, and purchase of conservation easements/land related to nutrients under the No Action/No Project Alternative are currently ongoing in the Upper Klamath Basin and are expected to continue to improve long-term pH in the Upper Klamath Basin. These restoration actions and implementation of water quality improvement measures under Oregon and California TMDLs to address water quality impairments are expected to improve pH during the period of analysis (50 years) under the No Action/No Project Alternative.

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Under the No Action/No Project Alternative, continued high rates of algal photosynthesis in the reservoirs would result in pH values that would not consistently meet applicable ODEQ and California Basin Plan water quality objectives (see Section 3.2, Water Quality). Based on existing conditions, pH during summer through fall within the reservoirs would continue to range from just above neutral (7) to greater than 9 (slightly basic). The ongoing presence of the reservoirs in the Hydroelectric Reach would continue to provide the conditions necessary for blue-green algae, including *M. aeruginosa*, which can contribute to reduced health and increased mortality rates for fish and other aquatic resources both within the reservoirs and in areas downstream. The lower levels of the J.C. Boyle, Copco, and Iron Gate Reservoirs would continue to have very low oxygen levels when stratified (FERC 2007). This would affect dissolved oxygen levels downstream of these reservoirs.

**Lower Klamath River: Downstream of Iron Gate Dam** Ongoing efforts to improve water quality conditions are underway through the TMDL process and considerable efforts to improve habitat are also underway (Hamilton et al. 2011). Once implemented, these efforts could reduce existing conditions that contribute to reduced health and increased mortality rates for aquatic resources (described below) to some extent, but this process would be slower and more challenging than with the dams removed. In the interim, water quality conditions that may reduce survival of fish and other aquatic resources would persist downstream of Iron Gate Dam.

Given existing conditions, long-term dissolved oxygen levels under the No Action/No Project Alternative would continue to exhibit seasonal variability and would not consistently meet California Basin Plan and Hoopa Valley Tribe water quality objectives

for dissolved oxygen and they would not consistently support designated beneficial uses in the lower Klamath River downstream of Iron Gate Dam.

Modeling conducted for development of the California Klamath River TMDL indicates that under the No Action/No Project Alternative, dissolved oxygen concentrations downstream of Iron Gate Dam to the Shasta River (RM 176.7), without additional mitigation, would not meet the North Coast Basin Plan water quality objective of 85 percent saturation during July–September and from the Shasta River to approximately the Scott River (RM 143) from September–November (see Section 3.2.4.3.1.4 Lower Klamath Basin). Farther downstream with full attainment of TMDL allocations, predicted dissolved oxygen concentrations would remain at or above 85 percent saturation, meeting the North Coast Region Basin Plan water quality objective from Seiad Valley (RM 129.4) to the Klamath Estuary.

Under the No Action/No Project Alternative, continued high rates of algal photosynthesis in the reservoirs would result in high pH values in the lower Klamath River downstream of Iron Gate Dam (see Section 3.2, Water Quality). Under the No Action/No Project Alternative, pH would continue to be elevated with high diurnal variability during summer and early fall months.

The overall anticipated effect on dissolved oxygen in the lower Klamath River under the No Action/No Project Alternative would be an increasing trend toward compliance with water quality objectives and support of designated beneficial uses, but with possible continued seasonally low dissolved oxygen downstream of Iron Gate Dam, and so would not consistently meet California Basin Plan and Hoopa Valley Tribe water quality objectives for dissolved oxygen. Turbine venting studies, currently ongoing as part of KHSA IMs (see Section 3.2, Water Quality), could be used to further increase dissolved oxygen in the river downstream of the dam in the long term under the No Action/No Project Alternative. However, results from turbine venting studies are inconclusive at this time and it is uncertain whether or not increases of dissolved oxygen downstream of Iron Gate Dam can be consistently achieved. The No Action/No Project Alternative would continue to periodically result in dissolved oxygen levels that may be deleterious to aquatic resources below Iron Gate Dam, but this effect would be similar to or less than that which currently occurs.

#### Water Temperature

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** Under the No Action/No Project Alternative, the temperature in the upper Klamath River would remain similar to existing conditions in the near term, but would be expected to show a gradual cooling trend through implementation of the TMDLs.

Climate change is expected to play a role in future temperatures. Climate change impacts on the Klamath River and Estuary are based on current estimates of potential future changes in air temperature and precipitation patterns for the California North Coast hydrologic region (Stillwater Sciences 2009a). Regional climate models estimate that median annual air temperature would increase 2.5 to 3°C by 2050 (Snyder et al. 2004). These ambient air temperatures could in turn raise water temperatures. Additionally,

decreases in snowpack from higher air temperatures from January to March are also predicted, resulting in a more modest spring runoff peak. Despite climate predictions, temperatures in Upper Klamath Lake have exhibited a downward trend from 1990 to 2009 (Jassby and Kann 2010).

As described in Section 3.2, Water Quality, the Wood River Wetland Restoration Project and the Agency Lake and Barnes Ranches Project represent a reasonably foreseeable set of actions under the No Action/No Project Alternative that would improve springtime water temperatures for rearing fish in the upper basin. Specific options for both projects still need to be developed and studied as part of a separate project-level National Environmental Policy Act evaluation and ESA consultation.

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Under the No Action/No Project Alternative, the effects of ongoing and future upstream water quality improvements under the TMDLs would improve water temperatures below Keno Dam. However, climate change would offset temperature improvements. The river's thermal regime downstream of the reservoirs would continue to be out of phase with the natural temperature regime (Hamilton et al. 2011). Unnatural temperature fluctuations would continue downstream from the J.C. Boyle Bypass Reach, from the mixture of cold-water inflow from Big Springs and the warmer water discharge from the J.C. Boyle Powerhouse (Hamilton et al. 2011). Similar impacts from climate change as described above are also predicted to occur in this reach; therefore, water temperatures are expected to remain similar to existing conditions. Project operations have and continue to be deleterious to the resident trout fishery by: a) confining the resident trout between the Four Facilities and associated reservoir thereby impairing their utilization of the full range of life history strategies and spawning productivity; b) unscreened flow through Project turbines result in mortality of juvenile and adult trout migrating down stream; and the inability to effectively migrate will reduce the genetic health and long-term survival of the resident species (Administrative Law Judge 2006).

**Lower Klamath River: Downstream of Iron Gate Dam** The lower Klamath River downstream of Iron Gate Dam would continue to have elevated water temperatures in the summer and fall in the near term. These elevated water temperatures are primarily influenced by the reservoirs and their perpetuation of an increased hydraulic residence time and thermal mass (Bartholow et al. 2005). Bartholow et al. (2005) and PacifiCorp (2004a) showed that the reservoirs delay seasonal thermal signatures by 18 days. Implementation of the TMDLs in these mainstem and tributaries is expected to result in lower water temperatures over time; however, these improvements would likely be offset by the effects of climate change, as described above. In the long term, water temperatures in the mainstem and tributaries are expected to remain similar to existing conditions.

Under this alternative, the current phase shift and lack of temporal diversity will persist, including current warm temperatures in late summer and fall. Current cooler temperatures in spring and early summer could benefit both adult and juvenile salmonids migrating during spring. However, juveniles and adults migrating later in the year would continue to experience warm temperatures in late summer and fall that could be

deleterious to health and survival, including increased risk of disease, and high rates of delayed spawning and prespawn mortality (Hetrick et al. 2009).

In addition to the direct stress that increasing temperatures could place on salmonids, these increasing water temperatures could result in an increased intensity and duration of algal blooms, decreased dissolved oxygen levels, and increased parasite abundance. These effects would put additional stress on cold-water fish communities, and be deleterious to warm-water fish communities as well.

**Klamath River Estuary and Pacific Ocean Nearshore Environment** Under the No Action/No Project Alternative, the temperature in the Klamath River Estuary and Pacific Ocean would remain similar to the existing conditions and climate change would continue to play a role in future temperatures as described above.

#### Fish Disease and Parasites

The ongoing presence of the dams under the No Action/No Project Alternative would continue to contribute to the stable, warm habitat conditions that are favorable for polychaetes and for *C. shasta* and *P. minibicornis*. The hatchery would continue to operate and discharge its nutrient-rich effluent to the river. Salmon would continue to concentrate below the Iron Gate Dam, where the polychaete hosts are abundant, facilitating the cross infection between the fish and the polychaetes. Based on this scenario, mortality associated with *C. shasta* and *P. minibicornis* would be expected to remain similar to existing conditions. If temperatures warm over time with climate change, these infection rates could increase. The No Action/No Project Alternative would result in continued substantial deleterious effects on salmon in terms of fish disease.

#### Algal Toxins

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** Under the No Action/No Project Alternative, high nutrient inputs supporting the growth of toxin-producing nuisance algal species such as *M. aeruginosa* in Upper Klamath Lake would remain similar to existing conditions for decades into the future. This would result in continued bioaccumulation of microcystin in suckers in Upper Klamath Lake and could be deleterious to fish health. Upon full attainment of the TMDLs (implementation mechanism and timing currently unknown), nutrients and toxin-producing nuisance algal species would decrease (see Sections 3.2, Water Quality and 3.4, Algae for additional detail regarding TMDLs and algal growth). Accordingly, with full attainment of the TMDLs, improvements to microcystin tissue levels in suckers in the lake would occur.

**Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Continued impoundment of water at the Four Facilities under the No Action/No Project Alternative would support growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* in Copco 1 and Iron Gate Reservoirs, resulting in high seasonal concentrations of algal toxins in the Hydroelectric Reach for decades into the future. This would result in continued bioaccumulation of microcystin in fish tissue for species in the Hydroelectric Reach and could be deleterious to fish health. Upon full attainment of the TMDLs (implementation mechanism and timing currently unknown), nutrients and toxin-

producing nuisance algal species would decrease in the Hydroelectric Reach (see Sections 3.2 and 3.4 for additional detail regarding TMDLs and algal growth). Accordingly, with full attainment of the TMDLs, improvements to microcystin tissue levels in fish in the Hydroelectric Reach would occur.

**Lower Klamath River: Downstream of Iron Gate Dam** Continued impoundment of water at the Four Facilities under the No Action/No Project Alternative would support the seasonal transport of toxin-producing nuisance algae and microcystin to the Klamath River downstream of Iron Gate Dam. This would result in continued bioaccumulation of microcystin in fish tissue for species in the river and could be deleterious to fish health. Upon full attainment of the TMDLs (implementation mechanism and timing currently unknown), nutrients and toxin-producing nuisance algal species would decrease in the Hydroelectric Reach (see Sections 3.2 and 3.4 for additional detail regarding TMDLs and algal growth). Accordingly, with full attainment of the TMDLs, improvements to microcystin tissue levels in fish in the Klamath River downstream of Iron Gate Dam would occur.

#### Aquatic Habitat

Under the No Action/No Project Alternative, hydrology of the Klamath River from its headwaters to the estuary would generally remain the same as under existing conditions, subject to the influence of climate change (discussed under 3.10, Greenhouse Gases/Global Climate Change). Activities currently underway to recover salmonid and sucker populations within the Klamath Basin would continue at their current levels. The ongoing Wood River Wetland Restoration, Agency Lake and Barnes Ranches Project, and the Williamson River Delta Project would likely improve springtime rearing habitat for fish in the upper basin. Recovery actions under the Klamath River Coho Salmon Recovery Plan would continue, depending on available funding. These actions would improve habitat conditions over time relative to current conditions.

Under the No Action/No Project, PacifiCorp would need to obtain a long-term operating license for the Klamath Hydroelectric Project from FERC to continue operating the Project (FERC 2007). Until a new license is issued, operations would continue under the annual license terms described in Section 3.3.3.3.

#### **Aquatic Resources Effects**

##### Critical Habitat

*As described below, continued impoundment of water within reservoirs under the No Action/No Project Alternative could alter the water quality and habitat suitability within critical habitat.*

**Coho Salmon** As described above in detail, under the No Action/No Project Alternative, habitat supporting PCEs for coho salmon will continue to be degraded (NOAA Fisheries Service 1999b, NOAA Fisheries Service 2010a). Spawning habitat would continue to be impaired by sediment and instream flows within tributary streams, with little mainstem spawning. Rearing habitat with food resources would continue to be impaired as result of habitat degradation, high water temperature, and disease within tributaries and the mainstem. Water quantity supporting PCEs would continue to be depleted both within

tributaries and within the mainstem. The quality of PCEs would likely improve gradually over time, through the actions undertaken under the Klamath River Coho Salmon Recovery Plan. TMDL implementation is anticipated to result in improved water quality to meet PCEs; however, water quality would initially be reduced similar to that under existing conditions. However, full attainment of the water temperature TMDLs is likely to be offset by climate change. **The effect of the No Action/No Project Alternative would be no change from existing conditions for coho salmon critical habitat in the short and long term.**

**Bull Trout** Because bull trout are restricted in distribution to the headwaters of limited number of streams, under the No Action/No Project Alternative, PCEs of critical habitat supporting bull trout are not expected to be affected by implementation of the Oregon TMDL processes. Over the long-term climate change would be expected to result in warmer temperatures, although the headwater streams supporting bull trout may be not be affected. **The effect of the No Action/No Project Alternative would be no change from existing conditions for bull trout critical habitat in the short and long term.**

**Southern Resident Killer Whale** The Klamath River may affect PCEs of critical habitat for Southern Resident Killer Whales through its potential contribution of Chinook salmon to the food supply for Southern Resident Killer Whales, the survival and fecundity of which appears dependent upon the abundance of this species (Ward et al. 2009; Ford et al. 2009). Chinook salmon originating from the Fraser River are the dominant prey of resident killer whales in the summer months when they are usually in inland marine waters (Hanson et al. 2010). Less is known of their diet during the remainder of the year (September through May) when they spend much of their time in outer coastal waters, but it is believed likely that they preferentially feed on Chinook salmon when available, and roughly in proportion to their relative abundance (Hanson et al. 2010). The contribution of Klamath-origin salmonids to the diet of Southern Residents is unknown, but during this period they may travel from central California to northern British Columbia (Krahn et al. 2004, as cited in Hanson et al. 2010). No change from existing conditions is expected in the short term.

TMDL implementation in the basin could improve water quality conditions over time, which might result in increased Chinook salmon production over time. However, full attainment of the water temperature TMDLs is likely to be offset by climate change. **The effect of the No Action/No Project Alternative would be no change from existing conditions for Southern Resident Killer Whales in the short and long term.**

#### Essential Fish Habitat

*Dams and the continued impoundment of water within reservoirs under the No Action/No Project Alternative could alter the availability and suitability of Essential Fish Habitat (EFH).*

**Chinook and Coho Salmon EFH** Under the No Action/No Project Alternative, EFH for Chinook and coho salmon would be expected to remain similar to its current condition. Access to habitat would be limited to its current levels; water quality would improve through TMDL implementation, but would be offset by warming expected as a result of

climate change. The amount of suitable habitat in currently accessible tributaries would likely be reduced by climate change. Conditions under the No Action/No Project Alternative would continue to contribute to elevated concentrations of disease parasites and would provide the conditions required for the cross infection of fish and polychaetes. These interacting factors could decrease the viability of Chinook and coho salmon populations in the future. **The effect of the No Action/No Project Alternative would be no change from existing conditions for Chinook and coho salmon EFH in the short and long term.**

**Groundfish EFH** Under the No Action/No Project Alternative, sediment and habitat conditions in the estuary and nearshore ocean would remain the same as they are under existing conditions. **The effect of the No Action/No Project Alternative would be no change from existing conditions for groundfish EFH in the short and long term.**

**Pelagic Fish EFH** Under the No Action/No Project Alternative, sediment and habitat conditions in the estuary and nearshore ocean would continue to be the same as they are under existing conditions. **The effect of the No Action/No Project Alternative would be no change from existing conditions for pelagic fish EFH in the short and long term.**

#### Species-Specific Impacts

*As described below, continued impoundment of water within reservoirs under the No Action/No Project Alternative, and the continued blockage of habitat access at project dams, could affect aquatic species.*

Species-specific impacts are based upon existing conditions for key ecological attributes summarized above.

**Fall-Run Chinook Salmon** As described in Section 3.2, Water Quality, long-term dissolved oxygen levels under the No Action/No Project Alternative would continue to exhibit seasonal variability. These dissolved oxygen levels would not consistently meet Oregon and California Basin Plan water quality objectives for dissolved oxygen, and would not consistently support designated beneficial uses in Oregon for cold-water aquatic life, cool-water aquatic life, warm-water aquatic life, and spawning and in California for cold freshwater habitat, warm freshwater habitat, and spawning habitat beneficial uses. In addition, the thermal regimes downstream of Iron Gate Dam would continue to be altered as a result of project facilities and operations, particularly retention time of water in the reservoirs.

Under the No Action/No Project Alternative, Iron Gate Dam would continue to block fall-run Chinook salmon access to an estimated 420 miles of their historical habitat, which used to extend upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). The consequences of this ongoing loss of habitat to the population could include reduced resilience to recover from catastrophic disturbances of natural or anthropogenic origin, such as wildfire or chemical spills. Because areas upstream of the barrier include cold-water refugia, opportunities for the population to adapt to changing

temperatures are reduced, whether these temperatures are a result of short- or long-term changes.

Under the No Action/No Project Alternative, the system of reservoirs and dams in the hydroelectric reach will continue to create conditions conducive to the spread of parasites among the fall-run Chinook salmon population downstream of Iron Gate Dam, especially where adults tend to congregate in high numbers, just downstream of Iron Gate Dam (Stocking and Bartholomew 2007, Bartholomew and Foott 2010), but also in other locations further downstream. Additional factors related to the project would continue to exacerbate the situation downstream of Iron Gate Dam, including increased water temperatures and dampened thermal variability, reduced dissolved oxygen concentrations, loss of sediment transport through the reach due to capture of sediment by the dams, and reservoirs contributing plankton to the filter-feeding polychaete hosts of the myxozoan parasites (Hamilton et al. 2011). Under the No Action/No Project Alternative, downstream-migrating juvenile Chinook salmon may continue to have high infection rates (Bartholomew and Foott 2010) during summer months in some years. Heavy parasite loads may increase disease-related mortality in outmigrant smolts, particularly when water temperatures are high, or may reduce ocean survival by affecting growth or fitness.

Effects of suspended sediment on fall-run Chinook salmon under the No Action/No Project Alternative and existing conditions are described in Appendix E, Section E.3.1.1. Overall, fall-run Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Although SSCs under existing conditions and the No Action/No Project Alternative are relatively high in the mainstem downstream of Orleans, and even more so downstream of the Trinity River (California State Water Resources Control Board [SWRCB] 2006, NCRWQCB 2010) (see Section 3.2.3), they are relatively low in the reach downstream of Iron Gate Dam where most mainstem spawning occurs. Suspended sediment concentrations and durations during upstream and downstream migration, even under extreme conditions, are low enough that effects are limited to physiological stress and possibly reduced growth rates. In general, fall-run Chinook salmon appear relatively unaffected by current suspended sediment conditions because smolt outmigration primarily occurs when SSC are naturally low.

Under the No Action/No Project Alternative, ongoing hatchery operations would continue to mitigate for habitat lost due to construction of the dam by releasing millions of juvenile and yearling Chinook salmon annually. These fish may compete with the progeny of naturally spawned fish for food and other limited resources, such as thermal refugia, or can increase disease infection rates through crowding. In addition, some adult fish may stray and spawn with wild fish, which can reduce genetic and phenotypic diversity and reproductive success within the wild population (McLean et al. 2003, Araki et al. 2007, Araki et al. 2009, all as cited in Hamilton et al. 2011).

Under the No Action/No Project Alternative, the interruption of sediment transport processes by the dams would continue, reducing spawning gravel supply to downstream reaches and changing the dynamics of channel morphology and riparian vegetation

communities that create and maintain rearing habitats for fry and juvenile fall-run Chinook salmon. It may also be contributing to the high densities of polychaetes downstream of Iron Gate Dam that host salmonid parasites.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for fall-run Chinook salmon in the short and long term.**

**Spring-Run Chinook Salmon** Under the No Action/No Project Alternative, poor water quality conditions caused partly by nutrient enrichment during spring-run Chinook salmon upstream and downstream migration may cause high stress. Water quality in the mainstem Klamath River below Iron Gate Dam is characterized by altered seasonal water temperature patterns, dissolved oxygen, and increased nutrient input, as well occasional blooms of *M. aeruginosa*. Although water quality tends to improve downstream of the Salmon River (current upstream extent of spring-run distribution in the Klamath River), the effect of water quality alterations is that conditions (especially water temperature and DO) are critically stressful for spring-run Chinook salmon for much of the summer (June through September). Maximum temperatures often reach 25°C during summer, considered lethal for most Pacific salmon (Sullivan et al.2000). Spring Chinook salmon that are stressed by high temperatures, whether adults or juveniles, likely have lower survival rates, especially when challenged by additional water quality factors, such as low dissolved oxygen, the presence of toxic blue-green algae (*M. aeruginosa* ) and fish diseases, and high pH and unionized ammonia. High water temperatures during summer may reduce the growth of juvenile fish that are rearing and migrating downstream to the ocean due to greater metabolic requirements. Because size is correlated with ocean survival, this could lead to reduced smolt survival and subsequently, reduced escapement. Finally, high temperatures can selectively reduce the survival of fish migrating later in the summer (the “summer run”), thus reducing genetic and life-history diversity. High water temperatures likely limit adult holding and summer rearing habitat for spring Chinook salmon in main spawning tributaries, the Salmon and Trinity Rivers, which would likely reduce overall production. Low flows in dry years can cause migration barriers to form, reducing habitat available to spawning and rearing fish.

Under the No Action/No Project Alternative, Iron Gate Dam would continue to block spring-run Chinook salmon access to an estimated 420 miles of their historical habitat, which used to extend upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). The consequences of this ongoing loss of habitat to the population could include reduced resilience to recover from catastrophic disturbances of natural or anthropogenic origin, such as wildfire or chemical spills. Because areas upstream of the barrier include cold-water refugia, opportunities for the population to adapt to changing climate are reduced, whether these changes are a result of short- or long-term cycles or trends.

Effects of suspended sediment on spring-run Chinook salmon under the No Action/No Project Alternative and existing conditions are described in Appendix E, Section E.3.1.2. Overall, spring Chinook salmon mostly use the mainstem Klamath River as a migratory corridor during adult migration, and downstream smolt migration. Although suspended

sediment under existing conditions and the No Action/No Project Alternative is relatively high in the mainstem Klamath River downstream of Orleans, and especially downstream of the Trinity River (Appendix E), increases in suspended sediment in the mainstem Klamath River during critical migratory periods are low enough in concentration and short enough in duration that effects are limited to physiological stress and possibly inhibited growth, even during extreme conditions. Spring-run Chinook salmon appear less vulnerable to suspended sediment impacts than other Klamath River salmon populations (e.g., coho salmon and fall-run Chinook salmon).

One of the main spawning streams for spring-run Chinook salmon, the Salmon River has double the historical sediment production from road, timber harvest, and wildfire disturbance (Elder et al. 2002). Habitat degradation is believed to be the primary cause of the decline of the spring-run salmon population in the Klamath River system. Under the No Action/No Project Alternative, spawning and rearing habitat would continue to be reduced in both quantity and quality, and production may be low in some years.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for spring-run Chinook salmon in the short and long term.**

**Coho Salmon** As described in Section 3.2, Water Quality, long-term dissolved oxygen levels under the No Action/No Project Alternative would continue to exhibit seasonal variability. These dissolved oxygen levels would not consistently meet Oregon and California Basin Plan water quality objectives for dissolved oxygen, and would not consistently support designated beneficial uses in Oregon for cold-water aquatic life, cool-water aquatic life, warm-water aquatic life, and spawning and in California for cold freshwater habitat, warm freshwater habitat, and spawning habitat beneficial uses. In addition, the thermal regimes downstream of Iron Gate Dam would continue to be altered as a result of project facilities and operations, particularly retention time of water in the reservoirs.

Under the No Action/No Project Alternative, Iron Gate Dam would continue to block coho salmon to an estimated 68 miles of their historical habitat, 45 of which would be in the mainstem Klamath River and tributaries (United States Department of the Interior [DOI] 2007; NOAA Fisheries Service 2007a) and an additional 23 miles of habitat currently inundated by the reservoirs (Cunanan 2009) which used to extend upstream to Spencer Creek (Hamilton et al. 2005). The consequences of this ongoing loss of habitat to the population could include reduced resilience to recover from catastrophic disturbances of natural or anthropogenic origin, such as wildfire or chemical spills. Because areas upstream of Iron Gate Dam include cold-water refugia, opportunities for the population to adapt to changing climate are reduced under the No Action/No Project Alternative, whether these changes are a result of short- or long-term cycles or trends. The above factors could reduce the natural genetic and life-history diversity found in Klamath Basin subpopulations of coho salmon that make them ideally suited to adapting to changing watershed conditions.

Access to suitable habitat under the No Action/No Project Alternative is also limited by small dams and diversions, culverts, road crossings, and aggraded channels (NRC 2004, CalFish query 2008, <http://www.calfish.org>). These barriers prevent use of formerly available spawning and rearing habitat, which represents another factor suppressing production under the No Action/No Project Alternative.

Under the No Action/No Project Alternative, upstream-migrating adult coho salmon will continue to be exposed to high water temperatures and poor water quality in the mainstem Klamath River, which can cause physiological stress, delay migration, reduce coldwater refugia, and increase mortality from disease. Low flows and increased sedimentation in tributaries can create barriers at the mouths of spawning streams, which would reduce spawning habitat area and production under the No Action/No Project Alternative in some years.

Effects of suspended sediment on coho salmon under the No Action/No Project Alternative and existing conditions are described in Appendix E Section E.3.1.3. Overall, under existing conditions and the No Action/No Project Alternative, SSC in the mainstem are sufficiently high and of long enough duration that major physiological stress and reduced growth of coho salmon are anticipated in most years. Consistent with these findings, the lower Klamath River downstream of the Trinity River confluence (RM 40.0) to the estuary mouth (RM 0.0) is listed as sediment impaired under Section 303(d) of the Clean Water Act (SWRCB 2006, NCRWQCB 2010) (see Section 3.2.2). Relatively high SSC, in association with elevated water temperatures and disease may be contributing to the high smolt mortality that has been observed in the mainstem Klamath River (Beeman et al. 2007, 2008).

Suitable rearing habitat for juvenile salmon under the No Action/No Project Alternative would continue to be restricted by high temperatures in some areas. High water temperatures may promote higher incidence of disease or parasitism, which may increase direct and indirect mortality (Stutzer et al. 2006, NOAA Fisheries Service 2010a). During a 2008 PIT-tag study of juvenile coho salmon in the Shasta River, Chesney et al. (2009) found juvenile coho salmon only in areas where temperatures were moderated by cold springs; the remainder of potential rearing habitat was too warm (>20°C). Rearing habitat would continue to be compromised by livestock grazing and the legacy of logging impacts in riparian habitat that simplify channel and floodplain interactions that are conducive to creating habitat for rearing coho salmon in the winter.

Under historical, unregulated conditions, an annual spring pulse flow occurred in the Klamath River and in its tributaries (NRC 2004). Under current conditions a spring pulse still occurs, but is altered by water management. The magnitude of the spring flow is believed to have resulted in higher survival of coho salmon juvenile outmigrants and smolts relative to current conditions through several mechanisms, including (1) reduced rates of infection in juvenile salmon by *C. shasta* and *P. minibicornis*, (2) a reduced period of residency spent in the mainstem prior to smolting, and (3) greater habitat availability in the mid-Klamath River (Hardy et al. 2006), especially in the reach between Shasta River and Scott River where survival is particularly poor (Beeman et al. 2007, 2008).

High numbers of hatchery fish may affect wild coho salmon in the Klamath Basin under the No Action/No Project Alternative. The vast majority of coho salmon that spawn in the Klamath Basin are believed to be of hatchery origin, although the percentage varies among years (Ackerman et al. 2006).

Coho salmon populations in the Klamath Basin are in decline; less than 70% of streams historically used by coho salmon in the basin still contain small populations (NRC 2004). The No Action/No Project Alternative would likely continue to produce the types of habitat alterations that have helped to cause this decline.

More detail on current conditions for coho salmon can be found in NOAA Fisheries Service's (2010a) *Biological opinion on operation of the Klamath Project between 2010 and 2018*.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for coho salmon from all populations within the Klamath River watershed in the short and long term.**

**Steelhead** As described in Section 3.2, Water Quality, long-term dissolved oxygen levels under the No Action/No Project Alternative would continue to exhibit seasonal variability. These dissolved oxygen levels would not consistently meet Oregon and California Basin Plan water quality objectives for dissolved oxygen, and would not consistently support designated beneficial uses in Oregon for cold-water aquatic life, cool-water aquatic life, warm-water aquatic life, and spawning and in California for cold freshwater habitat, warm freshwater habitat, and spawning habitat beneficial uses. In addition, the thermal regimes downstream of Iron Gate Dam would continue to be altered as a result of project facilities and operations, particularly retention time of water in the reservoirs.

Summer steelhead use the mainstem Klamath River primarily as a migration corridor because most spawning and rearing occurs in the tributaries. Under the No Action/No Project Alternative, summer steelhead spawning and rearing habitat availability and distribution would continue to be restricted during summer and fall to reaches downstream of Seiad Valley by high water temperatures farther upstream. If water temperatures upstream of Seiad Valley were historically cooler, then this represents an ongoing loss of habitat that might otherwise be contributing to smolt production and escapement. Conditions in the mainstem are generally suitable for adult upstream migration; however, high water temperatures in the late summer and fall may restrict movements and spawning distribution of later-arriving adults. Under a more normative flow regime, temperatures would be cooler in the summer and fall months for adult migrating fish (Bartholow et al. 2005; FERC 2007). Altered flow patterns downstream of Iron Gate Dam may thus be affecting the population by selecting for earlier-arriving fish, potentially reducing life-history diversity in the population. Water temperatures are likely to rise over the next decades as a result of climate change, which could result in further reduction of suitable habitat, with potential consequences for population abundance.

Fall and winter steelhead are more widely distributed than any other anadromous salmonid downstream of Iron Gate Dam. Under the No Action/No Project Alternative, they would continue to be restricted from hundreds of miles of historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). As with summer steelhead, they use the mainstem primarily as a migration corridor to access tributaries for spawning. Increases in fine sediment in tributaries used by steelhead for spawning could be reducing egg-to-emergence survival in some tributaries.

Under the No Action/No Project Alternative, high summer water temperatures in the summer months can cause density-independent mortality on juveniles that have left spawning tributaries to rear in the mainstem. In the winter months, velocity refuge habitat is often limiting to juvenile salmonids; juvenile steelhead seem to prefer hiding in the interstitial spaces between substrate particles to keep from being displaced by high flows. If fine sediment input has increased due to watershed disturbance, embeddedness of the substrate can reduce the availability of interstitial habitat, reducing the carrying capacity of these streams for juvenile steelhead and forcing them into suboptimal rearing habitats where growth rates are slower.

Effects of suspended sediment on steelhead under the No Action/No Project Alternative and existing conditions are described in Appendix E, Section E.3.1.4. Overall, steelhead use the mainstem Klamath River as a migratory corridor during adult migration, and downstream smolt migration, and for juvenile rearing. Although SSCs under existing conditions and the No Action/No Project Alternative are relatively high in the mainstem Klamath River downstream of Orleans, and especially downstream of the Trinity River (SWRCB 2006, NCRWQCB 2010) (see Section 3.2.3), SSC in the mainstem Klamath River during critical migratory periods, even during extreme conditions, are low enough and exposure times short enough that effects are likely limited to physiological stress and possibly reduced growth rate. Conditions for fish rearing in the mainstem are likely worse, but in general steelhead appear resilient to suspended sediment regimes under existing conditions and the No Action/No Project Alternative.

Habitat conditions for juvenile steelhead rearing in the mainstem are generally suitable, except for reaches upstream of Seiad Valley where summer water temperatures are considered stressful. Juvenile outmigration peaks in the spring and extends through the summer and fall. Growth during their rearing and outmigration may be reduced by high temperatures due to increased metabolism, which can reduce ocean survival. High summer water temperatures causing physiological stress to fish can also make them more vulnerable to mortality from disease or other compounding factors.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for steelhead in the short and long term.**

**Pacific Lamprey** Pacific lamprey populations appear to have been in decline since the late 1980s in the Klamath Basin; (Larson and Belchik 1998; Moyle et al. 2009; all as cited in Hamilton et al. 2011), and are considered “vulnerable” throughout their range by

the American Fisheries Society (Jelks et al. 2008, as cited in Hamilton et al. 2011). Major factors believed to be affecting their populations include barriers to upstream migration at dams; dewatering of larval habitat through flow regulation; reducing larval habitat by increasing water velocity and/or reducing sediment deposition areas; and susceptibility to contaminants in the larval stage (Close et al. 2002, as cited in Hamilton et al. 2011).

Under the No Action/No Project Alternative, Iron Gate Dam would continue to form a barrier to Pacific lamprey migration, which represents an ongoing loss of available habitat and productive capacity. Although the exact upstream extent of suitable habitat for Pacific lamprey prior to the completion of the Four Facilities is unknown, it is believed that Pacific lamprey would have migrated at least as far as Spencer Creek (Hamilton et al. 2005, as cited in Hamilton et al. 2011). The loss of this portion of historical spawning and larval rearing habitat reduces the basin's population viability through contracting their distribution within the watershed and reducing abundance, although the relative significance of the inaccessible areas upstream of Iron Gate Dam are unknown.

Under the No Action/No Project Alternative, the dams would continue to reduce sediment supply to the mainstem Klamath River downstream of Iron Gate Dam, which may limit availability of gravel-cobble substrates for nest building and fine sediment for burrowing; armoring of substrate would also be expected to reduce spawning habitat quality. The overall effect on the basin population is likely to be small because (1) the effects of the dam on fine sediment and gravel/cobble substrates diminish with distance downstream because of input from tributaries and become less significant downstream of Cottonwood Creek (RM 182.1), and (2) a large proportion of the population may spawn and rear in large tributaries to the mainstem, such as the Trinity, Salmon, Shasta, and Scott Rivers.

Effects of suspended sediment on Pacific lamprey under the No Action/No Project Alternative and existing conditions are described in Appendix E, Section E.3.1.5. Overall, under both normal and extreme conditions, Pacific lamprey are anticipated to suffer from stressful levels of suspended sediment while rearing and migrating through the mainstem Klamath River, with exposure durations generally much longer under extreme conditions. Because there are multiple year-classes of lamprey in the mainstem Klamath River at any given time, and since adults may migrate upstream throughout the year, Pacific lamprey populations may be well-adapted to persisting through years when suspended sediment concentrations are high, especially since they remain within the sublethal range.

The effects of dams and reservoirs would continue to affect water quality downstream of Iron Gate Dam under the No Action/No Project Alternative, which may reduce habitat quality for spawning and rearing Pacific lamprey, as well as reproductive success. Stone et al. (2002) found dissolved oxygen to be positively associated with lamprey presence at the reach scale ( $P = 0.0002$ ). Meeuwig et al. (2005) reported that survival of larval Pacific lamprey under laboratory conditions was optimal at 18°C, but declined sharply at 22°C, with eggs and larvae at these higher temperatures also exhibiting deformities. Under

existing conditions and the No Action/No Project Alternative water quality would improve through TMDL implementation, but would be offset by warming expected as a result of climate change.

Flow management under a No Active/No Project Alternative would continue to modify temperature and instream flow patterns from pre-project conditions. Movements of adult, ammocoete, and macrophthalmia Pacific lamprey life stages tend to occur in association with discharge, while temperature and day length may be of less importance as life-history cues (Stone et al. 2002, Luzier et al. 2009). Stone et al. (2002) observed downstream migration of macrophthalmia (juvenile phase) in Cedar Creek in association with summer low flows, with larger ammocoetes also moving downstream during this period as well, indicating that such movements were voluntary. In contrast, Beamish and Levings (1991, as cited in Stone et al. 2002) found that macrophthalmia downstream movements to be associated with high flows, but also observed greater downstream movement of larger, older ammocoetes during these periods.

High discharge appeared to result in involuntary downstream displacement of ammocoetes (especially of smaller individuals) and macrophthalmia outside of their normal migration period, which may reduce survival (Stone et al. 2002).

Under the No Action/No Project Alternative, Pacific lamprey populations in the Klamath Basin may remain at current levels or population numbers may continue to decline over the long term (Close et al. 2010). Because so little is known of Pacific lamprey life history and habitat requirements compared to those of anadromous salmonids, it is more difficult to predict the potential effects of alternatives on their abundance and distribution. **The effect of the No Action/No Project Alternative would be no change from existing conditions for Pacific lamprey in the short and long term.**

**Green Sturgeon** Green sturgeon spend a majority of their lives in estuaries, bays, and nearshore waters, with adults only returning to fresh water to spawn after more than 15 years, and spawning every four years on average (Klimley et al. 2007). In the Klamath River mainstem, green sturgeon spawn and rear in the lower 67 miles, downstream of Ishi Pishi Falls.

The Klamath Basin supports the largest spawning population of Northern Green Sturgeon (Moyle 2002), so it plays a critically important role in the viability and persistence of the entire DPS. Concentration of spawning to only a very few areas renders these spawning populations vulnerable to local catastrophic impacts. A loss of any of the few spawning areas would have much greater effects than the loss of a spawning population of salmon that spawn in other streams throughout their range.

Under the No Action/No Project Alternative, temperatures in the lower Klamath River in dry years may be reducing reproductive success of green sturgeon (Van Eenennaam et al. 2005). Studies conducted by Van Eenennaam et al. suggest that temperatures above 17–18°C are suboptimal for hatching and embryonic development, with temperatures from

23°C to 26°C resulting in 100% pre-hatching mortality. Cech et al. (2000) put the lethal temperature for embryos at 20°C.

Effects of suspended sediment on green sturgeon under the No Action/No Project Alternative and existing conditions are described in Appendix E. Overall, under existing conditions and the No Action/No Project Alternative, green sturgeon in the Klamath River mainstem are regularly exposed to suspended sediment concentrations documented to cause major physiological stress, reduced growth, and mortality in other fish species, especially during their egg and larval stages, and the year-round juvenile rearing period. However, these metrics likely overestimate effects on sturgeon.

Under the No Action/No Project Alternative, changes in the timing and magnitude of high flows downstream of Iron Gate Dam that are related to hydroelectric project operations have the potential to reduce green sturgeon survival in the mainstem. Adult green sturgeon that have held over the summer in the river after spawning appear to migrate downstream in conjunction with increases in discharge in the fall. Attenuation of high flows downstream of Iron Gate Dam may affect a key environmental cue used to stimulate the fall outmigration of adult green sturgeon that have remained in holding pools over the summer (Benson et al. 2007). This lower portion of the river was quite responsive to discharge increases related to rainfall events; the timing of peak flows changed significantly following the construction of the Four Facilities (Balance Hydrologics Inc. 1996). Under existing conditions, the Four Facilities result in higher flows in October compared with historically, and lower flows in late spring and summer (Balance Hydrologics Inc. 1996). Because temperatures in the lower river are close to lethal for eggs and embryos in dry years, reductions in flows related to the Four Facilities may exacerbate the effects of temperature on reproductive survival in these years, as would any temperature increases occurring as a result of climate change in the future. Shifts in the timing of seasonal life-history cues could also affect survival rates by changing the timing of their entry into habitats, such as entry of juveniles into the estuary.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for green sturgeon in the short and long term.**

**Lost River and Shortnose Sucker** Upper Klamath Lake, one of the primary habitats of Lost River and shortnose suckers, has long been recognized as eutrophic, characterized by extremely high temperatures and pH in the summer, accompanied by huge daily fluctuations in dissolved oxygen and high ammonia concentrations. Although eutrophic conditions in Upper Klamath Lake have caused fish die-offs since the late 1800s, these have become more frequent and severe in recent years, with chubs and suckers being perhaps the hardest hit species (Perkins et al. 2000, Buchanan et al. 2011a, as cited in Hamilton et al. 2011). Upper Klamath Lake inflows and outflows have declined since the 1960s while demand for water has increased for both agriculture and endangered fish species recovery. Along with direct mortality, poor water quality in Upper Klamath Lake affects endangered sucker species through suppressing growth, reducing resistance to disease and parasites, and reducing reproductive success.

Under current conditions, suckers in reaches of the Four Facilities suffer mortality by entrainment in hydroelectric project turbines (Gutermuth et al. 2000). (Partially effective fish screens at J.C. Boyle facility would continue to contribute to entrainment (Administrative Law Judge 2006)). Suckers would continue to be stranded due to Four Facilities operations and peaking.

Reservoir sucker populations are not believed to be self-sustaining or to contribute to populations upstream; but, under the No Action/No Project Alternative, they would persist, providing some additional insurance, no matter how small, that fish would be available for recolonization efforts if for some reason their primary populations underwent catastrophic decline. This would only be feasible with a species of this type, which is extremely long-lived.

Shortnose and Lost River suckers would continue to be subject to poor water quality within reservoirs. But with little or no successful reproduction (Buettner et al. 2006), populations downstream of Keno Dam contribute minimally to conservation goals and insignificantly to recovery (Hamilton et al. 2011).

Under the No Action/No Project Alternative, existing efforts to restore habitat for shortnose and Lost River sucker and improve water quality conditions would continue. These actions would be expected to improve conditions for these species over time and their populations would be expected to increase. **The effect of the No Action/No Project Alternative would be no change from existing conditions for Lost River and shortnose sucker populations in the short and long term.**

**Redband Trout** Resident trout upstream of Iron Gate Dam are considered to be redband trout. Before construction of the Four Facilities, redband trout in the area belonged to one population, with no migration barriers isolating populations from one another (Administrative Law Judge 2006). Under the No Action/No Project Alternative, genetic exchange and movement between reaches would continue to be limited by the J.C. Boyle fish ladder (Administrative Law Judge 2006) and lack of fish ladders at the Copco 1 and 2 Dams, as will access to productive spawning habitat in Spencer Creek by redband trout in the J.C. Boyle Bypass and Peaking Reaches (Administrative Law Judge 2006). The isolation of this population into several smaller subpopulations renders each more vulnerable to extinction due to stochastic events (wildfire, landslides, disease outbreaks, etc.) and limits genetic exchange among subpopulations.

Redband trout populations in the Four Facilities reaches and reservoirs are isolated from the larger populations upstream of Upper Klamath Lake, such as in the Williamson and Wood Rivers; no natural recruitment from the upper basin to populations in project-affected reaches can occur, as may have occurred historically.

Under the No Action/No Project Alternative, water quality in the Keno Reach would continue to be influenced by Keno Impoundment upstream. In the summer, problems with low dissolved oxygen, high nutrients, and warm temperatures (occasionally exceeding 21°C) may increase physiological stress on redband trout, making them more

vulnerable to mortality from other stressors. Measures implemented to meet TMDL targets would likely improve water quality in this area to some degree.

Under the No Action/No Project Alternative, habitat connectivity for redband trout in the Klamath River would continue to be compromised by structural features of the Four Facilities as well as project operations. Fish downstream of J.C. Boyle Dam would continue to be hindered or obstructed from migrating to spawning grounds in Spencer and Shovel creeks by requiring them to ascend a fish ladder at J.C. Boyle Dam (USFWS and ODFW 2004, as cited in Hamilton et al. 2011). Factors influencing their movements include the necessity of passage at the J.C. Boyle Dam fish ladder as well as stresses resulting from power peaking operations downstream of the dam. Migration over the Copco 1 and 2 Dams is in the downstream direction only, as there is no fishway at this project feature.

The lack of functioning fish screens at Iron Gate, Copco 1 and 2 Dams minimizes recruitment of redband trout to downstream reaches, another factor adding to isolation of subpopulations in the Four Facilities area. At the J.C. Boyle facility, the partially effective fish screens would continue to contribute to entrainment (Administrative Law Judge 2006). The use of a Francis turbine at the J.C. Boyle facility would result in high mortality rates for fish that are entrained by it (EPRI 1987).

The health and productivity of redband trout in the J.C. Boyle Peaking Reach and J.C. Boyle Bypass Reach would continue to be affected under the No Action/No Project Alternative. Obstruction of sediment transport at J.C. Boyle Dam has altered substrates and channel features in the peaking and bypass reaches. High flows have mobilized and removed sediment from storage sites and transported them downstream, reducing habitat quality for redband trout as well as for the macroinvertebrates they feed on. In the J.C. Boyle Peaking Reach, redband trout numbers would continue to be subject to large fluctuations in flows that: (1) cause fluctuations in water temperature and pH, (2) strand fish, (3) displace fish downstream, (4) reduce fry habitat along channel margins, (5) reduce access to suitable gravels where they are affected by flow fluctuations, and (6) reduce macroinvertebrate food production by reducing the area of the channel suitable for their survival (City of Klamath Falls 1986, Addley et al. 2005, as cited by Hamilton et al. 2011). All of these conditions could result in substantial declines in redband trout abundance in this reach.

Diversion of water at Keno Diversion Dam would continue to alter flows downstream, reducing base flows in the summer when water quality is a concern, and reducing the magnitude and frequency of high flows important for creating and maintaining physical and ecological processes that affect habitat for trout, their macroinvertebrate food, and other aquatic organisms. Productivity of redband trout in the bypass and peaking reaches would continue to be suppressed by Four Facilities effects that limit spawning and rearing habitat in these reaches (Hamilton et al. 2011). Under existing conditions, spawning of redband trout in the Bypass Reach appears limited to an area just downstream of the emergency canal spillway (Hamilton et al. 2011). Patches of gravel that might otherwise be suitable for spawning are rendered inaccessible to redband trout

by reductions in instream flows (FERC 1990, ODFW 2003, Administrative Law Judge 2006, all as cited in Hamilton et al. 2011).

Reduced redband trout abundance and distribution upstream of Iron Gate Dam attributable to Four Facilities features and operations would continue under the No Action/No Project Alternative. Habitat connectivity and suitability are substantially reduced in some reaches, which also suppresses the full range of life-history options formerly available to them. Other features of the redband trout populations in these reaches would likely be sustained under the No Action/No Project Alternative, such as declines in size (Jacobs et al. 2008, as cited in Hamilton et al. 2011) and condition factor (ODFW 2003, as cited in Hamilton et al. 2011).

**The effect of the No Action/No Project Alternative would be no change from existing conditions for redband trout in the short and long term.**

**Bull Trout** The distribution and numbers of bull trout are believed to have declined in the Klamath Basin due to habitat isolation, loss of migratory corridors, poor water quality, and the introduction of nonnative species. The geographic isolation of the Klamath populations places them at greater risk of genetic effects and extirpation (NRC 2004).

**The effect of the No Action/No Project Alternative would be no change from existing conditions for bull trout in the short and long term.**

**Eulachon** The southern population of Pacific eulachon consists of populations spawning in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NOAA Fisheries Service 2009a). On March 18, 2010, NOAA Fisheries Service listed the southern DPS of eulachon as threatened under the ESA (NOAA Fisheries Service 2010b). The Klamath River is near the southern limit of the range of eulachon (Hubbs 1925, Schultz and DeLacy 1935, both as cited in BRT 2010). Large spawning aggregations of eulachon historically occurred regularly in the Klamath River (Fry 1979; Moyle et al. 1995; Larson and Belchik 1998; Moyle 2002; Hamilton et al. 2005; Wallace, pers. comm., 2011). However, CDFG did not capture any eulachon in the Klamath River from 1989 to 2003 (Wallace, pers. comm., 2011), and clearly they are in decline.

Under the No Action/No Project Alternative, habitat conditions in the estuary for eulachon would remain the same as they are under existing conditions. However, very little is known about the factors leading to decline of the eulachon.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for eulachon in the short and long term.**

**Longfin Smelt** Longfin smelt are a state-listed threatened species throughout their range in California (CDFG 2009), but the USFWS denied the petition for federal listing because the population in California (and specifically San Francisco Bay) was not believed to be sufficiently genetically isolated from other populations (USFWS 2009).

The importance of ocean rearing is unknown. Little is known about longfin smelt populations in the Klamath River, except that they are presumably small.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for longfin smelt in the short and long term.**

**Introduced Resident Species** Introduced resident species occur in Lake Ewauna, Upper Klamath Lake, within reservoirs upstream of Iron Gate Dam, and infrequently downstream of Iron Gate Dam. Under the No Action/No Project Alternative, conditions favorable for introduced species would continue to occur within the Four Facilities reservoirs (Buchanan et al. 2011a). Because these species were introduced and they occur in other nearby water bodies, their abundance is not considered a benefit from a biological perspective.

**The effect of the No Action/No Project Alternative would be no change from existing conditions for introduced resident species in the short and long term.**

**Freshwater mussels** Of the freshwater mussel species found on the mainstem Klamath River, the western ridge freshwater mussel (*G. angulata*) seems to be the most abundant and is widely distributed between Iron Gate Dam and the confluence of the Trinity River (Westover 2010). The floater species (*Anodonta spp.*) are less abundant, with the largest single bed found immediately below Iron Gate Dam (Westover 2010). The western pearlshell (*Margaritifera falcata*) is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found below the confluence of the Salmon River (Westover 2010).

**The effect of the No Action/No Project Alternative would be no change from existing conditions for freshwater mussels in the short and long term.**

**Benthic Macroinvertebrates** **The effect of the No Action/No Project Alternative would be no change from existing conditions on macroinvertebrates in the short and long term.**

#### **Interim Measures**

*Implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement could result in alterations to habitat availability and habitat quality, and affect aquatic species.* Under this IM, suitable spawning gravel would be placed in the J.C. Boyle Bypass and Peaking Reaches beginning in the fall of 2011 for one year (it is assumed that work would cease in the event of a Negative Determination). This IM would involve placing gravel using a passive approach before high flow periods, or developing other habitat enhancement measures to provide equivalent fishery benefits in the Klamath River upstream of Copco Reservoir. These actions would provide improvements in habitat quality for resident fish prior to dam removal, and for resident and anadromous species following dam removal. **Based on anticipated improvements in habitat availability and habitat quality, implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement in the fall of 2011 under the No Action/No Project Alternative would**

**be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. These actions would also be beneficial for coho salmon from the Upper Klamath River Population Unit, and less-than-significant for all other population units in the basin. Effects on bull trout, freshwater mussels, shortnose and Lost River suckers would be less-than-significant. Effects on green sturgeon, eulachon, and Southern Resident Killer Whales would not change from existing conditions.**

*Implementation of J.C. Boyle Bypass Barrier Removal could result in alterations to habitat availability, and affect aquatic species.* Under this IM, the sidecast rock barrier located approximately three miles upstream of the J.C. Boyle Powerhouse in the J.C. Boyle Bypass Reach would be removed. The objective of this IM is to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead, Pacific lamprey, and redband trout. This action would provide improvements in habitat availability for resident fish prior to dam removal, and for resident and anadromous species following dam removal. **Based on anticipated improvements in habitat availability, implementation of J.C. Boyle Bypass Barrier Removal under the No Action/No Project Alternative would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, and redband trout. These actions would also be beneficial for coho salmon from the Upper Klamath River Population Unit, and less-than-significant for all other population units in the basin. Effects on bull trout, shortnose and Lost River suckers would be less-than-significant. Effects on macroinvertebrates, freshwater mussels, green sturgeon, eulachon, and Southern Resident Killer Whales would not change from existing conditions.**

#### **Alternative 2: Full Facilities Removal of Four Dams (the Proposed Action)**

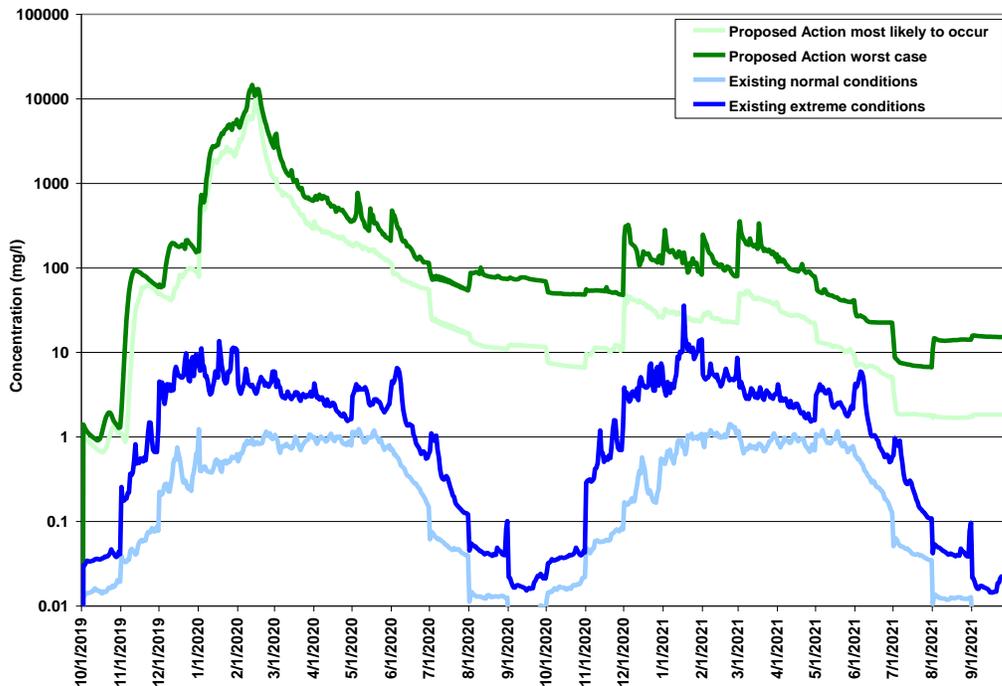
This alternative includes the removal of the Four Facilities along with the ancillary facilities of each installation in a 20-month period which includes an 8-month period of site preparation and partial drawdown at Copco 1 and a 12-month period for full drawdown and removal of facilities. This includes the entire dam, the powerhouses, spillways, and other infrastructures associated with the power generating facilities, as well as the transfer of the Keno Dam facilities to the DOI, and the implementation of the KBRA. The Proposed Action would result in effects on key ecological attributes that could affect aquatic resources, as summarized below. More detailed technical descriptions of the effects on suspended sediment, bedload sediment, and potential impacts on aquatic species, can be found in Appendices F and G.

#### **Key Ecological Attributes**

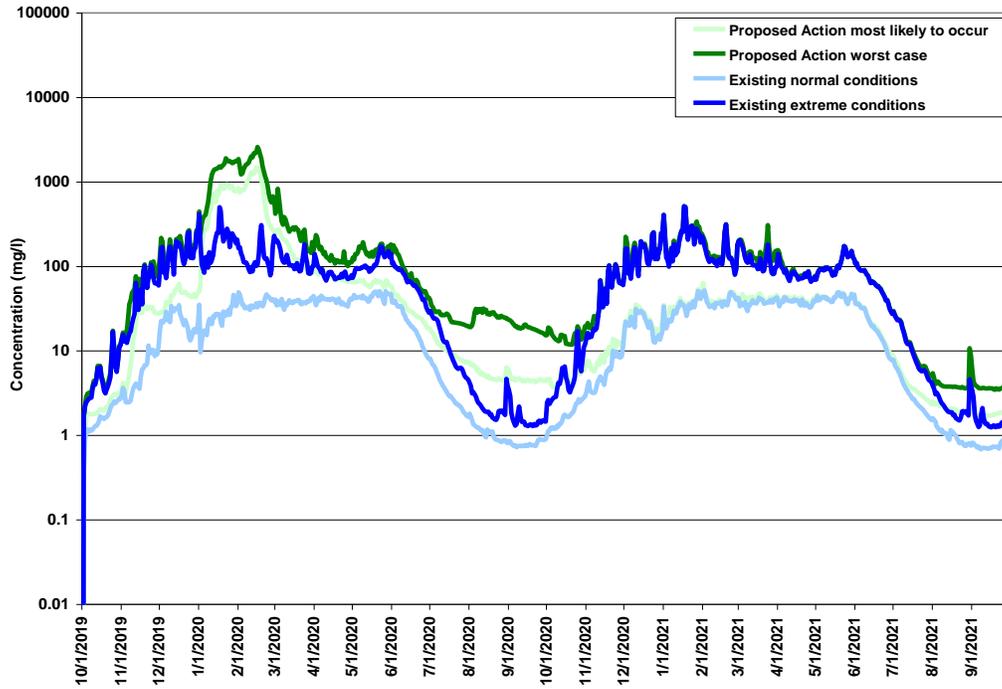
##### **Suspended Sediment**

**Lower Klamath River: downstream of Iron Gate Dam** Under the Proposed Action, full facility removal would result in the release of 5.3 to 8.6 million yd<sup>3</sup> of sediment stored in the reservoirs into the Klamath River downstream of Iron Gate Dam (Reclamation 2011), resulting in higher SSCs than would normally occur under existing conditions (Figure 3.3-5). SSCs would begin to increase during reservoir drawdown, prior to the deconstruction of the dams and continue to rise through the spring runoff period as material behind the dams is mobilized downstream. Reservoir drawdown is

expected to commence in November 2019 for Copco Reservoir and in December 2019 for J.C. Boyle and Iron Gate Reservoirs. Based on the suspended sediment modeling conducted to analyze each alternative (including facility removal) (Reclamation 2011), SSCs are expected to exceed 1,000 mg/L for weeks, with the potential for peak concentrations exceeding 5,000 mg/L for hours or days, depending on hydrologic conditions during facility removal. At Iron Gate Dam (Figure 3.3-5), where SSCs are artificially low under current conditions (because of sediment trapping by the dam) SSCs would remain elevated above existing conditions throughout the first 2 years. At Orleans (Figure 3.3-6), where SSC under existing conditions is higher because of inputs of many tributaries, under a most-likely-to-occur scenario the effects of the Proposed Action would be similar to existing conditions by late April when releases of SSC from the Proposed Action are predicted to decrease. Under extreme conditions, SSCs are projected to remain somewhat elevated above existing conditions until October.

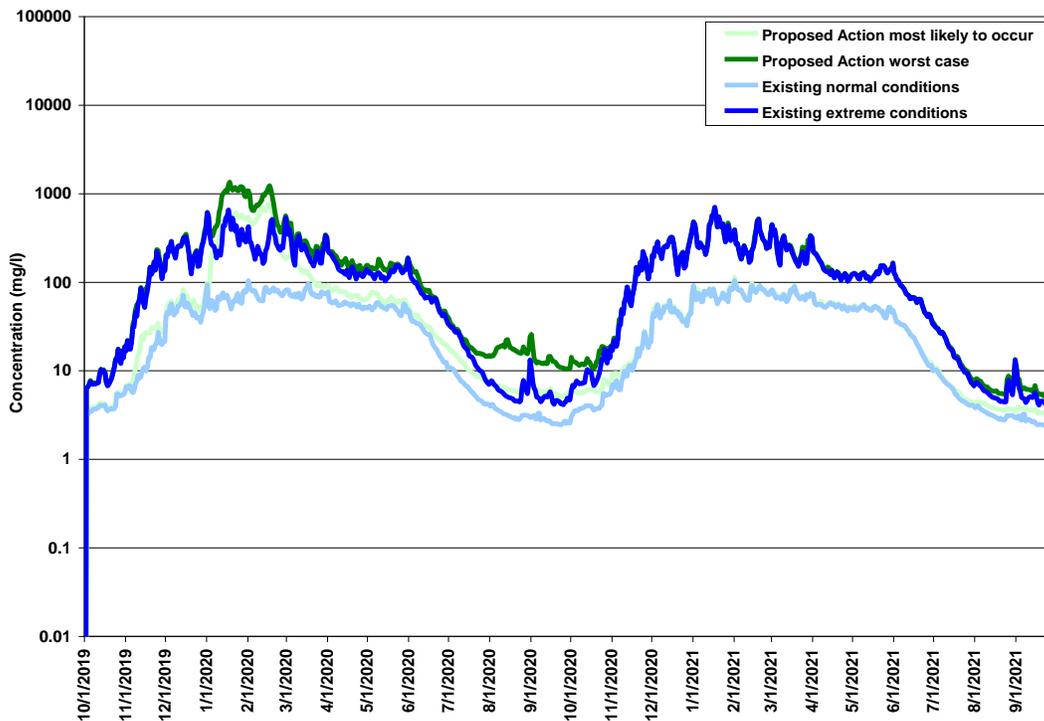


**Figure 3.3-5. Comparison of SSCs under Proposed Action and Existing Conditions at Iron Gate Dam, as Predicted Using SRH-1D Model.**



**Figure 3.3-6. Comparison of SSCs under Proposed Action and Existing Conditions at Orleans, as Predicted Using SRH-1D Model.**

**Klamath River Estuary and Pacific Ocean** Under the Proposed Action, sediment would be released from Iron Gate Dam, and would decline in concentration in the downstream direction as a result of dilution by input from downstream tributaries. Also, SSCs under existing conditions at Klamath Station are higher than at the upstream sites as a result of sediment input from tributaries. As a result, the difference of SSCs from the Proposed Action relative to existing conditions would be smallest in the Klamath River Estuary (Figure 3.3-7). The SSCs under the most-likely-to-occur scenario would be similar to those that occur under existing extreme conditions, and so resemble those that would be expected to occur about 1 year in 10 on average. Under the worst-case simulation, SSCs concentrations are only marginally higher than those for the existing extreme conditions. Therefore, effects on aquatic species from SSCs within the estuary are not anticipated to be distinguishable from existing conditions.



**Figure 3.3-7. Comparison of SSCs under Proposed Action and Existing Conditions at Klamath Station, as Predicted Using SRH-1D Model.**

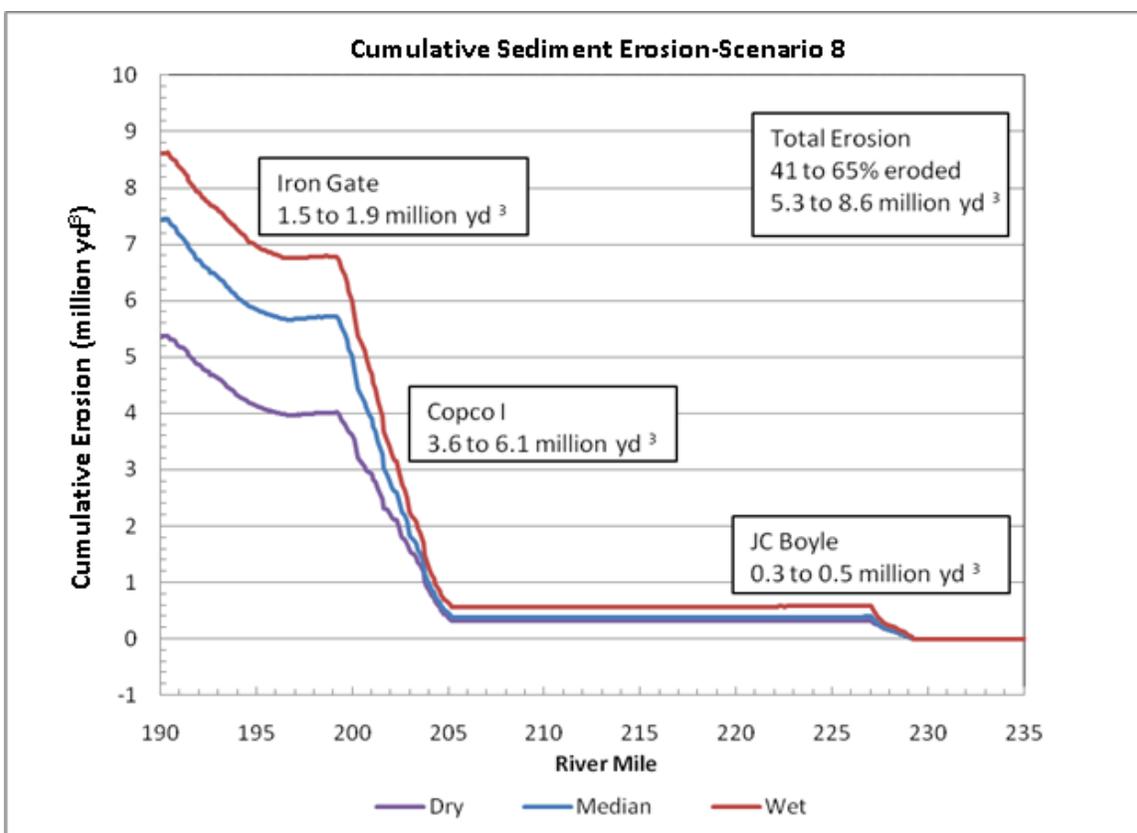
**Pacific Ocean Nearshore Environment** In contrast to the lower Klamath River, modeled short-term SSCs following dam removal are not available for the nearshore marine environment adjacent to the Klamath River. Substantial dilution of the high (>1,000 mg/L) mainstem river SSCs is expected to occur in the nearshore under the Proposed Action; based on data from 110 coastal watersheds in California, where nearshore SSCs were measured at >100 mg/L during the El Nino winter of 1998 (Mertes

and Warrick 2001), peak SSCs leaving the Klamath River Estuary may be diluted by 1 to 2 orders of magnitude from >1,000 mg/L to >10-100 mg/L. Based on the modeled SSCs at Klamath Station presented above, the SSCs in the nearshore ocean would be expected to be similar to what would occur during existing extreme conditions. Overall, any SSCs elevations associated with the Proposed Action are not anticipated to have effects on species distinguishable from existing conditions.

**Bedload Sediment**

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

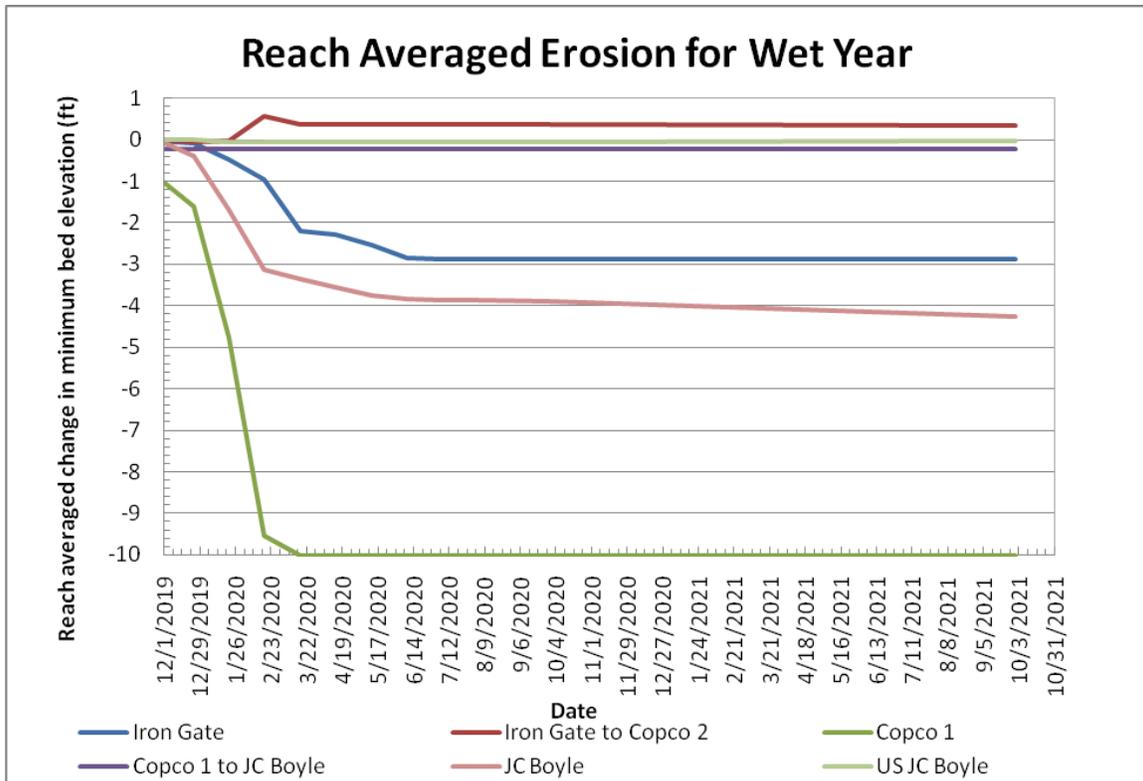
Dams in the Hydroelectric Reach currently store 13,150,000 yd<sup>3</sup> of sediment (Reclamation 2011). No sediment is stored within the Copco 2 Reservoir, Copco 1 Reservoir stores the greatest amount, and J.C. Boyle Reservoir stores the least. The SRH-1D model estimated 41 to 66 percent (5.3 to 8.6 million yd<sup>3</sup>) of dam-stored sediment would be eroded the first year after dam removal depending on simulation type (wet, median, or dry) (Figure 3.3-8). Of this sediment, about 15 percent would be transported as bedload. Sediment not eroded from the reservoirs during the first year would be stored in gravel bars and terraces, and released more slowly through surficial and fluvial processes (Stillwater Sciences 2008).



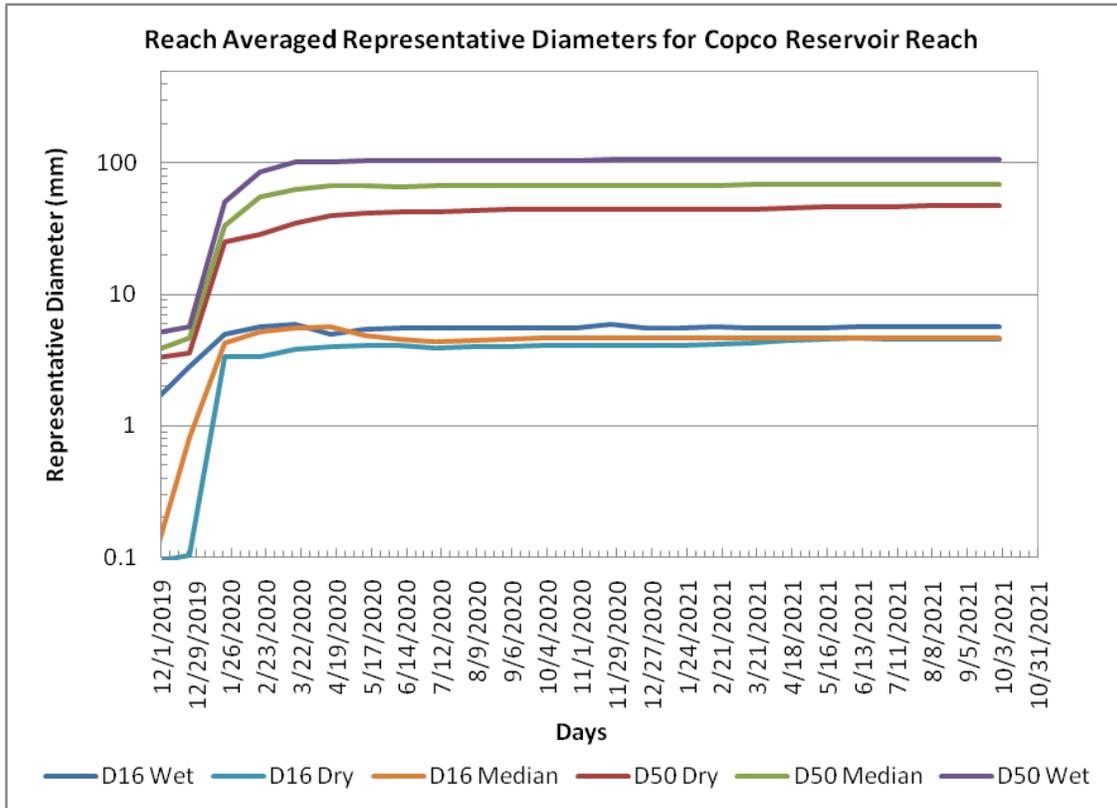
**Figure 3.3-8. Cumulative Sediment Erosion from Dams in the Hydroelectric Reach During 2020 Drawdown Beginning in January (Reclamation 2011).**

SRH-1D model results indicate decreases in bed elevation and increases in median substrate size within the reservoirs during drawdown (January 2020 to May 2020) (Figure 3.3-9 and Figure 3.3-10). These changes would stabilize within 5 months as the bed within the historical river channel reaches pre-dam elevations (Reclamation 2011; B. Greimann, pers. comm., December 23, 2010). These river sections are expected to revert to and maintain a pool-riffle morphology due to restoration of riverine processes along the Hydroelectric Reach (PacifiCorp 2004a). Still, after dam removal, channels currently inundated by reservoirs would likely vary from narrow, single-threaded channels to wide and sinuous channels with the potential to form complex features, such as meander cut-offs and vegetated islands (Reclamation 2011).

The river reaches upstream of J.C. Boyle Reservoir and from Copco 1 Reservoir to J.C. Boyle Dam show little change in bed composition or median substrate size during drawdown (Figure 3.3-10) (Reclamation 2011). Currently, these reaches are predominantly cobble (90 percent) with small fractions of gravel and sand. Very little temporal change in substrate size would be expected to occur in response to dam removal (Appendix E).



**Figure 3.3-9. Reach-Averaged Erosion in the Hydroelectric Reach during Wet Year (Reclamation 2011).**

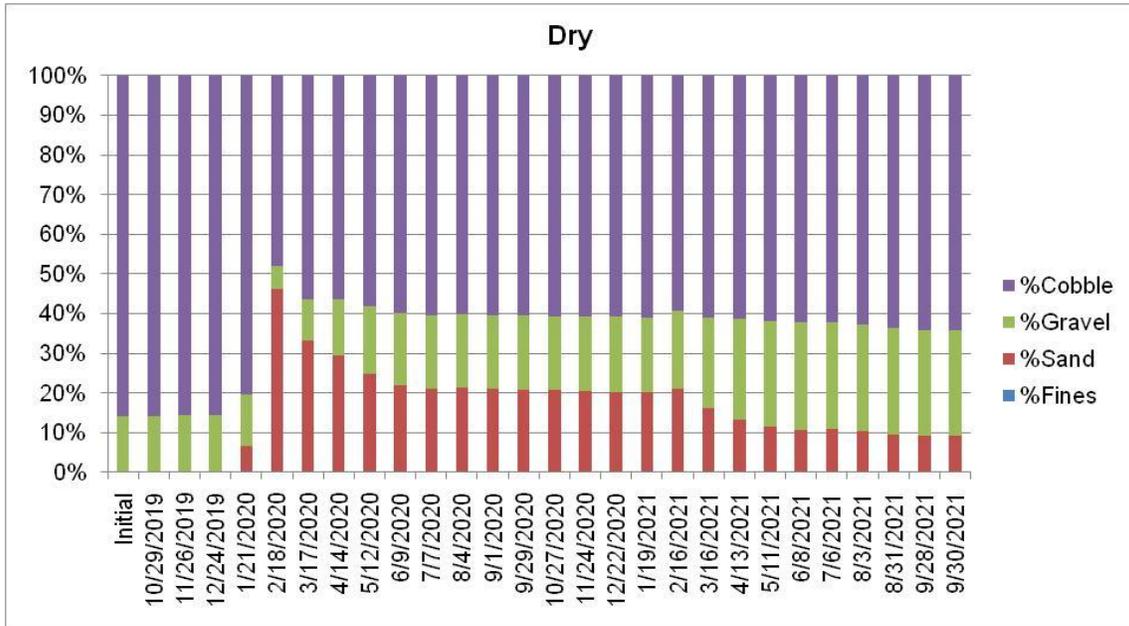


**Figure 3.3-10. Reach-Averaged D16 and D50 in Copco 1 Reservoir Reach Following Dam Removal (Reclamation 2011).**

The Copco 2 Dam to Iron Gate Reservoir reach shows increases in the proportion of sand to 35 to 45 percent shortly after drawdown (from January 2020 to February 2020) (Figure 3.3-11). In the dry simulation, the percent sand decreases to 20 percent from April 2020 to February 2021, then again to 10 percent from February 2021 to the end of the simulation.

**Lower Klamath River: Downstream of Iron Gate Dam** The streambed downstream of Iron Gate Dam would be affected by dam-released sediment and reconnection of the natural sediment supply from upstream. The sediment stored within the reservoirs has a high water content and 85 percent of the particles are silts and clays (less than 0.063 mm) while 15 percent are sand or coarser (larger than 0.063 mm) (Gathard Engineering Consulting 2006; Stillwater Sciences 2008; Reclamation 2011). As such, most sediment eroded from the reservoirs would be silt and clay (less than 0.063 mm) with smaller fractions of sand (0.063 to 2 mm), gravel (2 to 64 mm), and cobble (64 to 256 mm) (Gathard Engineering Consulting 2006; Stillwater Sciences 2010a; Reclamation 2011). A large portion of the silt and finer substrate would likely be transported as suspended

sediment and would travel to the ocean shortly after being eroded and mobilized (Stillwater Sciences 2010a). Coarser (larger than 0.063 mm) sediment, including sand, would travel downstream more slowly, attenuated by channel storage and the frequency and magnitude of mobilization flows. The amount of sand transported in suspension would vary with discharge, with greater proportions of sand in suspension at higher discharges. A substantial amount of sand may deposit on the channel, potentially embedding larger substrate.

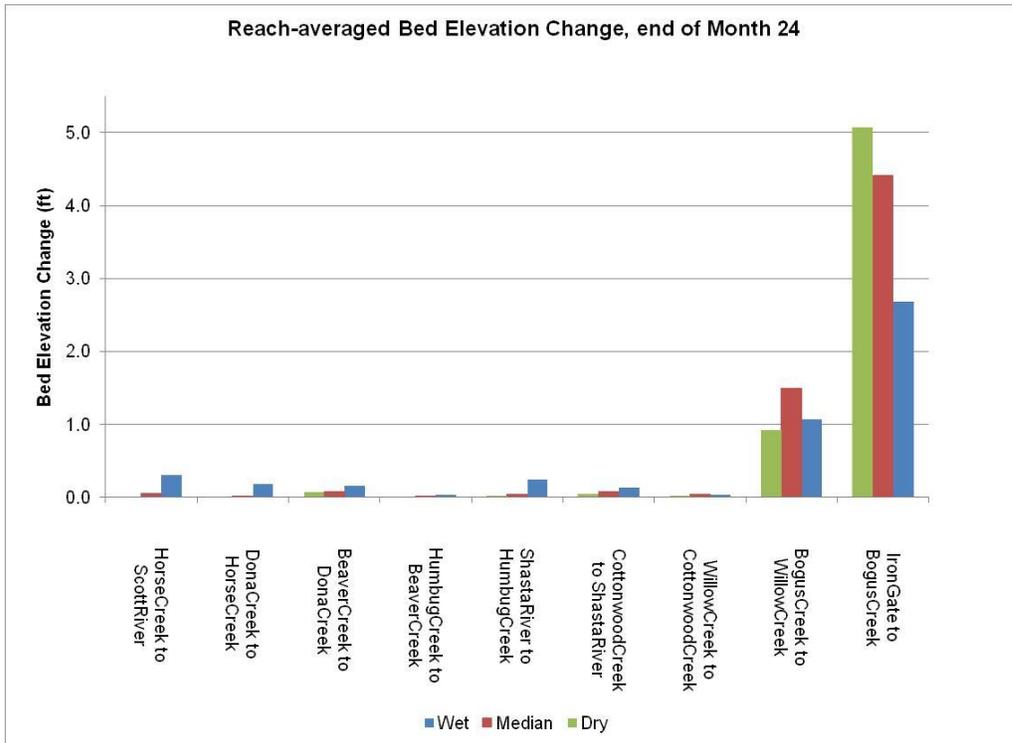


**Figure 3.3-11. Simulated Bed Composition from Copco 2 to Iron Gate Reservoirs during Two Successive Dry Water Years after Dam Removal.**

The effect of dam-released sediment and sediment resupply would likely extend from Iron Gate Dam to Cottonwood Creek (Reclamation 2011). Estimates of reach-averaged stream power (the ability of the river to move sediment) show a decrease from Iron Gate Dam to Cottonwood Creek, with stream power then increasing again downstream of Cottonwood Creek. The increase suggests that short- or long-term sediment deposition, either from dam release or sediment resupply, is unlikely downstream of Cottonwood Creek. Using this point as the downstream extent of bedload-related effects, 8 miles of channel could be affected by sediment release and resupply. The affected channel represents 4 percent of the total channel length of the mainstem Klamath River downstream of Iron Gate Dam (190 miles).

Short-term (2-year) SRH-1D model simulations estimate up to 5 feet of reach-averaged deposition of fine and coarse sediment between Iron Gate Dam and Bogus Creek (RM 189.8) (2.5 to 5 feet), decreasing to 1.0 to 1.5 feet of deposition between Bogus Creek and Willow Creek (RM 185.2), while reaches farther downstream showed no apparent increase (Figure 3.3-12, Reclamation 2011).

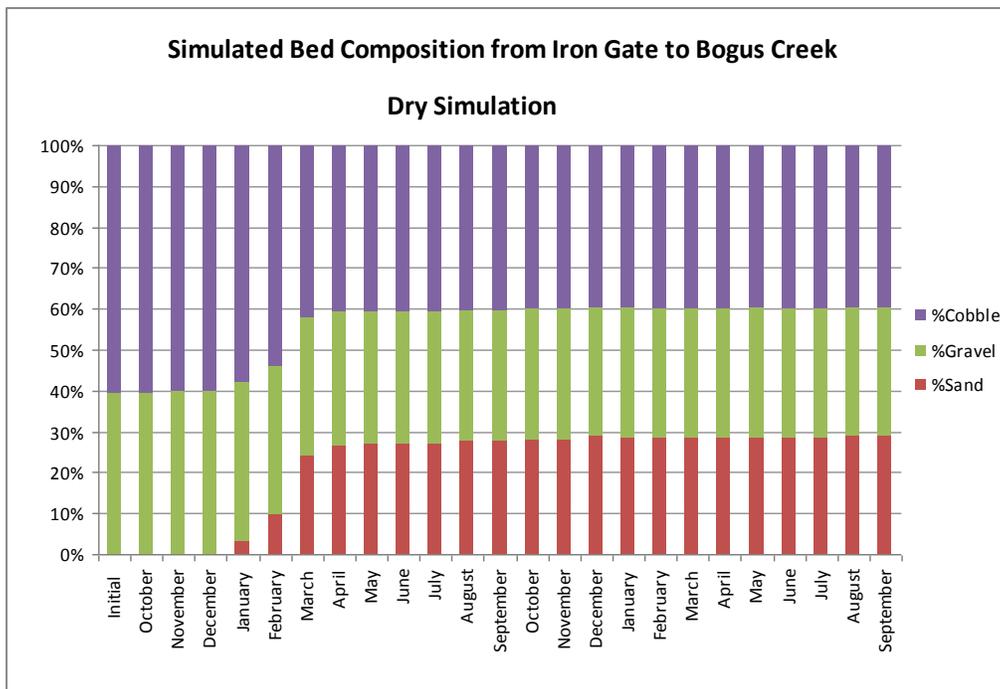
Reach averaged bed elevation between Iron Gate Dam to Bogus Creek would increase by 5 feet after drawdown (January 2020) until March 2020 under dry and median simulations, and would increase by 3 feet after drawdown until April 2020 under the wet simulation (Figure 3.3-12). Elevations under the dry and median simulation would be expected to approach a level similar to the wet simulation (3 feet) over time as flows carry dam released sediment downstream directly below Iron Gate Dam. In the long-term (from 5 to 50 years), after downstream translation of dam released sediment, bed elevation would adjust to a new equilibrium, which includes sediment supplied by upstream tributaries that was formerly trapped by dams within the Hydroelectric Reach. The average bed elevation increase predicted over the next 50 years is 1.5 ft in the reach from Bogus to Willow Creek and less than 1 foot downstream from there (Reclamation 2011). In the long-term (from 5 to 50 years), after downstream translation of dam released sediment, bed elevation would adjust to a new equilibrium, which includes sediment supplied by upstream tributaries that was formerly trapped by dams within the Hydroelectric Reach. Reclamation (2011) expects 2 to 3 feet of aggradation between Iron Gate Dam and Cottonwood Creek over the next 50 years.



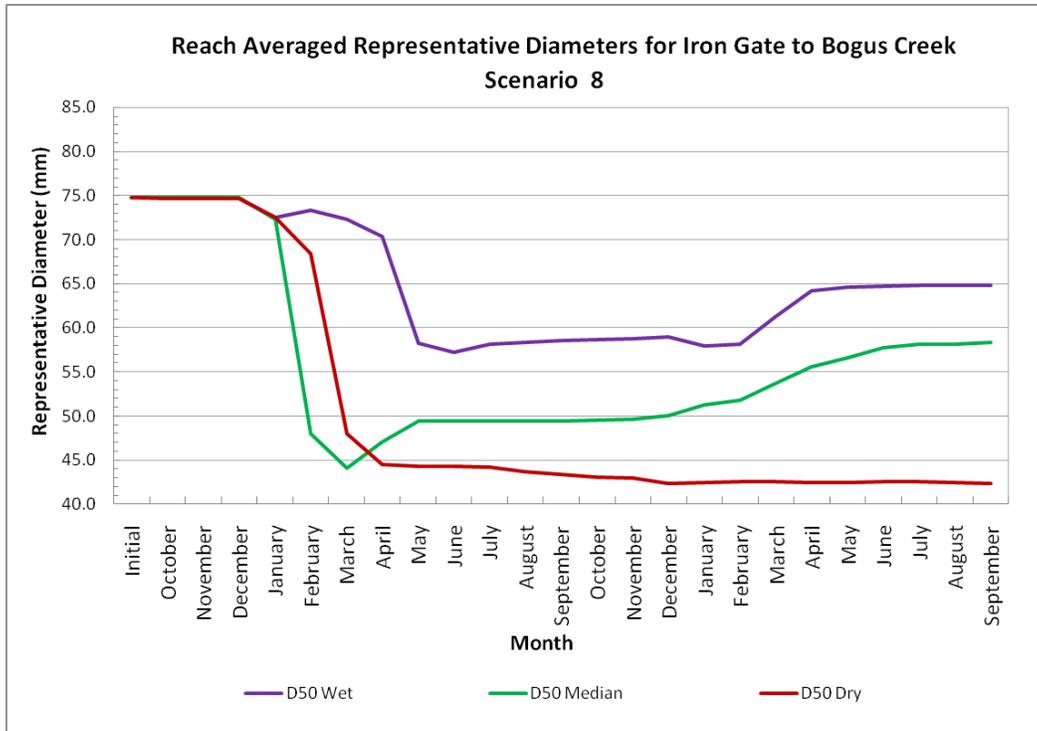
**Figure 3.3-12. Reach Averaged Bed Elevation during Two Successive Wet, Median, or Dry Water Years from Iron Gate Dam to Bogus Creek (Reclamation 2011).**

In the short-term (within 2 years), SRH-1D model output indicates dam released sediment and sediment resupply would increase the proportion of sand in the bed and decrease median bed substrate size (Figure 3.3-13 and Figure 3.3-14) (Reclamation 2011). The model predicts that after two successive dry years, the proportion of sand on the bed would increase to 30 percent and median substrate size would decrease to 45 mm after drawdown in January 2020 to March 2020 and remain at these values though to September 2021. Longer-term (5, 10, 25, and 50 years) simulations show increases in the proportion of sand to 5 to 22 percent and decreases in D50 to approximately 50 to 55 mm (Appendix E) after 5 years that stabilize and continue through to year 50.

Under the Proposed Action, sediment mobilization flows would decrease from existing conditions. Reclamation (2011) estimated the magnitude and return period of flows required to mobilize sediment downstream of Iron Gate Dam 50 years after dam removal using reach averaged, predicted grain sizes from long-term SRH-1D simulations. The estimates show that under the Proposed Action, sediment mobilization flows from Bogus Creek to Willow Creek and from Willow Creek to Cottonwood Creek would range from 3,000 to 7,000 cfs (1.5 to 2.5 year return period) and 5,000 to 9,000 cfs (1.5 to 3.2 year return period), respectively, lower than existing conditions or the No Action/No Project Alternative (see Figure 3.3-4). Downstream of the Shasta River, there would be no difference in bed mobilization flows or return period between the Proposed Action and existing conditions or the No Action/No Project Alternative.



**Figure 3.3-13. Simulated Bed Composition from Iron Gate Dam to Bogus Creek during Two Successive Dry Water Years Dam Removal.**



**Figure 3.3-14. Simulated D50 (mm) from Iron Gate Dam to Bogus Creek during Successive Wet, Median, and Dry Water Years.**

Water Quality

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** The Proposed Action (independent of KBRA actions described below) would not affect water quality in the following areas of the Upper Klamath Basin: Wood, Williamson, and Sprague Rivers, Upper Klamath Lake, and Link River to the upstream end of J.C. Boyle Reservoir.

Water quality problems (e.g., excessive water temperatures) in the Keno Impoundment/Lake Ewauna during late spring, summer, and early autumn, led NOAA Fisheries Service and the DOI to prescribe interim trap-and-haul measures to transport juvenile and adult fish past Keno Impoundment/Lake Ewauna during periods when conditions would be harmful to salmonids. During most years, the Lake Ewauna Reach of the Klamath River (Link River Dam to Keno Dam) has dissolved oxygen concentrations greater than 6 mg/L from mid-November through mid-June; these measurements are within United States Environmental Protection Agency criteria for migrating adult anadromous salmonids for these months (DOI 2007). Interim, seasonal, upstream trap and haul for primarily fall-run adult Chinook salmon around the Keno Impoundment/Lake Ewauna would be necessary when dissolved oxygen and temperature exceed the United States Environmental Protection Agency criteria. Water quality would

be expected to improve over the long term through the implementation of the TMDL process (DOI 2007).

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** As described in Section 3.2, Water Quality, the Proposed Action could cause long-term overall increases in dissolved oxygen, as well as increased diel variability in dissolved oxygen, in the Hydroelectric Reach. Facility removal under the Proposed Action would cause slight long-term increases in summer and fall dissolved oxygen, increasing the likelihood of consistently supporting beneficial uses during this period.

California Klamath River TMDLs (NCRWQCB 2010) model results indicate that under the Proposed Action (analogous to the TMDL TOD2RN model run, which includes Oregon TMDL allocations), pH in the Hydroelectric Reach immediately downstream of J.C. Boyle Dam would be slightly less between March and May than pH levels modeled under the No Action/No Project Alternative (analogous to the TMDL T4BSRN model run). At the California-Oregon state line, pH under the Proposed Action would exhibit lower values April through June and October through December, with slightly more diurnal variation July through August than those predicted under the No Action/ No Project Alternative.

**Lower Klamath River: Downstream of Iron Gate Dam** Sediment release associated with the Proposed Action could cause short-term increases in oxygen demand and reductions in dissolved oxygen that could result in non-attainment of Basin Plan numeric water quality objectives for dissolved oxygen and contribute to reductions in beneficial uses in the lower Klamath River, the Klamath River Estuary, and the Pacific Ocean nearshore environment. As described in Section 3.2, Water Quality, model results indicate that short-term effects on dissolved oxygen would resolve well upstream of the Klamath River Estuary (at approximately 190 miles downstream of Iron Gate Dam) and, therefore, would not affect the Klamath River Estuary or the Pacific Ocean nearshore environment.

Overall, predicted short-term increases in oxygen demand and reductions in dissolved oxygen under the Proposed Action would not cause dissolved oxygen concentrations to fall below the minimum acceptable dissolved oxygen concentration (5 mg/L) for salmonids. However, short-term dissolved oxygen would fall below the Basin Plan numeric water quality objective (>8.1 to 8.8 mg/L) and would contribute to reductions in the most sensitive beneficial use (SPWN) for the mainstem river approximately 30 to 60 miles downstream of Hydroelectric Reach, or generally in the reach downstream of the Beaver Creek confluence and Seiad Valley.

Facility removal under the Proposed Action could cause long-term overall increases in dissolved oxygen, as well as increased diel variability in dissolved oxygen, in the lower Klamath River, particularly for the reach immediately downstream of Iron Gate Dam. Effects would diminish with distance downstream of Iron Gate Dam, such that no effects on dissolved oxygen would occur by the confluence with the Trinity River.

### Water Temperature

**Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir** This region is upstream of any proposed dam removal; therefore, the Proposed Action would not affect water temperature. Any changes in water temperature in this region would be a result of other factors, including climate change. The effects in this area would be similar to those described for the No Action/No Project Alternative.

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Under the Proposed Action, the Klamath River would no longer be dominated by hydropower peaking events and flows in the former Hydroelectric Reach would more closely mimic the natural hydrograph. The removal of the dams could also provide habitat for anadromous fish (Hetrick et al. 2009).

In the absence of the reservoirs, hydraulic residence time in this reach would decrease from several weeks to less than a day, and water quality would also be improved by nutrient assimilation in this reach (Hamilton et al. 2011). Evaporation from the surface of reservoirs (about 11,000 acre feet [Reclamation 2011]) would be reduced, adding to the river flow. The reservoir drawdowns would allow tributaries and springs such as Fall, Shovel, and Spencer Creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). Water quality conditions would also improve further downstream in the Hydroelectric Reach. From Copco 1 to Iron Gate Reservoir, removal of the Four Facilities would result in a 2-10°C decrease in water temperatures during the fall months and a 1-2.5°C increase in water temperatures during spring months (PacifiCorp 2004a, Dunsmoor and Huntington 2006, NCRWQCB 2010a, Perry et al. 2011; see also Section 3.2.4.3.2.1), an increase dissolved oxygen concentrations (PacifiCorp 2004b, NCRWQCB 2010; see also Section 3.2.4.3.2.4), and eliminate reservoir habitat that creates ideal conditions for seasonal nuisance and/or noxious phytoplankton blooms (see Section 3.4, Algae).

Removing the dams would allow access to at least 49 tributaries upstream of Iron Gate Dam that could provide 420 miles of habitat for anadromous fish (DOI 2007), including groundwater-fed areas resistant to water temperature increases caused by changes in climate (Hamilton et al. 2011). In addition, the mainstem downstream of Iron Gate Dam would reflect natural temperature regimes (Hamilton et al. 2011). An additional 22.4 miles of riverine and riparian habitat would improve water quality by restoring the nutrient cycling and aeration processes provided by a natural channel. These improvements resulting from the Proposed Action would likely moderate the anticipated stream temperature increases resulting from climate change.

**Lower Klamath River: Downstream of Iron Gate Dam** The thermal lag formerly caused by water storage in reservoirs and the associated increased thermal mass would be eliminated in the lower Klamath River. This elimination would cause water temperatures to have natural diurnal variations and become more in sync with historical migration and spawning periods for Klamath River Chinook salmon, warming earlier in the spring, and cooling earlier in the fall compared to existing conditions (Stillwater Sciences 2009b;

Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem.

Simulations of water temperatures without the reservoirs (as discussed in Hamilton et al. 2011) show that the temperature difference with and without dams would be greatest downstream of Iron Gate Dam, but could extend an additional 120 to 130 miles downstream. Estimated decreases in stream temperature with dam removal relative to current conditions are likely to be smaller with continued climate change; however, temperature conditions would be much improved under the Proposed Action as compared to the No Action/No Project Alternative (See Water Quality Section 3.2.4.3.2.1).

**Klamath River Estuary and Pacific Ocean Nearshore Environment** The influence of the Proposed Action would decrease with distance downstream of Iron Gate Dam (PacifiCorp 2004b), and it is unlikely that facility removal would have detectable effects on temperatures in the Klamath River Estuary and Pacific Ocean nearshore environment.

#### Fish Disease and Parasites

The Proposed Action would be expected to reduce impacts on salmonids from fish disease. The main factors contributing to parasitic fish disease in the Klamath River include habitat (pools, eddies, and sediment); microhabitat characteristics (stable flows and low velocities); host proximity to spawning areas; and water temperatures greater than 15°C (Bartholomew and Foott 2010).

The removal of the Four Facilities would be likely to reduce habitat quality for the polychaete host by reducing reservoir habitat, and restoring seasonal flow patterns and sediment dynamics that reduce the stability of the host's favored habitats. The removal of Iron Gate Dam would also remove a major barrier to fish migration, reducing the concentration of adults that presently occurs downstream of the dam. Greater dispersal of spawning adult salmon would reduce their proximity to dense populations of polychaetes.

Daily water temperature ranges would be expected to be more variable under the Proposed Action than under existing conditions. Fish might avoid migrating during periods when temperatures are high, or smolts might begin to move downstream earlier in spring, thus reducing their risk of being infected.

Short-term increases in sediment below Iron Gate Dam during drawdown of the reservoirs could also reduce the population density of polychaetes (Bartholomew and Foott 2010). This effect might be limited, as not all populations would be affected, and recolonization could occur following drawdown. However, increased variability in flow management, and the restoration of a more natural sediment regime, would likely reduce the suitability of habitat conditions for *M. speciosa*, the invertebrate host for *P. minibicornis* and *C. shasta*. In some areas, increased mobilization of the substrate would help reduce the availability of habitat for polychaetes (Stocking and Bartholomew 2007).

Among all of the salmonid lifestages, juvenile salmon tend to be most susceptible to *P. minibicornis* and *C. shasta*, particularly during their outmigration in the spring months (Beeman et al. 2008). Infection rates are related in part to warm water temperatures. If

flows increase during spring, juvenile migration time could be decreased, potentially resulting in reduced disease exposure, especially for fish originating from lower Klamath River tributaries. The net result of these effects would also depend on temperature and smolt behavior.

Removal of the Four Facilities would allow anadromous salmonid migration upstream in the mainstem Klamath River and tributaries. Movement of adult salmon into the Upper Klamath Basin would result in introduction of new parasite genotypes that were previously restricted to the lower river (e.g., Chinook salmon migrating upstream could introduce the Type I genotype to upstream areas where it does not presently occur). Some degree of host specificity appears to exist (Atkinson and Bartholomew 2010), indicating that newly exposed species, such as redband trout, would not likely be susceptible to the new genotypes of *C. shasta* introduced into the upper watershed. As an example, redband trout are thought to be susceptible to Type 0, which already occurs in the upstream basin and Chinook salmon are susceptible to Type I, which occurs in the lower basin. But Type 0 genotype occurs in low densities and it is not very virulent (infection results in low or no mortality); if Type I genotype were to move above Iron Gate Dam, it would affect only Chinook salmon. It is not expected that introduction of *C. shasta* genotypes upstream would be deleterious because fish in the upstream basin have shown resistance to the downstream genotypes. Prior to the installation of Copco 1 Dam in 1918, Chinook salmon are known to have accessed the upper watershed, including tributaries to Upper Klamath Lake. Redband trout would presumably have been exposed to genotypes of *C. shasta* at that time, and their populations were abundant. Because the salmonid species in the Klamath Basin already co-occur with the genotype of *C. shasta* to which they are susceptible, and the salmonid species are less susceptible to other genotypes of *C. shasta*, expanding the distribution of the different genotypes of *C. shasta* would be unlikely to be deleterious to salmonids. New research findings in the past five years do not appear to contradict the finding that movement of anadromous salmonids into the Upper Basin presents a relatively low risk of introducing pathogens to resident fish (Administrative Law Judge 2006, USFWS/NOAA Fisheries Service Issue 2(B)).

#### Algal Toxins

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** This region is upstream of any proposed dam removal; therefore, removal of the reservoirs at the Four Facilities under the Proposed Action would not affect fish health as related to algal toxins. Any changes in algal toxin production in this region would be a result of other factors, including TMDL implementation. The effects in this area would be similar to those described for the No Action/No Project Alternative.

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Removal of the reservoirs at the Four Facilities under the Proposed Action would eliminate growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* in the Hydroelectric Reach, alleviating high seasonal concentrations of algal toxins and associated bioaccumulation of microcystin in fish tissue for species in this reach. While some microcystin may be transported downstream from large blooms

occurring in Upper Klamath Lake, the levels would not be as high as those currently experienced due to the prevalence of seasonal in-reservoir blooms. Overall, bioaccumulation of algal toxins in fish tissue would be expected to decrease in the Hydroelectric Reach and would be beneficial.

**Lower Klamath River: Downstream of Iron Gate Dam** Removal of the reservoirs at the Four Facilities under the Proposed Action would eliminate growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa*, alleviating the transport of high seasonal concentrations of algal toxins to the Klamath River downstream of Iron Gate Dam. This would also decrease the associated bioaccumulation of microcystin in fish tissue for species downstream of the dam. While some microcystin may be transported downstream from large blooms occurring in Upper Klamath Lake, the levels would not be as high as those currently experienced due to the prevalence of seasonal in-reservoir blooms. Overall, bioaccumulation of algal toxins in fish tissue would be expected to decrease in the Klamath River downstream of Iron Gate Dam and would be beneficial.

#### Aquatic Habitat

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Under the Proposed Action, short-term effects would include the release of water stored in the Four Facilities. Based on modeling results, this release is expected to last about 4 months, from January 1 into April 2020, but could vary depending on hydrologic conditions (Reclamation 2011), increasing flows downstream of the dams during the drawdown period. River flows would be expected to remain below the 10-year flood event of 11,000 cfs. Flows would increase not only in the bypass reaches, but also all other mainstem reaches due to changes in operations and the absence of reservoir evaporation. Hydrology in the J.C. Boyle Peaking Reach would follow the natural hydrograph more closely, including increased duration and magnitude of high flows, and cessation of daily extreme flow fluctuations (characteristic of hydroelectric peaking operations). Seasonal high flows will contribute to improving the quality of riparian habitat in the J.C. Boyle Bypass Reach by increasing the sediment deposit within the channel and decreasing reed canary grass (Administrative Law Judge 2006). The more normative flow regime associated with this alternative would provide these seasonal high flows.

These flow increases would provide more habitat than under existing conditions for redband/rainbow trout and other resident riverine species, as well as anadromous fish or lamprey that reestablish in this area. These flows are expected to meet channel maintenance needs to route coarse sediments, build bars, erode banks, flush fine sediments, scour vegetation and undercut and topple large woody riparian vegetation (NRC 2008). The removal of project dams would reestablish geomorphic and vegetative processes that form channels that provide fish habitat and spawning gravels in this reach, especially in the former bypassed reaches (FERC 2007). In addition, the impacts associated with daily extreme flow fluctuations resulting from peaking operations, such as stranding, displacement, reduced food production, and increased stress, would no longer occur. The removal of the Four Facilities would eliminate existing habitat for

adult shortnose and Lost River suckers, as well as nonnative species occupying the reservoirs. The few shortnose and Lost River suckers that have been observed in these reservoirs are believed to be fish that have moved down from the upstream areas, but are not thought to represent a viable, self-supporting population (Buettner et al. 2006). The Proposed Action would restore 22.4 miles of riverine habitat (Cunanan 2009) for resident and anadromous fish through removal of reservoirs.

Overall, because the Proposed Action would result in flows more favorable to all life stages, eliminate peaking operations, and remove barriers that have isolated populations, the Proposed Action would result in benefits to salmonid populations and their habitat.

Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed reservoir sediment. No short-term effects are anticipated from these reservoir restoration efforts, and in the long-term aquatic habitat may be improved from restored riparian vegetation.

**Lower Klamath River: Downstream of Iron Gate Dam** As described above, the Proposed Action would result in elevated flows for about 4 months once drawdown begins, but the flows would be expected to remain below the 5-year flood event. These elevated flow rates could have the beneficial effect of maintaining unsuitable habitat conditions for introduced species in the river downstream of Iron Gate Dam. These increased flows could result in faster transport of outmigrant fish and slower upstream migration of adult fish in the Klamath River during this time.

Over the long term, the Proposed Action would alter the hydrograph so that the duration, timing, and magnitude of flows would be more similar to the unregulated conditions under which the native fish community evolved (Hetrick et al. 2009). While mean annual flows would not substantially change from existing flows due to the lack of active reservoir storage (Stillwater Sciences 2009b; Greimann et al. 2010), flow variability would increase.

The Proposed Action would substantially decrease the transit time of water in the Hydroelectric Reach, because it would no longer be detained by the reservoirs, resulting in a shift in the timing of the minimum flows (Balance Hydrologics Inc. 1996; NRC 2004, Fig. 4-2, p. 148, accessible at [http://www.nap.edu/openbook.php?record\\_id=10838&page=144](http://www.nap.edu/openbook.php?record_id=10838&page=144)). These hydrologic effects would likely be more important in upstream areas (directly downstream of Iron Gate Dam) than downstream areas (below the confluence of the Scott River) due to the substantial flow contribution of tributaries to the Klamath River (Reclamation 2011, Hydrologic modeling, Appendix E). In addition, these hydraulic changes would result in changes to water quality, water temperatures, sediment transport, and riparian habitat, as described in subsequent sections.

**Klamath River Estuary and Pacific Ocean Nearshore Environment** Modeling results indicate that because of the influence of the tributaries entering the Klamath River downstream of Iron Gate Dam, the flow changes for the Proposed Action would not substantially affect the flows entering the estuary. Section 3.6, Flood Hydrology,

provides further information on this effect. Therefore, the Proposed Action would not affect flow-related fisheries habitat in the estuary or the Pacific Ocean.

### **Aquatic Resources Effects**

#### **Critical Habitat**

*As described below, lowering the water surface elevation of the reservoirs associated with dam removal under the Proposed Action could alter the quality of critical habitat. In addition, the removal of dams and reservoirs could alter the availability and quality of critical habitat.*

**Coho Salmon** Elevated levels of SSCs occurring during 3 to 4 months of drawdown would degrade critical habitat for coho salmon. Bedload movement following dam removal would cause substantial aggradation and increase supply of gravel below the dam as far downstream as Cottonwood Creek. This effect would potentially improve critical habitat for coho salmon by reducing median substrate to a size more favorable for spawning (Reclamation 2011).

The Proposed Action would increase the amount of habitat available to coho salmon upstream of currently designated critical habitat and improve water quality in the mainstem Klamath River within current critical habitat. NOAA Fisheries Service may consider whether to designate the newly available habitat as critical habitat as part of its 5-year status review or as a separate reconsideration of the critical habitat designation for the species (J. Simondet, NOAA Fisheries Service, pers. comm., 2011). Removal of the Four Facilities would allow coho salmon access to at least 68 miles of additional habitat and possibly up to as much as 82 miles (Administrative Law Judge 2006), including approximately 38 miles in the mainstem and at least 30 miles in tributaries such as Fall, Jenny, Shovel, and Spencer Creeks, and others. These tributaries are thought to provide habitat suitable for coho salmon. In addition, coho salmon could find suitable temperatures for holding in pockets within the J.C. Boyle Bypass Reach, although the average and maximum temperatures in this reach are expected to exceed optimal temperatures for coho salmon. Access to this habitat would increase the availability of spawning sites, result in additional food resources, and provide access to areas of better water quality. Water quality conditions would also improve within the mainstem downstream of the J.C. Boyle Powerhouse. Removal of the Four Facilities would result in lower water temperatures during the fall months, but would increase water temperatures slightly in the spring months, increase dissolved oxygen concentrations, and eliminate reservoir habitat that creates the conditions necessary for the growth of blue green algae and other phytoplankton. These changes would be beneficial for coho salmon critical habitat. **Based on reductions in habitat quality during reservoir drawdowns that would be detrimental to PCEs, the Proposed Action would have a significant effect on coho salmon critical habitat in the short term. Based on benefits to the PCEs, the Proposed Action would have a beneficial effect on critical habitat for coho salmon in the long term.**

**Bull Trout** Based on the restricted distribution of bull trout, implementation of the Proposed Action would not affect the physical or chemical components of critical habitat. However, the Proposed Action would allow Chinook salmon and steelhead to access

areas they have not been able to access since the completion of the Copco 1 Development in 1918. These species would potentially compete with and prey upon bull trout fry and juveniles; however, bull trout would also be expected to consume the eggs and fry of Chinook salmon and steelhead. These species co-evolved in the watershed together, and it is anticipated that they would be able to co-exist in the future. **The Proposed Action would have a less-than-significant impact on critical habitat for bull trout in the short and long term.**

**Southern Resident Killer Whale** The Klamath River contributes to critical habitat for Southern Resident Killer Whales through its contribution of Chinook salmon to their food supply. The Proposed Action would not affect the geographic extent of critical habitat for this species, as it is located in the state of Washington. The Proposed Action is expected to increase wild populations of anadromous salmonids, which could increase food supply for Southern Resident Killer Whales. In a compilation of potential adult production from habitats upstream of Iron Gate Dam, estimates ranged from 9,180 to 21,245 (Hamilton et al. 2011). Klamath River salmon are anticipated to provide less than 1 percent of the diet of Southern Resident Killer Whales in most months. The Proposed Action would not be likely to materially affect the food supply of Southern Resident Killer Whales. **Based on small influence of the Klamath River on PCEs of Southern Resident Killer Whale, the Proposed Action would have a less-than-significant impact on critical habitat for Southern Resident Killer Whales in the short and long term.**

#### Essential Fish Habitat

*As described below, lowering the water surface elevation of the reservoirs associated with dam removal under the Proposed Action could alter the quality of Essential Fish Habitat (EFH). In addition, the removal of dams and reservoirs could alter the availability and quality of EFH.*

**Chinook and Coho Salmon EFH** The short-term release of sediment from the dams under the Proposed Action would be detrimental to Chinook and coho salmon EFH during the months when SSC concentrations are elevated. In the long term, the Proposed Action would increase habitat for Chinook and coho salmon (upstream of currently designated EFH) by providing access to habitats upstream of Iron Gate Dam. EFH quality would be affected by improved water quality, and decreased prevalence of disease, as described above for coho salmon critical habitat. Improved access to habitats (upstream of designated EFH), improved water quality and decreased prevalence of disease would provide a benefit to EFH for Chinook and coho salmon. **Based on a substantial reduction in EFH quality during reservoir drawdown, the Proposed Action would have a significant effect on EFH for Chinook and coho salmon in the short term. Based on benefits to quality, the Proposed Action would have a beneficial effect on EFH for Chinook and coho salmon in the long term.**

**Groundfish EFH** Under the Proposed Action, EFH in the estuary could be affected by elevated turbidity from sediment releases during dam removal for about 3 months. After this time, SSCs would return to levels similar to existing conditions. SSCs in the estuary would be less than 40 percent of the peak concentrations that are anticipated to occur

immediately downstream of Iron Gate Dam. These peaks would still be substantial, and would be higher than the extreme values estimated by the sediment transport model for existing conditions (see Section 3.2.4.3.2.2).

In the long term, SSCs would be similar to that under existing conditions. Natural bedload transport processes would resume, as the dams would no longer trap sediments upstream of Iron Gate Dam. Bedload in the estuary and ocean would not be appreciably affected, because of the small contribution of the area above Iron Gate Dam to the total bedload in the system. With the exception of algal toxins, water quality benefits resulting from dam removal would largely have dissipated upstream of the estuary, and therefore, water quality in the estuary would be expected to remain similar to existing conditions. **Based on short duration of poor water quality during reservoir drawdown in the estuary, the Proposed Action would have a less-than-significant effect on EFH for groundfish in the short and long term.**

**Pelagic Fish EFH** The effects of the Proposed Action on pelagic fish EFH would be the same as those described for groundfish EFH, with substantial short-term increases in SSCs. These increases would subside after about 3 months. After this time SSCs would be expected to be similar to those under existing conditions. **Based on short duration of poor water quality during reservoir drawdown in the estuary, the Proposed Action would have a less-than-significant effect on EFH for pelagic fish in the short and long term.**

#### Species-Specific Impacts

*As described below, lowering the water surface elevation of the reservoirs associated with dam removal under the Proposed Action could affect aquatic species. In addition, the removal of dams and reservoirs could alter the availability and quality of habitat, resulting in effects on aquatic species.*

Species-specific impacts are based upon effects on key ecological attributes summarized above.

**Fall-Run Chinook Salmon** To help determine if the Proposed Action will advance restoration of the salmonid fisheries of the Klamath Basin, a Chinook Salmon Expert Panel was convened to attempt to answer specific questions that had been formulated by the project stakeholders to assist with assessing the effects of the Proposed Action compared with existing conditions (Goodman et al. 2011). The Panel concluded that the Proposed Action appears to be a major step forward in conserving target fish populations in the Klamath Basin. The Panel predicted that, based on the information provided to them, it was possible that the Proposed Action would provide a substantial increase in the abundance of naturally spawned Klamath River Chinook salmon above that expected under existing conditions in the reach between Iron Gate Dam and Keno Dam. While the Panel agreed that there was also evidence for dramatic increases in abundance associated with the Proposed Action upstream of Keno Dam, they cautioned that achieving substantial gains in Chinook salmon abundance and distribution in the Klamath Basin is contingent upon successfully resolving key factors (discussed in this report in detail) that will continue to affect population, such as water quality, disease, and instream flows. In

addition, they stated the concern that successful implementation of KBRA would be required, and would need appropriate scientific leadership. Quantitative modeling of fall-run Chinook salmon populations further substantiates the conclusions of the Expert Panel. Modeling under both the Proposed Action and existing conditions suggests that dam removal would substantially increase numbers of spawners over a 50-year period (Oosterhout 2005). Additional production modeling efforts support this conclusion (Huntington 2006, Dunsmoor and Huntington 2006, Hendrix 2011, Lindley and Davis 2011). Of these, the Hendrix (2011) approach is considered the most intensive and robust conducted to date, because it used stock-recruitment data from the Klamath River; incorporated variability in watershed, climate, and ocean conditions; and presented variance estimates of uncertainty. Nobel applied a life-cycle model to forecast the abundance of Chinook salmon (fall-run and spring-run combined) for both the Proposed Action and continuation of existing conditions for the years 2012 to 2061. Hendrix (2011) results indicated substantial uncertainty in Chinook salmon stock recruitment dynamics, resulting in uncertain escapement and harvest abundance forecasts. Despite the uncertainty, modeling results indicate that the Proposed Action would result in higher relative abundance of Chinook salmon. Median escapements to the Klamath Basin are predicted to be higher with the Proposed Action than under existing conditions. Harvest is also predicted to be greater with the Proposed Action, and the probability of low escapement leading to fishery closures was less under the Proposed Action. Finally, simulations predicted that there is an approximately 75 percent probability that there would be higher escapement with the Proposed Action, and an approximately 70 percent probability of higher annual harvest.

The influence of the Proposed Action within specific reaches is described below.

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Proposed Action, removal of the Four Facilities would allow fall-run Chinook salmon to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. The access would expand the Chinook salmon's current habitat to include historical habitat along the mainstem Klamath River, upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). This would be a potential increase in access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive habitat (DOI 2007), including access to groundwater areas resistant to climate change (Hamilton et al. 2011).

Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011). However, evidence indicates that Upper Klamath Lake habitat is presently suitable to support Chinook salmon for at least the October through May period (Maule et al. 2009). Summer poor water quality conditions, may necessitate seasonal trap and haul around Keno Impoundment for some life stages of Chinook until KBRA and TMDL implementation improve water quality. This is consistent with the fishway prescriptions of DOI and US Department of Commerce (DOC) (DOI 2007; NOAA Fisheries Service 2007). Overall, dam removal and associated KBRA actions would accelerate water

quality improvements (Dunne et al. 2011) and TMDL water quality benefits to anadromous fish (Water Quality Subgroup 2011).

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Proposed Action would restore fall-run Chinook salmon access to the Hydroelectric Reach. Adults could first access this reach in fall 2020 after dam removal. Because of this they would not be exposed to the elevated SSCs that would occur during dam removal. By fall 2020, elevated SSCs from dam removal would have subsided. Most of the sediment stored within the removed reservoirs would likely be eroded within the first 5 months after dam removal, and, at most, cause minor (less than 0.5 foot) deposition in river reaches between reservoirs, settling into pool and other low-velocity habitats as water velocities decrease. River channels within reservoir reaches would likely excavate to their pre-dam elevations within a few months, and revert to and maintain a pool-riffle morphology due to restoration of riverine processes, likely creating holding and rearing habitat for anadromous salmonids.

Modeling data (Reclamation 2011) indicate that after dam removal, spawning gravel in all sections of the Hydroelectric Reach would be within the range usable for fall-run Chinook salmon, but the amount of sand within the bed within former reservoir sections could inhibit spawning success. The bed material within the reservoirs and between Iron Gate to Cottonwood Creek is expected to have a high content (30 to 50 %) of sand immediately following reservoir drawdown until a flushing flow moves the sand sized material out of the reach (Reclamation 2011). The flushing flow is expected to be at least 6,000 cfs and of several days to weeks to return the bed to a bed dominated by cobble and gravel with a sand content less than 20%. After the flushing flow, the bed is expected to maintain fractions of sand, gravel, and cobble which would be expected under natural conditions. Based on the historical record a sufficient flushing flow would likely occur within 5 years following dam removal. Riverine sections between reservoirs would be expected to provide the preferred substrate size range for fall-run Chinook salmon, with very little sand, suggesting that high-quality spawning habitat would be created.

The Proposed Action would establish a flow regime that more closely mimics natural conditions by increasing spring flow and by incorporating more variability in daily flows. The reservoir drawdowns would allow tributaries and springs such as Fall, Shovel, and Spencer Creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). The removal of the four dams would likely reduce habitat availability for the polychaete host for *C. shasta* and *P. minibicornis*. Drawing down the reservoirs would reduce the amount of lentic habitat available, and increased flow variability would reduce the stability of pools, eddies, and low-velocity habitats. These changes would result in more favorable water temperature for salmonids, as well as improve water quality and reduce the incidence of disease and algal toxins.

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment downstream to the lower Klamath River in the short term, and restore a flow regime that more closely mimics natural conditions the long term. Suspended sediment effects on fall-run Chinook salmon under the Proposed Action are described in detail in Appendix E, and summarized here.

Under the most-likely-to-occur scenario or worst-case scenario, no effect from suspended sediment relative to existing conditions is anticipated for all adult fall-run Chinook salmon migrating or spawning within tributaries to the Klamath River during fall 2019 (around 92 percent of the population), or for juveniles rearing within tributaries (Table 3.3-5). Suspended sediment is anticipated to have sublethal effects on Type I and Type II outmigrants (Table 3.3-5). Direct mortality from suspended sediment is anticipated to include the following:

- Under the most-likely-to-occur or worst-case scenario predicted complete loss of the eggs of the 2019 brood year deposited in the mainstem in fall 2019. Based on redd surveys from 2001 through 2009 (CDFG, unpublished data), an average of around 4,600 redds could be affected, or around 8 percent of all anticipated redds in the basin in 2019.
- Type III juvenile fall-run Chinook salmon from the 2019 cohort (hatched from eggs laid in 2018) outmigrating to the ocean during spring 2020 would be exposed to high SSCs. However, based on outmigrant trapping in the mainstem Klamath River at Big Bar (Scheiff et al. 2001), Type III age 1 spring outmigrants are very rare, and only 31 were observed at Big Bar in four years of trapping, or around 0.1 percent of trap captures. Under a most-likely-to-occur scenario 0 to 20 percent mortality is predicted, or around 0 to 189 smolts (around 0.02 percent of the total fall-run Chinook salmon smolt production). Under a worst-case scenario mortality rates of up to 71 percent are predicted for the Proposed Action, equating to 669 smolts, or around 0.07 percent of the total fall-run Chinook salmon smolt production. Type I and Type II juvenile outmigrants are expected to experience sublethal effects.

The Proposed Action would also result in the release of bedload sediment, as described in detail in Appendix F. Effects associated with release of coarse sediment are expected to impact the same individuals as described for suspended sediment above. For example, bedload sediment is predicted to bury redds constructed in fall 2019, which are the same redds expected to suffer from suspended sediment. In addition, bedload sediment could result in the deposition that could aggrade pools or overwhelm other habitat features that Chinook salmon use for adult holding or juvenile rearing. However, the effect on habitat is anticipated to be short term, and pools would likely return to their pre-sediment release depth within one year (Stillwater Sciences 2008). In the long term, the river is predicted to revert to and maintain a pool-riffle morphology.

**Table 3.3-5. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Fall-run Chinook Salmon.**

Scenario	Life History Stage: Fall-run Chinook Salmon			
	Adult migration (July 15–Oct 31 2020)	Spawning through fry emergence (Oct 15 2019–Feb 28 2020)	Age 0+ rearing (March 1–March 31 2020)	Outmigration (Type I April 1–August 31 2020) (Type II Sept 1–Nov 30 2020) (Type III Feb 1–April 15 2020)
Most-likely	<b>Normal Existing Conditions (50% exceedance probabilities)</b>			
	No effects	No effects.	Moderate stress for age 0 in upper mainstem.	<b>Type I:</b> Major stress for Type I fry (about 60% of production) <b>Type II:</b> No effects <b>Type III:</b> Major stress for about 2 weeks for Type III outmigrants (<1% of production)
	<b>Proposed Action</b>			
	Same as existing conditions	Up to 100% mortality of the progeny of mainstem spawners (approximately 4,600 redds, or around 8% of production).	No juvenile progeny anticipated rearing in mainstem due to impacts during incubation. Most other juveniles assumed to rear in tributaries prior to outmigration.	<b>Type I:</b> Major stress and reduced growth <b>Type II:</b> Same as existing conditions <b>Type III:</b> Major stress, reduced growth, and up to 20% mortality (0 to 189 smolts, or less than 1% of production)
	<b>Extreme Existing Conditions (10% exceedance probabilities)</b>			
Worst-case	No effect	A few days of suspended sediment may reduce size at emergence for progeny from mainstem spawning (about 8% of escapement).	Major stress for age 0 in upper mainstem.	<b>Type I:</b> Major stress and reduced growth for the about 60% of fry entering mainstem in April–May <b>Type II:</b> Moderate stress for the about 40% of Type II juveniles entering mainstem in Sept–Nov <b>Type III:</b> Major stress for the less than 1% of juveniles entering mainstem in Feb–April
	<b>Proposed Action</b>			
	Major stress and impaired homing	Up to 100% mortality of the progeny of mainstem spawners (approximately 4,600 redds, or around 8% of production).	No juvenile progeny anticipated in mainstem due to impacts during incubation. Most other juveniles assumed to rear in tributaries prior to outmigration.	<b>Type I:</b> Same as existing conditions <b>Type II:</b> Moderate (1 day) to major (about 1 wk) stress <b>Type III:</b> Major stress, reduced growth, and up to 71% mortality (Up to 669 smolts, or less than 1% of production)

As described in detail in Appendix F, the 2021 cohorts could also be affected by sediment deposits with high levels of sand that would likely remain through fall 2020. In the long term, increased supply of gravel from upstream sources is predicted to increase the amount of fall-run Chinook salmon spawning habitat by decreasing the median substrate size to 40 to 60 mm (Reclamation 2011), within the observed range for Chinook salmon spawning (16 to 70 mm [Kondolf and Wolman 1993]). However, in the short term, sand composition may be as high as 30 percent, reducing the quality of spawning habitat. These levels of sand may continue to affect the 2020 brood year (2021 cohort) as these levels of sand that could remain through fall 2020 unless it is flushed from the substrate during winter flows. Changes in bedload would be limited to the reach from Iron Gate Dam to Cottonwood Creek, a length of 8 miles, or 4 percent of the channel length of the mainstem Klamath River downstream of Iron Gate Dam. The most severe effects would also be limited to a small proportion of the total channel length (0.5 miles, or less than 1 percent of the channel downstream of Iron Gate Dam), as sediment deposition would lessen downstream of Bogus Creek to Cottonwood Creek. At most, around 8 percent of fall-run Chinook salmon in the Klamath Basin are expected to spawn in the mainstem, with an even smaller percentage expected to spawn within the 8-mile affected reach (Appendix E).

The Proposed Action would establish a flow regime that more closely mimics natural conditions in the lower Klamath River. Flows under the Proposed Action are intended to benefit fall-run Chinook salmon. Hetrick's analysis of KBRA type<sup>3</sup> flows showed the greatest benefits would be in years when production was low (Hetrick et al. 2009). Implementing either the KBRA type flows or the Hardy et al. (Hardy et al. 2006) Phase II flow recommendations was predicted to decrease the occurrence of poor production years in the future by two-thirds. This would have significant positive consequences for Chinook salmon given their life cycle in the Klamath River (Hetrick et al. 2009). Dam removal would also cause water temperatures to become warmer earlier in the spring and early summer and cooler earlier in the late summer and fall, and to have diurnal variations more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem.

Incidence of disease are expected to be reduced by enhancing the scour capabilities of flow by uninterrupted sediment transport, a flow regime that more closely mimics natural conditions, thereby disturbing the habitat of the polychaete worm that hosts *C. shasta*. Reducing polychaete habitat will likely increase abundance of smolts by increasing outmigration survival, particularly for Type I and Type III life-histories.

Estuary The Proposed Action would not substantially change or affect estuarine habitat used by fall-run Chinook salmon. Short- and long-term improvements to water quality and reductions in algal toxins would be expected with the establishment of a flow regime that more closely mimics natural conditions, and would benefit fall-run Chinook salmon.

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<sup>3</sup> This analysis assumed that low flows in water years 2012 to 2020 would resemble low flows in water years 1961 to 2000. The Hetrick et al. (2009) analysis was based on a period of record 1961-2000; thus we refer to these as 'KBRA type' flows.

Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect fall-run Chinook salmon.* Fall-run Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Overall, the effect of SSC from the Proposed Action on the fall-run Chinook salmon population, under both most-likely and worst-case scenarios, is expected to be relatively minor because of variable life histories, the large majority of age 0 juveniles that remain in tributaries until later in the spring and summer, and because many of the fry that outmigrate to the mainstem come from tributaries in the mid- or lower Klamath, where suspended sediment concentrations resulting from the Proposed Action are expected to be lower due to dilution from tributaries in between. Effects would be distributed over three year-classes, rather than a single year-class. Therefore, Type-II and Type-III progeny of adults that successfully spawn in tributaries during 2020 will produce smolts that outmigrate to the ocean a year after the spring pulse of suspended sediment in 2020 and should not be noticeably affected by the Proposed Action. However, direct mortality is predicted for 4,600 redds (around 8 percent of total redds in the basin), and for around 669 Type III smolts (< 1 percent of production). In addition, sublethal effects on Type I and Type II outmigrants are predicted. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for fall-run Chinook salmon in the short term.**

Mitigation Measures AR-1 through AR-4 (see Section 3.3.4.4) could be implemented to reduce the short-term effects of SSCs on fall-run Chinook salmon incubating eggs and smolts. There would still be short-term effects for fall-run Chinook salmon, including some direct mortality, but no one year class would suffer a substantial decrease in abundance. **Based on minimal reduction in the abundance of a year class in the short term, the Proposed Action would be a less-than-significant effect on fall-run Chinook salmon after mitigation.**

*Under the Proposed Action, removal of dams could alter habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins, all of which could affect fall-run Chinook salmon in the long term.* As stated above, dam removal would also restore connectivity to 420 miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach. Almost any type of fish passage structure would be less efficient as a migration corridor for fish than removing the obstacle to passage itself. For example, fish ladders may cause delays in adult upstream migration or may become blocked by debris, and juvenile fish may have to navigate through impoundments with poor water quality or non-native predatory fish. Any of these potential factors has a chance of affecting fitness, survival, or reproductive success (Buchanan et al. 2011a). By providing an unimpeded migration corridor, the Proposed Action would provide the greatest possible benefit related to fish passage, hence, the highest survival and reproductive success. It is anticipated that the Proposed Action would increase the

abundance, productivity, population spatial structure, and genetic diversity of fall-run Chinook salmon in the Klamath River watershed. In general, free flowing conditions as per the Proposed Action, would likely provide optimal efficiency, decrease outmigrant delay, and increase concomitant adult escapement (Buchanan et al. 2011a). **Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for fall-run Chinook salmon in the long term.**

**Spring-Run Chinook Salmon** As discussed above for fall-run Chinook salmon, a Chinook Salmon Expert Panel was convened to attempt to answer specific questions that had been formulated by the project stakeholders to assist with assessing the effects of the Proposed Action compared with existing conditions (Goodman et al. 2011). While noting uncertainties based on existing data, the panel concluded that the prospects for the Proposed Action to provide a substantial positive effect for spring Chinook salmon is more remote than for fall-run Chinook salmon. The primary concern of the panel was that low abundance and productivity (return per spawner) of spring Chinook salmon would limit recolonization of habitats upstream of Iron Gate Dam. However, KBRA includes a reintroduction component to establish populations in the new habitats, at least initially. In addition, KBRA actions would be implemented that are anticipated to improve productivity of existing and potentially newly accessible habitats. The influence of the Proposed Action within specific reaches is described below.

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Proposed Action, dam removal would allow spring-run Chinook salmon to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. The access would expand the Chinook salmon's current habitat to include historical habitat along the mainstem Klamath River and upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). This would be a potential increase in access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive habitat (DOI 2007), including access to areas influenced by groundwater exchange that are more resistant to climate change (Hamilton et al. 2011). The Proposed Action would not result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006).

Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011). However, evidence indicates that Upper Klamath Lake habitat is presently suitable to support Chinook salmon for at least the October through May period (Maule et al. 2009). Summer poor water quality conditions, may necessitate seasonal trap and haul around Keno Impoundment for some life stages of Chinook until KBRA and TMDL implementation improve water quality. This is consistent with the fishway prescriptions of DOI and DOC (DOI 2007; NOAA Fisheries Service 2007). Overall, dam removal and associated KBRA actions would accelerate water quality improvements (Dunne et al. 2011) and TMDL water quality benefits to anadromous fish (USDI Secretarial Determination Water Quality Subgroup In Review).

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Proposed Action would restore spring-run Chinook salmon access to the Hydroelectric Reach. Adults could first access this reach in spring 2021 after dam removal; thus, short-term gains in flow-related habitat or habitat expansion would be limited to later cohorts. Elevated SSCs and bedload movement from dam removal would have dissipated by this time (see Figure 3.3-5, Figure 3.3-6, and Figure 3.3-7), returning to background levels similar to those under existing conditions and would not be expected to affect spring-run Chinook salmon using this area.

The Proposed Action would eliminate the Four Facilities and would establish a flow regime that more closely mimics natural conditions by increasing spring flow and by incorporating more variability in daily flows. The removal of the reservoirs would allow Fall, Shovel, and Spencer Creeks to flow directly into the mainstem Klamath River, along with Big Springs in the J.C. Boyle Bypass Reach and additional springs, which would provide fish with patches of cooler water as refugia (Hamilton et al. 2011). The removal of the four dams would likely reduce habitat availability for the polychaete host for *C. shasta* and *P. minibicornis*. Removal of the reservoirs would reduce the amount of lentic habitat available, and increased flow variability would reduce the stability of pools, eddies, and low-velocity habitats. These changes would result in more favorable water temperature for salmonids, as well as improve water quality and reduce instances of disease and algal toxins.

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment downstream to the lower Klamath River Reach in the short term, and would establish a flow regime that more closely mimics natural conditions in the long term. Adult spring-run Chinook salmon do not currently occur upstream of the Salmon River, and would not be expected to be able to use the mainstem Klamath River upstream of Iron Gate Dam until conditions in the Hydroelectric Reach are suitable.

Suspended sediment effects on spring-run Chinook salmon under the Proposed Action are described in detail in Appendix E, and summarized here. The distribution of spring-run Chinook salmon in the Salmon River and tributaries downstream limits their exposure to mostly lower concentrations of suspended sediment. Under the most-likely-to-occur scenario or worst-case scenario, no effect from suspended sediment relative to existing conditions is anticipated for all spring-run Chinook salmon spawning and rearing, which occurs primarily within tributaries (Table 3.3-6). Suspended sediment is anticipated to have sublethal effects on adult migration, primarily for those adult returning to the Salmon River (around 5 percent of all spring-run migrants), and sublethal effects on Type I and Type II outmigrants (Table 3.3-6). Direct mortality from suspended sediment is anticipated to include the following:

- Type III juvenile spring-run Chinook salmon from the 2019 cohort (hatched from eggs laid in 2018) outmigrating to the ocean from the Salmon River during spring 2020 would be exposed to high SSCs. However, based on outmigrant trapping in the Salmon River (Karuk Tribe, unpublished data), Type III age 1 spring outmigrants are very rare, and only 30 were observed in five years of trapping.

Assuming a larger number of Type III smolts outmigrate from the Salmon River and are undetected (assume an average of around 78 Type III smolts per year), under a most-likely-to-occur scenario 0 to 20 percent mortality is predicted or 16 smolts at most (less than 1 percent of the total spring-run Chinook salmon smolt production). Under a worst-case scenario mortality rates of 20 to 36 percent are predicted, or around 28 smolts at worst (<1 percent of all production). Type I and Type II juvenile outmigrants are expected to experience sublethal effects.

Adults could first access the reach upstream of the Iron Gate Dam in Spring 2021 if dam removal is completed by April of that year. As described in detail in Appendix F, short- and long-term changes in bedload would be limited to the reach from Iron Gate Dam to Cottonwood Creek, a length of 8 miles, or 4 percent of the mainstem Klamath River channel downstream of Iron Gate Dam (Appendix F). The most severe effects would also be limited to a small proportion of the total channel length (0.5 miles, or less than 1 percent of the channel downstream of Iron Gate Dam), as sediment deposition would lessen downstream of Bogus Creek to Cottonwood Creek and, thus, would not affect the area currently used by spring-run Chinook salmon. By spring 2021, suspended sediment concentrations would have returned to background levels and the channel would likely have reverted back to its previous pool-riffle morphology (Stillwater Sciences 2008).

The Proposed Action would create a flow regime that more closely mimics natural conditions in the lower Klamath River by increasing spring flow and by incorporating more variability in daily flows. Dam removal would cause water temperatures to warm earlier in the spring and early summer and cool earlier in the late summer and fall, and to have diurnal variations more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem. Migrating adults and juveniles rearing or migrating in the mainstem in spring 2020 would be exposed to poor water quality due to the Proposed Action. Because most spawning occurs in the Salmon and Trinity Rivers, magnitude of exposure would be limited by dilution from tributaries entering downstream of Iron Gate Dam.

**Table 3.3-6. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Spring-run Chinook Salmon.**

Scenario	Life History Stage: Spring-run Chinook Salmon			
	Adult migration (Apr 1–Jun 30, 2020)	Spawning through fry emergence (Sept 1 2019–Feb 28, 2020)	Fry and juvenile rearing (year-round)	Outmigration (Type I: April 1–August 31 2020) (Type II: Sept 1–Nov 30 2020) (Type III: Feb 1–April 15 2020)
Most likely	<b>Existing Conditions (normal)</b>			
	<b>Spring Migration:</b> Moderate stress and Impaired homing for adults returning to Salmon River (average 5% of total run, up to 35% of natural run)	Most spawning takes place in tributaries; no effects predicted	Juveniles primarily rear in tributaries; no effects predicted	<b>Type I:</b> Major stress for Type I fry from Salmon River (about 80% of Salmon River production)
	<b>Summer Migration:</b> No effects			<b>Type II:</b> No effects (about 20% of Salmon R. production)
				<b>Type III:</b> Major stress for Type III juveniles from Salmon River (< 1% of Salmon River production)
	<b>Proposed Action</b>			
	<b>Spring Migration:</b> Major stress and impaired homing	Same as existing conditions	Same as existing conditions	<b>Type I:</b> Same as existing conditions
<b>Summer Migration:</b> Same as existing conditions	<b>Type II:</b> Same as existing conditions			
			<b>Type III:</b> Major stress, reduced growth, and up to 20% mortality. (around 16 smolts, less than 1% of the total smolt population from the Salmon River)	
Worst-case	<b>Existing conditions (extreme)</b>			
	<b>Spring Migration:</b> Major stress and impaired homing	Most spawning takes place in tributaries; no effects predicted	Juveniles primarily rear in tributaries; no effects predicted	<b>Type I:</b> Major stress for Type I fry from Salmon River (about 80% of Salmon River production)
	<b>Summer Migration:</b> Moderate stress			<b>Type II:</b> Moderate stress for Type II juveniles from Salmon River (about 20% of Salmon River production)
				<b>Type III:</b> Major stress for Type III juveniles from Salmon River (<1% of Salmon River production)
	<b>Proposed Action</b>			
	<b>Spring Migration:</b> Same as existing conditions	Same as existing conditions	Same as existing conditions	<b>Type I:</b> Same as existing conditions
<b>Summer Migration:</b> Impaired homing	<b>Type II:</b> Same as existing conditions			
			<b>Type III:</b> Major stress, reduced or no growth, and up to 36% mortality (up to 28 smolts, less than 1% of the total smolt population from the Salmon River)	

Incidence of disease are expected to be reduced by enhancing the scour capabilities of flow by uninterrupted sediment transport, a flow regime that more closely mimics natural conditions, thereby disturbing the habitat of the polychaete worm that hosts *C. shasta*. Reducing polychaete habitat would likely increase abundance of smolts by increasing outmigration survival, particularly for Type I and Type III life-histories.

Estuary The Proposed Action is not expected to substantially change or affect spring-run Chinook salmon estuarine habitat. Short- and long-term improvements to water quality and reductions in algal toxins would be expected with the establishment of a flow regime that more closely mimics would benefit spring-run Chinook salmon. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect spring-run Chinook salmon.* The overall effect of suspended sediment from the Proposed Action on the spring-run Chinook salmon population is not anticipated to differ much from existing conditions and the No Action/No Project Alternative. There is very little difference from existing conditions and the No Action/No Project Alternative for adult migrants, all of which is predicted to be sublethal, and no effects are anticipated for the spawning, incubation, and fry stages because they do not spawn in the mainstem. Type I and II outmigrants are expected to experience very similar conditions under the Proposed Action as under existing conditions and the No Action/No Project Alternative. However, direct mortality is predicted for around 16 to 28 Type III smolts (< 1 percent of production). In addition, sublethal effects on adult migrants and Type I and Type II outmigrants are predicted. **Based on minimal reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be less-than-significant for spring-run Chinook salmon in the short term.**

Implementation of Mitigation Measures AR-2 (see Section 3.3.4.4) could reduce the short-term effects of SSCs on spring-run Chinook salmon Type III smolts. With implementation of mitigation measures, there would still be short-term effects for spring-run Chinook salmon including some potential direct mortality, but there would not be a substantial reduction in the abundance of a year class. **Based on minimal reduction in the abundance of a year class in the short term, the Proposed Action would be a less-than-significant effect on spring-run Chinook salmon after mitigation.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect spring-run Chinook salmon in the long term.* Dam removal would restore connectivity to 420 miles of potentially usable habitat in the Upper Klamath Basin, including additional habitat within the Hydroelectric Reach. Access to additional habitat would provide a long-term benefit to spring-run Chinook salmon populations. Almost any type of fish passage structure would be less efficient as a migration corridor for fish than removing the obstacle to passage itself. For example, fish ladders may cause delays in adult upstream migration or may become blocked by debris, and juvenile fish may have to navigate through impoundments with poor water quality or non-native predatory fish. Any of these potential factors has a chance of

affecting fitness, survival, or reproductive success (Buchanan et al. 2011a). By providing an unimpeded migration corridor, the Proposed Action would provide the greatest possible benefit related to fish passage, hence, the highest survival and reproductive success. It is anticipated that as a result of the Proposed Action the spring-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. **Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for spring-run Chinook salmon in the long term.**

**Coho Salmon** A Coho Salmon and Steelhead Expert Panel was convened and charged with answering specific questions that had been formulated by the project stakeholders to assist with assessing the effects of the Proposed Action on coho salmon and steelhead (Dunne et al. 2011). While noting the constraints of the Panel to arrive at conclusions within a short time period and without adequate quantitative or synthesized information, the conclusion of the Panel was that the Proposed Action would result in a modest increase in the coho salmon population compared with existing conditions. The Panel indicated that a relatively modest increase in coho population would result from dam removal due to the following factors:

- Only modest increases in suitable coho salmon habitat would result from dam removal;
- Coho salmon use more tributary streams and rely less on the mainstem Klamath River habitats primarily affected by dam removal;
- Anticipated positive but unquantifiable changes in tributary habitats where most coho spawn and rear due to KBRA implementation; and,
- Potential for disease and low ocean survival to offset gains in production.

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir There is no historical evidence that coho salmon occurred upstream of J.C. Boyle Reservoir, primarily because most people at the time did not distinguish between the various anadromous salmonid species. Snyder (1931) noted that they occurred in large numbers in the Klamath River. He stated that “Nothing definite was learned about them from inquiry because most people are unable to distinguish them,” but also that “silver salmon are said to migrate to the headwaters of the Klamath to spawn.” Beginning in 1910-1911, adult coho salmon were trapped at the “Klamathon Racks” near the town of Klamathon, which is evidence that they migrated upstream of Iron Gate and Copco Dams.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Proposed Action would restore access for upper Klamath River Population coho salmon to the Hydroelectric Reach, expanding their distribution to include historical habitat along the mainstem Klamath River and all tributaries upstream as far as Spencer Creek; including in Jenny, Shovel, and Fall Creeks (Hamilton et al. 2005). Adults could first access this reach in fall 2020 after dam removal. By this time, elevated SSCs from dam removal would likely have dissipated, returning to background levels similar to those of existing conditions. Most sediment released from the reservoirs would likely be eroded

within the first five months after dam removal (by May 2020), returning sections of river currently inundated by the Four Facilities and riverine sections between reservoirs to pool-riffle morphology. Within this reach, coho salmon generally spawn in tributaries and not within the mainstem Klamath River, but might rear and migrate through the Hydroelectric Reach. Dam removal would result in the provision of suitable rearing habitat for juveniles and spawning habitat for the few individuals that might spawn in the mainstem Klamath River. Access to the cooler waters associated with spring inputs in the Hydroelectric Reach would benefit coho salmon rearing in the mainstem (Hamilton et al. 2011).

The Proposed Action would also eliminate the Four Facilities and would establish a flow regime that more closely mimics natural conditions by increasing spring flow and by incorporating more variability in daily flows. The reservoir drawdowns would allow tributaries and springs such as Fall, Shovel, and Spencer Creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). The removal of the four dams would also likely reduce habitat availability for the polychaete host for *C. shasta* and *P. minibicornis*. Removal of the reservoirs would reduce the amount of lentic habitat available, and increased flow variability would reduce the stability of pools, eddies, and low-velocity habitats. These changes would result in more favorable water temperature for salmonids, and would improve water quality and reduce instances of disease and algal toxins. All of these changes would benefit coho salmon produced in the Hydroelectric Reach in 2020 and thereafter.

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment downstream to the lower Klamath River Reach in the short term and would establish a flow regime that more closely mimics natural conditions in the long term. Suspended sediment effects on coho salmon under the Proposed Action are described in detail in Appendix E, and summarized here. There are nine coho salmon population units in the Klamath River watershed (see Section 3.3.3.1). Only negligible effects from suspended sediment would be expected on the three population units in the Trinity River, and on the lower Klamath River Population Unit relative to existing conditions. Effects on the Salmon River Population Unit are anticipated to remain sublethal even under a worst-case scenario (Table 3.3-7). Effects on the upper Klamath River, mid-Klamath River, Shasta, and Scott population units under the most-likely-to-occur or worst-case scenario are anticipated to be sublethal on most life-stages (Table 3.3-7), with the following exceptions:

- Under the most-likely-to-occur or worst-case scenario coho salmon from the Upper Klamath River Population Unit that spawn in the mainstem, as well as their progeny, would suffer up to 100 percent mortality; however, even under existing conditions and the No Action/No Project Alternative, 80–100 percent mortality is expected due to the effects of suspended sediment on these life stages (in addition to other sources of mortality). Based on spawning surveys conducted from 2001 to 2005 (Magneson and Gough 2006), from 6 to 13 redds could be affected in 2019 during the Proposed Action, many of which are thought to be hatchery

**Table 3.3-7. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Coho Salmon.**

Scenario	Life History Stage: Coho Salmon				
	Adult migration (Sept 1, 2019– Jan 1, 2020)	Spawning through fry emergence (Nov 1, 2019– Mar 14, 2020)	Age 0+ rearing during summer (Mar 15–Nov 14, 2020)	Age 1+ rearing during winter (Nov 15, 2019– Feb 14, 2020)	Outmigration Early spring outmigration: (Feb 15–March 31, 2020) Late spring outmigration: (April 1– June 30, 2020)
Most Likely	<b>Existing Conditions (normal)</b>				
	Stressful SSCs for about 5 days; deleterious affects on adults unlikely	Low survival (<20%)	<b>Age 0+ summer:</b> Major stress for age 0+ from 2020 cohort in mainstem (<50% of fry)	<b>Age 1+ winter:</b> Moderate stress for age 1+ juveniles from 2019 cohort in mainstem (assume <1% of juveniles)	<b>Early spring outmigration:</b> Major stress mortality for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring (approximately 44% of run outmigrate in early spring)
					<b>Late spring outmigration:</b> Major stress for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during late spring (approximately 56% of run)
	<b>Proposed Action</b>				
Major stress and impaired homing	Up to 100% mortality of progeny of mainstem spawners (about 13 redds, or 0.7–26% of Upper Klamath River Population Unit natural escapement)	<b>Age 0+ summer:</b> Reduced growth	<b>Age 1+ winter:</b> Major stress, reduced growth, and up to 20% mortality	<b>Early spring outmigration:</b> Major stress, reduced growth, and up to 20% mortality for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring (~44 percent of run outmigrate in early spring). (2,668 smolts, 3% of total production in basin)	
				<b>Late spring outmigration:</b> Major stress and reduced growth	

**Table 3.3-7. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Coho Salmon.**

Scenario	Life History Stage: Coho Salmon				
	Adult migration (Sept 1, 2019– Jan 1, 2020)	Spawning through fry emergence (Nov 1, 2019– Mar 14, 2020)	Age 0+ rearing during summer (Mar 15–Nov 14, 2020)	Age 1+ rearing during winter (Nov 15, 2019– Feb 14, 2020)	Outmigration Early spring outmigration: (Feb 15–March 31, 2020) Late spring outmigration: (April 1– June 30, 2020)
Worst-case	<b>Existing Conditions (extreme)</b>				
	Major stress and impaired homing	Up to 100% mortality of progeny of mainstem spawners ( about13 redds, or 0.7–26% of Upper Klamath River Population Unit natural escapement)	<b>Age 0+ summer:</b> Major stress and reduced growth for fish rearing in mainstem ( < 50% of fry)	<b>Age 1+ winter:</b> Major stress and reduced growth for fish rearing in mainstem (assume <1% of juveniles)	<b>Early spring outmigration:</b> Major stress and reduced growth for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring (approximately 44% of run outmigrate in early spring)
					<b>Late spring outmigration:</b> Major stress for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during late spring (approximately 56% of run)
	<b>Proposed Action</b>				
Same as existing conditions	Same as existing conditions	<b>Age 0+ summer:</b> No growth	<b>Age 1+ winter:</b> Major stress, reduced growth and up to 52% mortality	<b>Early spring outmigration:</b> Major stress, reduced growth, and up to 49% mortality for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring (approximately 44% of run outmigrate in early spring) (6,536 smolts, 8% of total production in basin)	
				<b>Late spring outmigration:</b> Major stress and reduced growth	

- returning fish (NOAA Fisheries Service 2010a). Based on the range of escapement estimates of Ackerman et al. (2006), 13 redds could represent anywhere from 0.7 to 26 percent of the naturally returning spawning in the Upper Klamath River Population Unit, and much less than 1 percent of the natural and hatchery returns combined.
- Coho salmon smolts outmigrating from tributaries in the Upper or Mid-Klamath River, Shasta, or Scott populations during early spring (around 46 percent of outmigrating smolts compared to those that outmigrate in late spring) are predicted to experience 20 percent mortality under a most-likely-to-occur scenario, or 49 percent mortality under a worst-case scenario. Anticipated total mortality varies by population, and is detailed in Appendix E.

The Proposed Action would also result in the release of bedload sediment, as described in detail in Appendix F. Effects associated with release of coarse sediment are expected to affect the same individuals described for suspended sediment above. For example, bedload sediment is predicted to bury redds constructed in fall 2019, which are the same redds expected to suffer from suspended sediment (~13 redds, or 0.7–26 percent of Upper Klamath River Population unit natural escapement). In addition, bedload sediment could result in the deposition that could aggrade pools or overwhelm other habitat features that coho salmon use for adult holding or juvenile rearing. However, the effect on habitat is anticipated to be short term, and pools would likely return to their pre-sediment release depth within one year (Stillwater Sciences 2008). If the magnitude and duration of flows in spring 2020 are sufficiently high to effectively mobilize the bed, coho salmon spawning habitat in the mainstem downstream of Iron Gate Dam could improve over existing conditions. In the long term, the river is predicted to revert to and maintain a pool-riffle morphology.

The described changes in water temperature would benefit upstream migrant adults and juveniles during fall upstream migration and juvenile redistribution to overwintering habitats by providing a broader window of suitable habitat. Spring outmigrants may also move out earlier, potentially reducing their susceptibility to parasites. As with SSCs, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to poor water quality due to the Proposed Action, but these effects would be short term.

Incidence of disease are expected to be reduced by enhancing the scour capabilities of flow by uninterrupted sediment transport, a flow regime that more closely mimics natural conditions, thereby disturbing the habitat of the polychaete worm that hosts *C. shasta*. Reducing polychaete habitat would likely increase abundance of smolts by increasing outmigration survival.

Estuary The Proposed Action is not expected to substantially change or affect coho salmon estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect coho salmon.* In general, the wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the Proposed Action. However, direct mortality is anticipated for around 13 redds, or 0.7–26 percent of Upper Klamath River Population unit natural escapement. Direct mortality is also anticipated for 2,668 smolts under the most-likely to occur scenario, or 6,536 smolts under a worst-case scenario. This equates to no mortality for the Salmon River, Trinity River, and lower Klamath River populations under the most likely or worst-case scenarios, and 9 percent of the production from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units, or 22 percent under a worst-case scenario. Sublethal effects are anticipated for all other life-stages. All population units would be expected to recover from these losses within one or two generations, given the long-term benefits described below. Although no single year-class is expected to be completely lost, mortality of a portion of the smolt outmigration from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units may affect the strength of the 2018 year class, requiring two or three generations to recover from losses. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units in the short term. Based on no reduction in the abundance of a year class, the effect of the Proposed Action would be less-than-significant for the coho salmon from the three Trinity River population units, Salmon River and the Lower Klamath River Population Unit in the short term.**

Implementation of Mitigation Measures AR-1 through AR-4 (see Section 3.3.4.4) could reduce the short-term effects of SSCs on coho salmon adults, incubating eggs, and smolts. With implementation of mitigation measures there would still be short term effects for coho salmon including direct mortality to as high as 18 percent of the smolts from some population units under a worst-case scenario (see Section 3.3.4.4). **Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would have a significant effect on coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units after mitigation in the short term.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect coho salmon in the long term.* Dam removal would restore connectivity to habitat on the mainstem Klamath River up to and including Spencer Creek and would create additional habitat within the Hydroelectric Reach. It is anticipated that as a result of the Proposed Action, the upper Klamath River, mid-Klamath River, Shasta River, Scott River, Salmon River, and lower Klamath River coho salmon population units would have an increase in abundance, productivity, population spatial structure, and genetic diversity. In general, free flowing conditions as per the Proposed Action, would likely provide optimal efficiency, decrease outmigrant delay, and increase concomitant adult escapement (Buchanan et al. 2011a). It is

anticipated that as a result of the Proposed Action, the three Trinity River population units would have increased productivity. **Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for the coho salmon from the Upper Klamath River, Mid-Klamath River, Lower Klamath River, Shasta River, Scott River, and Salmon River population units in the long term. Based on improved habitat quality, the effect of the Proposed Action on coho salmon from the three Trinity River population units would be less-than-significant for the long term.**

**Steelhead** A Coho Salmon and Steelhead Expert Panel was convened and charged with answering specific questions that had been formulated by the project stakeholders to assist with assessing the effects of the Proposed Action on coho salmon and steelhead (Dunne et al. 2011). The conclusion of the Panel was that the Proposed Action would result in increased spatial distribution and abundance of steelhead. This assessment is based on the observations that steelhead would be able to access a substantial extent of new habitat, steelhead are relatively tolerant to warmer water (compared to coho salmon), they are similar to other species (resident redband/rainbow trout) that are currently thriving in upstream habitats, and that while steelhead are currently at lower abundances than historical values, they are not yet rare. The influence of the Proposed Action within specific reaches is described below.

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Proposed Action, dam removal would allow steelhead to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. This would expand the population's distribution to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). Steelhead are known to use intermittent tributaries for spawning; Huntington (2006), counting only perennial stream miles, estimated that potential new habitat could reach 500 miles. Current distribution of redband trout within areas that would be accessible to steelhead has been estimated at 496 miles by ODFW (W. Tinniswood, pers. comm., 2011). Because redband trout have habitat requirements similar to those of steelhead, this can be used as a rough estimate of habitat that may also be available to steelhead. The Proposed Action would not result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006).

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Proposed Action would restore steelhead access to the Hydroelectric Reach. Adults could first access this reach in fall 2020 (winter steelhead) or winter 2021 (summer steelhead) after dam removal (summer steelhead spawning typically does not begin until December). Elevated suspended sediment concentrations resulting from dam removal would likely have returned to background levels similar to existing conditions. Steelhead could use this reach as a migration corridor, as most sediment released from the reservoirs would likely be eroded within the first 5 months after dam removal (by May 2020) and would not impede upstream movement. Reaches currently inundated by

reservoirs and reaches between reservoirs would likely return to a pool-riffle morphology, which would benefit rearing steelhead.

The Proposed Action would also eliminate the reservoirs and establish a flow regime that more closely mimics natural conditions by increasing spring flow and by incorporating more variability in daily flows. The reservoir drawdowns would allow tributaries and springs such as Fall, Shovel, and Spencer Creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). The action would also be likely to nearly eliminate blue-green algae blooms and their associated toxins, improving water quality. These changes would benefit steelhead.

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment downstream to the lower Klamath River in the short term, and restore a flow regime that more closely mimics natural conditions in the long term. Suspended sediment effects on steelhead under the Proposed Action are described in detail in Appendix E, and summarized here.

Under the most-likely-to-occur scenario or worst-case scenario, no effect from suspended sediment relative to existing conditions is anticipated for the half-pounder life history, all spawning (which occurs primarily in tributaries), and age 0 rearing (Table 3.3-8). Sublethal effects are anticipated for all other life stages (Table 3.3-8), with the following exceptions:

- Under the most-likely-to-occur scenario, up to 36 percent mortality is predicted for the winter run steelhead (up to 1,008 adults, or up to 14 percent of the total winter run escapement). On average around 20 percent of winter steelhead migrate prior to initiation of reservoir drawdown on December 15<sup>th</sup>. In addition, steelhead are highly mobile species that have been known to stray to avoid habitat degradation (Bisson et al. 2005), and regularly occur in environments with high SSC, and therefore the predictions described here are likely more dire than would occur. It is likely that at least some would enter tributaries if conditions within the mainstem were adverse.
- Under the most-likely-to-occur scenario, up to 52 percent mortality is predicted for age 1 juveniles in the mainstem (up to 8,200 juveniles or around 14 percent of total basin-wide age 1 production).
- Under the most-likely-to-occur scenario, up to 52 percent mortality is predicted for age 2 juveniles in the mainstem (up to 6,893 juveniles or around 13 percent of total basin-wide age 2 production).
- Under the worst-case scenario, 0 to 20 percent mortality is predicted for the summer run steelhead (from 0 to 130 adults, or from 0 to 9 percent of the basin-wide escapement).

**Table 3.3-8. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Summer and Winter Steelhead.**

Scenario	Life History Stage: Summer and Winter Steelhead					
	Adult migration Summer run: (Mar 1–June 30, 2020) Winter run: (Aug 1 2019–Mar 31, 2020)	Adult runbacks: (Apr 1–May 30, 2020) Half-pounder residency (Aug 15, 2019–Mar 31, 2020)	Spawning through fry emergence (Dec 1, 2019– June 1, 2020)	Age 0+ rearing (Mar 15– Nov 14, 2020)	Juvenile rearing Age 1+: (year- round 2019 and 2020) Age 2+: (Nov 15, 2019–Mar 31, 2020)	Outmigration (Apr 1–Nov 14, 2020)
Most likely	<b>Existing Conditions (normal)</b>					
	<p><b>Summer run:</b> Major stress, possibly impaired homing for fish spawning in mid- and upper-Klamath tributaries (about 45% of escapement)</p> <p><b>Winter run:</b> Major stress, possibly impaired homing for fish spawning in mid- and upper-Klamath tributaries (about 80% of escapement)</p>	<p><b>Adult runbacks:</b> Major stress depending on time spent in mainstem</p> <p><b>Half-pounder residency:</b> Many will have returned to the ocean or estuary; those remaining may experience major stress in the mainstem, but may avoid suspended sediment by entering nearby tributaries</p>	Most spawning takes place in tributaries; no effects predicted	Major stress for age 0+ juveniles in mainstem (about 60% of juveniles)	<p><b>Age 1+ rearing:</b> Major stress for juveniles in mainstem (about 60% of juveniles)</p> <p><b>Age 2+ rearing:</b> Major stress for juveniles in mainstem (about 60% of juveniles)</p>	Major stress during outmigration, depending on time spent in mainstem; about 57% outmigrate from Trinity River and will have less exposure

**Table 3.3-8. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Summer and Winter Steelhead.**

Scenario	Life History Stage: Summer and Winter Steelhead					
	Adult migration Summer run: (Mar 1–June 30, 2020) Winter run: (Aug 1 2019–Mar 31, 2020)	Adult runbacks: (Apr 1–May 30, 2020) Half-pounder residency (Aug 15, 2019–Mar 31, 2020)	Spawning through fry emergence (Dec 1, 2019– June 1, 2020)	Age 0+ rearing (Mar 15– Nov 14, 2020)	Juvenile rearing Age 1+: (year- round 2019 and 2020) Age 2+: (Nov 15, 2019–Mar 31, 2020)	Outmigration (Apr 1–Nov 14, 2020)
Most likely	<b>Proposed Action</b>					
	<p><b>Summer run:</b> Same as existing conditions</p> <p><b>Winter run:</b> Major stress, impaired homing, and up to 36% mortality (Up to 1,008 adults, or up to 14% of the total escapement)</p>	<p><b>Adult runbacks:</b> Same as existing conditions</p> <p><b>Half-pounder residency:</b> Same as existing conditions</p>	Same as existing conditions	Major stress resulting in reduced growth	<p><b>Age 1+ rearing:</b> Major stress, reduced growth, and up to 52% mortality. (Up to 8,200 juveniles or around 14% of total age 1 production)</p> <p><b>Age 2+ rearing:</b> Reduced growth and up to 52% mortality (Up to 6,893 juveniles or around 13% of total age 2 production)</p>	Major stress and reduced growth

**Table 3.3-8. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Summer and Winter Steelhead.**

Scenario	Life History Stage: Summer and Winter Steelhead					
	Adult migration Summer run: (Mar 1–June 30, 2020) Winter run: (Aug 1 2019–Mar 31, 2020)	Adult runbacks: (Apr 1–May 30, 2020) Half-pounder residency (Aug 15, 2019–Mar 31, 2020)	Spawning through fry emergence (Dec 1, 2019– June 1, 2020)	Age 0+ rearing (Mar 15– Nov 14, 2020)	Juvenile rearing Age 1+: (year- round 2019 and 2020) Age 2+: (Nov 15, 2019–Mar 31, 2020)	Outmigration (Apr 1–Nov 14, 2020)
Worst-case	<b>Existing conditions (extreme)</b>					
	<p><b>Summer run:</b> Major stress, impaired homing for fish spawning in mid- and upper-Klamath tributaries (about 53% of run)</p> <p><b>Winter run:</b> Major stress and potential for impaired homing for fish spawning in mid- and upper-Klamath tributaries (about 80% of run)</p>	<p><b>Adult runbacks:</b> Major stress; exposure dependant on time it takes runbacks to return to sea</p> <p><b>Half-pounder residency:</b> Major stress and reduced growth for any in mainstem, but most assumed to remain in tributaries or to have returned to the ocean or estuary. Those remaining may experience major stress and reduced growth in the mainstem, but may avoid suspended sediment by entering nearby tributaries.</p>	Most spawning takes place in tributaries; no effects predicted	Major stress and reduced growth for age 0+ juveniles in mainstem (about 60% of juveniles)	<p><b>Age 1+ rearing:</b> Stress, reduced growth, and up to 20% mortality for juveniles in mainstem (about 60% of juveniles)</p> <p><b>Age 2+ rearing:</b> Major stress and reduced growth for juveniles in mainstem for juveniles in mainstem (about 60% of juveniles)</p>	Major stress resulting in reduced growth, about 57% outmigrate from Trinity River and will have less exposure

**Table 3.3-8. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario SSCs Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Summer and Winter Steelhead.**

Scenario	Life History Stage: Summer and Winter Steelhead					
	Adult migration Summer run: (Mar 1–June 30, 2020) Winter run: (Aug 1 2019–Mar 31, 2020)	Adult runbacks: (Apr 1–May 30, 2020) Half-pounder residency (Aug 15, 2019–Mar 31, 2020)	Spawning through fry emergence (Dec 1, 2019– June 1, 2020)	Age 0+ rearing (Mar 15– Nov 14, 2020)	Juvenile rearing Age 1+: (year- round 2019 and 2020) Age 2+: (Nov 15, 2019–Mar 31, 2020)	Outmigration (Apr 1–Nov 14, 2020)
Worst-case	<b>Proposed Action</b>					
	<p><b>Summer run:</b> Major stress, impaired homing, and up to 20% mortality (from 0 to 130 adults, or from 0 to 9% of the basin-wide escapement)</p> <p><b>Winter run:</b> Major stress, impaired homing, and up to 71% mortality. The proportion migrating prior to January would not be affected. (Up to 1,988 adults, or up to 28% of the basin-wide escapement).</p>	<p><b>Adult runbacks:</b> Major stress</p> <p><b>Half-pounder residency:</b> Same as existing conditions</p>	Same as existing conditions	Same as existing conditions	<p><b>Age 1+ rearing:</b> Stress, reduced growth, and up to 71% mortality Up to 11,207 juveniles or around 19% of total age 1 production)</p> <p><b>Age 2+ rearing:</b> Stress, reduced growth and up to 71% mortality (Up to 9,412 juveniles or around 18% of total age 2 production).</p>	Same as existing conditions

- Under the worst-case scenario, 71 percent mortality is predicted for the winter run steelhead (up to 1,988 adults, or up to 28 percent of the basin-wide escapement). On average around 20 percent of winter steelhead migrate prior to initiation of reservoir drawdown on December 15<sup>th</sup>. In addition, steelhead are highly migratory species that stray to avoid habitat degradation (Bisson et al. 2005), and regularly occur in environments with high SSC, and therefore the predictions described here are likely more dire than would occur.
- Under the worst-case scenario, up to 71 percent mortality is predicted for age 1 juveniles in the mainstem (up to 11,207 juveniles or around 19 percent of total basin-wide age 1 production).
- Under the worst-case scenario, up to 71 percent mortality is predicted for age 2 juveniles in the mainstem (up to 9,412 juveniles or around 18 percent of total basin-wide age 2 production).

As described in detail in Appendix F, dam-released sediment associated with the Proposed Action might aggrade pools or overwhelm other habitat features used for adult holding or juvenile rearing above Cottonwood Creek. The effect would be short term, as pools would likely return to their pre-sediment release depth relatively quickly (Stillwater Sciences 2008). In the long term, the river would revert to and maintain a pool-riffle morphology.

The Proposed Action would establish a flow regime that more closely mimics natural conditions in the lower Klamath River. Dam removal would cause water temperatures to warm earlier in the spring and early summer and cool earlier in the late summer and fall, and to have diurnal variations more in sync with historical migration and spawning periods. These changes would result in water temperature more favorable for salmonids occurring in the mainstem. Migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to low dissolved oxygen due to the Proposed Action, but these effects would be short term. Restoring flow variability and natural sediment transport processes would likely reduce habitat conditions for the polychaete host for salmonid parasites, although this would benefit Chinook and coho salmon to a greater degree because steelhead are generally resistant to infection. All of these long-term changes would benefit steelhead using the lower Klamath River Reach.

Estuary The Proposed Action is not expected to substantially change or affect steelhead estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect steelhead.* In general, the effects of suspended sediment resulting from the Proposed Action on steelhead are likely to be much higher than under existing conditions and the No Action/No Project Alternative, particularly for the portion of the population that spawns in tributaries upstream of the Trinity River. For that portion of the population, effects are anticipated for at least six year-classes, including on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and outmigrating smolts. However, the broad spatial

distribution of steelhead in the Klamath Basin and their flexible life history suggests that some will avoid the most serious effects of the Proposed Action by (1) remaining in tributaries for extended rearing, (2) rearing farther downstream where SSC should be lower due to dilution (e.g., the progeny of the adults that spawn in the Trinity River Basin or tributaries downstream of the Trinity River), and/or (3) moving out of the mainstem into tributaries and off-channel habitats during winter. In addition, the life-history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to the effects of the Proposed Action. In addition, some portion of the progeny of those adults that spawn successfully would rear in tributaries long enough to not only avoid the most serious impacts of the Proposed Action in 2020, but may also not return to spawn for up to two years, when any suspended sediment resulting from the Proposed Action should be greatly reduced. The high incidence of repeat spawning among summer-run steelhead (ranging from 40 to 64 percent, Hopelain 1998) should also increase that population's resilience (including of all year classes) to effects of the Proposed Action. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for summer and winter steelhead in the short term.**

Implementation of Mitigation Measures AR-2 and AR-3 (see Section 3.3.4.4) could be implemented to reduce the short-term effects of SSCs on steelhead adults and outmigrating juveniles. With implementation of mitigation measures there would still be short-term effects on summer and winter steelhead, including sublethal and lethal effects. **Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would be a significant effect on summer and winter steelhead in the short term after mitigation.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and algal toxins which could affect steelhead in the long term.* Dam removal would restore connectivity to 496 miles of historical habitat in the Upper Klamath Basin and would create additional habitat within the Hydroelectric Reach (W. Tinniswood, pers. comm., 2011). It is anticipated that as a result of the Proposed Action the summer and winter steelhead within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. In general, free flowing conditions as per the Proposed Action, would likely provide optimal efficiency, decrease outmigrant delay, and increase concomitant adult escapement (Buchanan et al. 2011a). Almost any type of fish passage structure would be less efficient as a migration corridor for fish than removing the obstacle to passage itself. For example, fish ladders may cause delays in adult upstream migration or may become blocked by debris, and juvenile fish may have to navigate through impoundments with poor water quality or non-native predatory fish. Any of these potential factors has a chance of affecting fitness, survival, or reproductive success (Buchanan et al. 2011a). By providing an unimpeded migration corridor, the Proposed Action would provide the greatest possible benefit related to fish passage, hence, the highest survival and reproductive success. **Based on increased habitat**

**availability and improved habitat quality, the effect of the Proposed Action would be beneficial for summer and winter steelhead in the long term.**

**Pacific Lamprey** A Lamprey Expert Panel (Panel) was convened to compare the potential effects of the Proposed Action and existing conditions on lamprey (Close et al.2010). The conclusion was that the Proposed Action could increase Pacific lamprey production by up to 14 percent. The increase could potentially be more if habitat in the Upper Klamath Basin is accessible and suitable. The Panel expects that adult Pacific lamprey would recolonize newly accessible habitat after dam removal, but natural colonization of all habitat available to them may take decades. Larval rearing capacity downstream of Iron Gate Dam is expected to increase after dam removal because a large amount of fine sediment—a major component of larval rearing habitat—would be released through dam removal. The available burrowing habitat for larvae would subsequently decrease over time, but would likely remain higher than under current conditions because sediment input and transport processes would be restored and KBRA measures would increase sediment transport (Close et al. 2010). In addition, the return to a temperature regime and flows that more closely mimic natural patterns would likely benefit Pacific lamprey, which evolved under those conditions. The influence of the Proposed Action within specific reaches is described below.

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Pacific lamprey did not historically occur upstream of J.C. Boyle Reservoir (Hamilton et al. 2005) and are not anticipated to occupy this reach after implementation of this alternative.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Proposed Action would provide Pacific lamprey with access to the Hydroelectric Reach and to the mainstem Klamath River and its tributaries upstream as far as Spencer Creek, including Jenny, Shovel, and Fall creeks (Hamilton et al. 2011). Most sediment released from the reservoirs would likely be eroded within the first five months after dam removal (by May 2020), returning sections of river currently inundated by reservoirs and riverine sections between reservoirs to a pool-riffle morphology. After erosion of dam-stored sediment, the Hydroelectric Reach would likely contain gravel suitable for lamprey spawning and rearing.

The Proposed Action would also eliminate the reservoirs and establish a flow regime that more closely mimics natural conditions. Drawing down the reservoirs would allow tributaries and springs such as Fall, Shovel, and Spencer Creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). These changes would result in more favorable water temperatures for native fishes, and improved water quality. These changes would provide a long-term benefit to Pacific lamprey produced in the Hydroelectric Reach.

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment and reduce dissolved oxygen downstream to the lower Klamath River in the short term, and restore a flow regime that more closely mimics natural conditions in the long term. Suspended sediment effects on Pacific lamprey under the Proposed Action are described in detail in Appendix E, and summarized here.

Under the most-likely-to-occur scenario or worst-case scenario sublethal effects from suspended sediment relative to existing conditions is anticipated for outmigrants, and for Pacific lamprey migrating to or from the Trinity River or tributaries further downstream (Table 3.3-9). High rates of mortality are predicted for adults and ammocoetes in the mainstem Klamath River during winter and spring 2020. However, there is little to no literature on the effects of suspended sediment on lamprey. This analysis used the effects of suspended sediment on salmonids to predict effects on lamprey, with the assumption that effects on lamprey are equivalent or less severe than on salmonids. In general, most life stages of Pacific lamprey appear more resilient to poor water quality conditions than salmonids (Zaroban et al. 1999), so this is likely a conservative assessment of potential effects.

The Proposed Action would affect spawning and incubation in the area between Iron Gate Dam and Cottonwood Creek by burying gravel in dam-released sediment and increasing the proportion of sand in the bed, thereby decreasing ammocoete survival. The river would be expected to return to its existing bedform after a few years.

The Proposed Action would establish a flow regime that more closely mimics natural conditions in the lower Klamath River Reach. Dam removal would cause water temperatures to have natural diurnal variations. These changes would result in water temperatures that are more similar to those that Pacific lamprey evolved with and would improve water quality. These long-term changes would likely provide a benefit to Pacific lamprey using the lower Klamath River.

Estuary The Proposed Action is not expected to substantially change or affect Pacific lamprey estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

**Table 3.3-9. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Pacific Lamprey.**

Scenario	Life History Stage: Pacific Lamprey		
	Adult Migration and Spawning (all of 2020)	Ammocoete Rearing (all of 2020)	Outmigration Spring (May 1–June 30, 2020) Fall/winter (Sept 1–Dec 31, 2020)
Most Likely	<b>Existing Conditions (normal)</b>		
	Major stress and impaired homing; later-returning adults and those returning to lower tributaries would have less exposure	<b>Ammocoete rearing:</b> Major stress of ammocoetes in mainstem for multiple year classes of ammocoetes in mainstem; majority rear in tributaries and would have lower exposure	<b>Spring outmigration:</b> Major stress
			<b>Fall and winter outmigration:</b> Moderate stress and reduced feeding
	<b>Proposed Action</b>		
Major stress and up to 36% mortality; later-returning adults and those returning to lower tributaries would have less exposure	<b>Ammocoete rearing:</b> Major stress, reduced growth, and up to 52% mortality	<b>Spring outmigration:</b> Same as existing conditions	
		<b>Fall and winter outmigration:</b> Same as existing conditions	
Worst-case	<b>Existing Conditions (extreme)</b>		
	Major stress and impaired homing; later-returning adults and those returning to lower tributaries would have less exposure	<b>Ammocoete rearing:</b> Major stress and reduced growth	<b>Spring outmigration:</b> Moderate to major stress and reduced growth
			<b>Fall and winter outmigration:</b> Major stress
	<b>Proposed Action</b>		
Major stress, reduced growth, and up to 71% mortality	<b>Ammocoete rearing:</b> Major stress, reduced growth, and up to 71% mortality for multiple year classes of ammocoetes in mainstem; majority rear in tributaries and would not suffer mortality	<b>Spring outmigration:</b> Same as existing conditions	
		<b>Fall and winter outmigration:</b> Same as existing conditions	

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect Pacific lamprey.* The Proposed Action would have short-term effects related to SSCs, bedload sediment transport and deposition, and water quality (particularly dissolved oxygen). Overall, because multiple year classes of lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including January 2020 when effects from the Proposed Action will be most pronounced, effects on Pacific lamprey adults and ammocoetes could be much higher in the mainstem Klamath River than under existing conditions and the No Action/No Project Alternative. However, most of the population would likely avoid the most severe suspended sediment pulses resulting from the Proposed Action. In addition, Pacific lamprey are considered to have low fidelity to their natal streams, and may not enter the mainstem Klamath River if environmental conditions are unfavorable in 2020. Migration into the Trinity River and other lower Klamath River tributaries may also increase during 2020 because of poor water quality. Low fidelity also increases the potential that lamprey can recolonize mainstem habitat if ammocoetes rearing there suffer high mortality. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for Pacific lamprey in the short term.**

Implementation of Mitigation Measures AR-2 and AR-5 (see Section 3.3.4.4) could be implemented to reduce the short-term effects of dissolved oxygen and SSCs on lamprey ammocoetes. With implementation of mitigation measures there could still be short-term effects for lamprey including sublethal and lethal effects. **Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would be a significant effect on Pacific lamprey in the short term after mitigation.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation which could affect Pacific lamprey in the long term.* The Proposed Action would provide access to habitat in the Hydroelectric Reach and tributaries to this reach. It is anticipated that as a result of the Proposed Action the Pacific lamprey population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. **Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for Pacific lamprey in the long term.**

**Green Sturgeon** Listed Southern Green Sturgeon may enter the Klamath River estuary to forage during the summer months. They would not be present when the most severe effects of dam removal are occurring, and are not expected to be affected by the Proposed Action. The remainder of this section focuses on the effects of the Proposed Action on the Northern Green Sturgeon DPS. Northern Green Sturgeon do not occur upstream of Ishi Pishi Falls and would not be affected by Proposed Action effects that do not extend downstream past these falls.

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment downstream to the lower Klamath River in the short term, and restore a flow regime that more closely mimics natural seasonal flow patterns in the

long term. Suspended sediment effects on green sturgeon under the Proposed Action are described in detail in Appendix E, and summarized here.

Under the most-likely-to-occur scenario or worst-case scenario no effect relative to existing conditions is predicted for adults (Table 3.3-10), mostly because green sturgeon distribution within the mainstem Klamath River is primarily limited to areas downstream of Orleans, where the effects of SSC resulting from the Proposed Action are more diluted from tributary accretion. Up to 100 percent mortality is predicted for incubating eggs and larval life stages, and up to 20 percent mortality is predicted for rearing juveniles under a most-likely-to-occur scenario, or up to 40 percent mortality under a worst-case scenario. However, around 30 percent of juveniles rear in the Trinity River and would not be exposed to SSC from the Proposed Action.

Bedload sediment effects related to dam-released sediment would not extend as far downstream to Ishi Pishi Falls and would not affect green sturgeon.

The Proposed Action would establish a flow regime that more closely mimics natural conditions in the lower Klamath River and would improve water quality and reduce instances of algal toxins. These long-term effects would benefit green sturgeon using the lower Klamath River reach.

Estuary The Proposed Action is not expected to substantially change or affect estuarine habitat. Sediment, flow, and water temperature effects resulting from the Proposed Action would likely not extend downstream to the estuary.

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and affect green sturgeon.* Overall the effects of the Proposed Action are most likely to include physiological stress, inhibited growth, and high mortality for some portion of the age-0 2020 cohort and age 1 2019 cohort. However, effects on salmonids likely overestimate those on sturgeon. To summarize, green sturgeon in the Klamath Basin have the following traits likely to enhance the species' resilience to impacts of the Proposed Action:

- Most of the population (subadult and adult) would be in the ocean during the year of the Proposed Action (2020) and would be unaffected (Appendix E).
- The approximately 30 percent of the population that spawn and rear in the Trinity River would be unaffected.
- Much of the spawning and rearing of green sturgeon occurs downstream of the Trinity River, where sediment concentrations would be similar to existing conditions and the No Action/No Project Alternative.
- Green sturgeon are long-lived (>40 years) and are able to spawn multiple times (~8 times) (Klimley et al. 2007), so effects on two year classes may have little influence on the population as a whole.

**Table 3.3-10. Proposed Action, Most-Likely Scenario SSCs Compared with Normal Existing Conditions (50% Exceedance Probabilities) and Proposed Action, Worst-Case Scenario Compared with Extreme Existing Conditions (10% Exceedance Probabilities) for Green Sturgeon. Based on salmonid literature; effects likely overestimated.**

Scenario	Life History Stage: Green Sturgeon			
	Adult migration	Post-spawning holding	Spawning through hatching/larvae	Juvenile Rearing (year-round) and Outmigration
Most Likely	<b>Existing conditions (normal)</b>			
	Moderate to major stress; 75% of adults not expected to migrate in 2020	No effects	Up to 68% mortality; about 30% that spawn in Trinity River would be unaffected (based on salmonid literature; effects likely overestimated)	Major stress; about 30% of juveniles rear in Trinity River and would be unaffected (based on salmonid literature; effects likely overestimated)
	<b>Proposed Action</b>			
	Major stress	Same as existing conditions	76% mortality for all mainstem production	Reduced growth and up to 20% mortality
Worst-case	<b>Existing conditions (extreme)</b>			
	Major stress	Short period (<1 week) of relatively low SSCs, not expected to result in deleterious effects	84% mortality for all mainstem production	Major stress and reduced or no growth (based on salmonid literature; effects likely overestimated)
	<b>Proposed Action</b>			
	Same as existing conditions; about 25% of adults expected to be exposed in 2020	Same as existing conditions; about 75% of adults hold in mainstem after spawning; remainder return to ocean	95% mortality for all mainstem production ; about 30% that spawn in Trinity River would be unaffected	Reduced growth and up to 36% mortality; about 30% of juveniles rear in Trinity River and would be unaffected

**Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for green sturgeon in the short term.**

Implementation of Mitigation Measure AR-3 (see Section 3.3.4.4) could be implemented to reduce the short-term effects of SSCs on green sturgeon adults post-spawning. With implementation of mitigation measures there would still be short-term effects for green sturgeon including sublethal and sublethal effects. **Based on substantial reduction in the abundance of a year class in the short term, the Proposed Action would be a significant effect on green sturgeon in the short term after mitigation.**

*Under the Proposed Action, removal of dams could result in alterations in flow regime, water quality, temperature variation, and algal toxins which could affect green sturgeon in the long term.* It is anticipated that as a result of the Proposed Action, the green sturgeon population within the Klamath River watershed would have an increased productivity. **Based on improvements in habitat quality within part of their range, the effect of the Proposed Action would be less-than-significant for green sturgeon in the long term.**

#### **Lost River and Shortnose Sucker**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Proposed Action, water elevations in Upper Klamath Lake would be higher, which would benefit Lost River and shortnose suckers, but the difference in habitat value would not be substantive. The KBRA is expected to provide benefits to sucker populations through the following measures: nutrient reduction, reconnecting former wetlands to Agency Lake, reconstructing quality rearing habitat for early life stages, and restoring shoreline spring spawning habitat restoration, among others.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Lost River and shortnose suckers are found within reservoirs in Hydroelectric Reach. The Proposed Action would eliminate reservoir habitat, and as dams within the Hydroelectric Reach were removed, sediment would move downstream. Under the Proposed Action adult Lost River and shortnose suckers in reservoirs downstream of Keno Dam would be captured and relocated to Upper Klamath Lake (Buchanan et al. 2011a). Those not relocated to the Upper Basin would likely be lost; however, little or no reproduction occurs downstream of Keno Dam (Buettner et al. 2006), there is no potential for interaction with upstream populations, and they are not considered to substantially contribute to the achievement of conservation goals or recovery (Hamilton et al. 2011). Lost River and shortnose suckers are listed as fully protected species under California Fish and Game code; thus, any take of these species is prohibited. However, a component of the Proposed Action includes legislation to permit the take of some individuals during implementation.

Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). Generally, with the exception of *F. columnaris* and

Ich, pathogens associated with anadromous fish do not impact non-salmonids (e.g. suckers) (Administrative Law Judge 2006).

*Reservoir removal associated with dam removal under the Proposed Action could alter habitat availability and affect lost river and shortnose suckers. **Based on reduction in abundance within reservoirs, the effect of the Proposed Action would be significant for Lost River and shortnose sucker populations in the short term.***

Implementation of Mitigation Measure AR-6 (see Section 3.3.4.4) could be implemented to reduce the impact to individuals within reservoirs by rescuing fish prior to reservoir drawdown. **Based on small numbers of individuals affected after mitigation, and on anticipated legislation allowing take, the effect of the Proposed Action would be less-than-significant for Lost River and shortnose sucker populations in the short term after mitigation.**

*Restoration action associated with KBRA implementation under the Proposed Action could alter habitat availability and suitability and affect lost river and shortnose suckers. In the long term, restoration actions under KBRA are anticipated to improve conditions for sucker populations within Klamath Lake. **Based on improved habitat quality, the effect of the Proposed Action would be beneficial for Lost River and shortnose sucker populations in the long term.***

**Redband Trout** A Resident Fish Expert Panel (Panel) was convened to compare the potential effects of the Proposed Action and existing conditions on resident fish, including redband trout (Buchanan et al. 2011a). The Panel concluded that the habitat improvements associated with KBRA implementation, including water quality and quantity and riparian corridor improvements and protection, are anticipated to increase trout productivity in headwater and lower tributary areas of the Upper Klamath Lake Basin. The Panel predicted that following the Proposed Action, the abundance of redband trout in the free-flowing reach between Keno Dam and Iron Gate Dam could increase significantly. In addition, they expect the existing trout and colonizing anadromous steelhead to co-exist, as they do in other watersheds, although there may be shifts in abundance related to competition for space and food. The influence of the Proposed Action within specific reaches is described below.

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Proposed Action, redband trout would be able to migrate more successfully from the Hydroelectric Reach to the Upper Klamath Basin (Hamilton et al. 2011) than under existing conditions. Establishment of a flow regime that more closely mimics natural conditions downstream of Keno Dam would eliminate the stranding of redband trout caused by flow reductions at Klamath Hydroelectric Project facilities, and would create stable stream habitat between J.C. Boyle Reservoir and the California state line.

Redband trout could be affected by increased predation from reintroduced salmonids, but this loss might be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Hamilton et al. 2011). Adult salmon moving into the Upper Basin would likely bring with them genotypes of *C. shasta* that had previously

been restricted to the lower river. However, facilitating the movement of anadromous fish presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). While the effects of these introductions are uncertain, at least some degree of host specificity appears to exist (Atkinson and Bartholomew 2010), indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes. Additionally, the changes in habitat that could result from dam removal (fewer areas of slow-flowing, stable habitat) would likely reduce the density of polychaete populations, resulting in reduced disease exposure for fish. The close similarities between anadromous steelhead trout and resident rainbow/redband trout suggest these species historically co-existed. The distribution and resistance of rainbow/redband trout in Upper Klamath Lake to *C. Shasta* lends additional support that the two species co-existed and intermingled prior to the construction of Copco 1 Dam in 1917. There are many examples from nearby river systems in the Pacific Northwest showing that wild anadromous salmon and resident rainbow/redband trout can co-exist and maintain abundant populations without negative consequences. The Deschutes River in Oregon, the Yakima River in Washington, and the river systems in Idaho are examples (Administrative Law Judge 2006).

#### Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam

Under existing conditions, redband trout are found within the Hydroelectric Reach, migrating between tributaries and the reservoirs to complete their life cycle (Hamilton et al. 2011). Redband trout throughout this reach of the mainstem, except upstream of J.C. Boyle Reservoir, would be affected by high suspended sediment concentrations for a period of three to four months during reservoir drawdown associated with the Proposed Action. Redband trout in riverine reaches between the reservoirs in the Hydroelectric Reach would be vulnerable to sublethal and lethal effects of sediment released during dam removal and bedload deposition (Newcombe and Jensen 1996, Buchanan et al. 2011a); however, a large proportion of the adult population should be already spawning in Spencer or Shovel creeks during the dam removal. Juvenile redband trout outmigrating from Spencer Creek would be expected to recolonize the mainstem by late spring or summer when water conditions become suitable. Those in the affected area could move to tributaries for refuge.

The Proposed Action would eliminate reservoir habitat, returning sections of river currently inundated by reservoirs and riverine sections between reservoirs to a pool-riffle morphology. Modeling data indicate that after dam removal, spawning gravel in all sections of the Hydroelectric Reach would be within the range usable for salmonids, but the amount of sand within the bed within former reservoir sections might inhibit spawning success. Riverine sections between reservoirs would be expected to provide the gravel with very little sand, suggesting high-quality spawning habitat. The initial movement of coarse and fine sediment after drawdown would likely create unfavorable conditions for redband trout within the mainstem Klamath River, but these conditions would be short term. Buchanan et al. (2011a) estimate that 43 miles of additional riverine habitat would be available to resident redband trout as a result of the Proposed Action. The adfluvial life-history strategy would no longer be possible within this reach. Migratory opportunities would increase for these fish, allowing them to access areas with

suitable habitat when conditions become unfavorable in one area of their range. The Proposed Action would also increase the number of thermal refugia available to redband trout as they would have access to more tributaries, as well as to the cool areas near the mouths of tributaries and the many springs in this reach.

*The Proposed Action would have short term effects related to SSCs and bedload movement. Based on a small proportion of the population with a potential to be exposed to short-term effects, the effect of the Proposed Action would be less-than-significant for redband trout in the short term.*

*Dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional riverine habitat within the Hydroelectric Reach. Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for redband trout in the long term.*

### **Bull Trout**

Upper Klamath River Upstream of the Influence of J.C. Boyle Reservoir To evaluate the effects of the Proposed Action on bull trout, a four member expert panel (Buchanan et al. 2011a) was convened and tasked with reviewing all available information on bull trout in the upper Klamath River, and information on potential effects of the Proposed Action. The panel concluded that the Proposed Action provides promise for preventing extinction of bull trout and for increasing overall population abundance and distribution (Buchanan et al. 2011a).

Buchanan et al. (2011a) observed that the proposed KBRA actions would enhance resident populations of headwater bull trout, and implementation of KBRA could have a significant contribution toward recovery of these populations. Passage from Sun Creek to the Wood River may be improved by KBRA actions allowing for fluvial life history forms of bull trout in the Wood River system. The cold waters of the Wood River may successfully provide habitat for reintroductions of anadromous salmon and steelhead. Rearing anadromous juveniles could provide an increased prey base for fluvial bull trout and produce predator/prey interactions ecologically similar to historical conditions (Buchanan et al. 1997).

*Dam removal associated with the Proposed Action could alter habitat availability for anadromous fish, which could affect bull trout. Based on the restricted distribution of bull trout, the Proposed Action would have a less-than-significant impact on bull trout in the short and long term.*

### **Eulachon**

Lower Klamath River: Downstream of Iron Gate Dam The Proposed Action would release dam-stored sediment downstream to the lower Klamath River. Adult eulachon entering the Klamath River after January 2020 might be exposed to elevated SSCs for a portion of their migration period. However, these SSCs are expected to be similar to those encountered about one in ten years under existing conditions. Because eulachon generally occur within 8 miles of the coast and dam-release-related SSCs would decrease

in the downstream direction from Iron Gate Dam due to dilution from tributaries, the magnitude of the effect would likely be low. Short-term decreases in water quality associated with the Proposed Action might affect adults and larvae in the mainstem Klamath River. As with SSCs, these effects might be muted by tributary inputs.

Estuary The Proposed Action is not expected to substantially change or affect estuarine habitat. SSCs are likely to be elevated above those occurring normally under existing conditions, but would be similar to those observed under extreme existing conditions. In the long term, sediment, flow, and water temperature effects resulting from the Proposed Action would likely not extend downstream to the estuary.

*The Proposed Action would have short term effects related to SSCs and bedload movement. **Based on short duration of poor water quality during reservoir drawdown in the estuary, the Proposed Action would have a less-than-significant effect on eulachon in the short and long term.***

**Longfin Smelt** Impacts to longfin smelt would be the same as those described for eulachon.

**Based on short duration of poor water quality during reservoir drawdown in the estuary, the Proposed Action would have a less-than-significant effect on longfin smelt in the short and long term.**

### **Introduced Resident Species**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Introduced resident species occur in Lake Ewauna and Upper Klamath Lake, but the Proposed Action would not affect populations in this area.

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Proposed Action would eliminate reservoir habitat upstream of Iron Gate Dam, and thus the abundance of these species would decline substantially or be reduced to nothing, as their preferred reservoir habitat would be eliminated (Buchanan et al. 2011a).

Lower Klamath River: Downstream of Iron Gate Dam A few introduced resident species occur in the lower Klamath River, but habitat conditions there are generally not suitable for these species. Under the Proposed Action, conditions would be expected to become less suitable.

*The Proposed Action would eliminate habitat for introduced resident species in the Hydroelectric Reach. **Because these species were introduced and they occur in other nearby water bodies, their loss would not be considered significant from a biological perspective, and would benefit native species. Their loss would, however, decrease opportunities for recreational fishing for these species, as discussed in Section 3.20, Recreation.***

### **Freshwater mussels**

Suspended Sediment Concentrations Due to the limited data available regarding overall abundance, distribution, life history, and population recruitment of freshwater mussels within the mainstem Klamath River, the overall effects that would be associated with predicted short- and long-term exposure to elevated SSCs on freshwater mussel populations as a result of the Proposed Action are difficult to determine.

Under the Proposed Action, SSCs would be expected to be higher than under existing conditions and would likely exceed 600 mg/L, the minimum SSCs level that would be considered detrimental to freshwater mussels, for 2 to 4 months after facility removal, depending on hydrologic conditions and location on the river. The SSCs in excess of 600 mg/L for 2 to 3 months would occur as far downstream as Klamath Station (at RM 5.0; see Figure 3.3-10); however, the highest levels, well in excess of 1,000 mg/L, would occur between Seiad Valley and Iron Gate Dam. Over time, as sediment stored behind the dams was diminished, the expected increase in SSCs over background levels would also diminish. Under existing conditions, SSCs could spike to levels exceeding 600 mg/L upstream of Orleans, although these spikes generally occur for a few days as opposed to several months, which is what would be expected under the Proposed Action. SSCs in excess of 600 mg/L for more than 4- to 5-day periods within the mainstem Klamath River would cause major physiological stress to freshwater mussels and might result in substantial mortality. The most significant impacts would occur downstream of Iron Gate Reservoir, especially to those individual freshwater mussels or freshwater mussel beds upstream of Orleans and closest to Iron Gate Dam.

Because freshwater mussels found within the Klamath River are so long lived (from 10 to more than 100 years, depending on the species) and sexual maturity might not be reached until 4 years of age or more, even relatively short term (e.g., for more than 5 consecutive days) SSCs in excess of 600 mg/L, would be expected to be detrimental for freshwater mussel populations within the mainstem Klamath River. However, it is anticipated that mainstem Klamath freshwater mussel populations would rebound, recolonizing through the transport of larvae (glochidia) by host fish from downstream populations less affected by excessive SSCs or from populations within tributaries, such as the Salmon or Scott Rivers, or from populations on the Klamath River upstream of Iron Gate Reservoir. This process is expected to take many years, however.

Changes in Bed Elevation Silt and fine material make up the largest proportion of the volume of sediment stored behind the dams and would be transported downstream primarily as suspended sediment. Coarser material (larger than 0.063 mm) would also be transported downstream and would likely be deposited in the river channel, changing riverbed elevations from the existing condition 8 miles between Iron Gate Dam and Cottonwood Creek. The 182 miles of mainstem downstream of Cottonwood Creek are not predicted to have any substantial aggradation.

Of the freshwater mussel species found on the mainstem Klamath River, the western ridge freshwater mussel (*G. angulata*) seems to be the most abundant and is widely distributed between Iron Gate Dam and the confluence of the Trinity River (Westover 2010). The floater species (*Anodonta spp.*) are less abundant, with the largest single bed

found immediately below Iron Gate Dam (Westover 2010). The western pearlshell (*Margaritifera falcata*) is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found below the confluence of the Salmon River (Westover 2010). It is not known how well any of these species could tolerate deposition of sediment and whether they could move upward through deposited material to the surface to breathe and feed. It seems reasonable to presume that some percentage of Klamath River freshwater mussels buried under 0.5 to 3.0 feet of new sediment would not survive. Because of the relatively small area affected, these changes in bed elevation are not expected to substantially affect the overall population of freshwater mussels. It is anticipated that Klamath freshwater mussel populations would rebound eventually, recolonizing through the transport of larvae (*glochidia*) by host fish from downstream populations less affected by bed elevation changes or from populations within tributaries, such as the Trinity, Salmon or Scott Rivers, or from populations on the Klamath River upstream of Iron Gate Reservoir. However, due to the extended time it takes for freshwater mussels to reach sexual maturity (4 years or more, depending on the species), the reestablishment of freshwater mussel populations within affected reaches might be slow and might not be readily noticeable for some time, possibly a decade or more. The seven to eight species of fingernail clams and peaclams, including the montane peaclam, found in the Hydroelectric Reach and from Iron Gate Dam to Shasta River, are expected to be similarly affected.

Changes in Bed Substrate Draining the Four Facilities under the Proposed Action would result in the erosion of accumulated sediments, changing substrate characteristics within the Klamath River, especially within the current reservoir reaches. The reformation of river channels in the reservoir reaches is expected to occur within 5 months (see Figure 3.3-9). The reformation of river channels between Iron Gate Dam and the upstream reaches of J.C. Boyle Reservoir would benefit freshwater mussels by providing more suitable substrates (i.e., large gravel, cobble, and boulder) than currently exists, especially within the current reservoir reaches. In addition, the Proposed Action would also open access to river reaches upstream of Iron Gate Dam to migratory fish species, which might serve as host fish for parasitic freshwater mussel larvae (*glochidia*). As a result, suitable habitats upstream of Iron Gate Dam might be opened to additional, or more rapid, colonization of freshwater mussel species, transported as *glochidia* from downstream reaches by migratory fish species, which are currently blocked by Iron Gate Dam. However, due to the long time it might take for freshwater mussels to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam might be slow and might not be readily noticeable for some time.

*The Proposed Action would have short term effects related to SSCs and bedload movement. Based on substantial reduction in the abundance of multiple year classes in the short term and the slow recovery time of freshwater mussels, the effect of the Proposed Action would be significant for mussels in the short term.*

Implementation of Mitigation Measure AR-7 (see Section 3.3.4.4) could be implemented to reduce the short- and long-term impacts of the Proposed Action on freshwater mussels.

With implementation of mitigation measures there would still be impacts to a portion of the freshwater mussel population, and there could still be a substantial reduction in the abundance of at least one year class. **Based on substantial reduction in year classes, the Proposed Action would have a significant effect on freshwater mussels after mitigation in the short term.**

*Dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional riverine habitat within the Hydroelectric Reach. **Based on increased habitat availability and habitat quality in the long term, the effect of the Proposed Action would be beneficial for mussels in the long term.***

### **Benthic Macroinvertebrates**

Suspended Sediment Concentrations Under the Proposed Action, increased SSCs would be expected to affect filter-feeding BMIs in much the same fashion as described for freshwater mussels. Excessive levels of SSCs for durations longer than normally occur under existing conditions are expected to cause physiological stress, reduced growth, and potential mortality to filter-feeding BMIs. The scraper-grazers feeding guild among the BMIs are also expected to be deleteriously affected, but due to their increased mobility, would be affected less than the filter-feeders. This could affect BMI as far downstream as the Orleans. The high concentrations of suspended sediment released during winter are not predicted to have a severe effect on macroinvertebrates during their winter dormancy period. During spring and summer SSC will be lower, but would be expected to impact macroinvertebrates during the peak of their feeding and reproductive period.

Recolonization of affected BMI populations would occur relatively quickly due to the shortened life cycle of BMIs and rapid dispersal through drift and/or the flying stages of many BMI adults. In addition, recolonization is expected to occur rapidly through drift or dispersal of adult life stages from established BMI populations within the many tributary rivers and streams of the Klamath River.

Changes in Bed Elevation Under the Proposed Action, changes in bed elevation would affect BMIs in much the same fashion as described for freshwater mussels. Higher levels of sediment deposition than would normally occur under existing conditions would be expected to cause physiological stress, reduced growth, and potentially mortality to BMIs. As with the freshwater mussels, the most substantial impacts on BMIs would occur between Cottonwood Creek and Iron Gate Dam (approximately 8 river miles), with the greatest impacts occurring between Willow Creek and Iron Gate Dam.

Recolonization of affected BMI populations would occur relatively quickly due to the shortened life cycle and greater dispersal capabilities of BMIs compared to freshwater mussels.

Changes in Bed Substrate The reformation of river channels in the reservoir reaches upstream of Iron Gate Dam under the Proposed Action would benefit BMIs by providing more suitable substrates than currently exist. As a result, suitable habitats formed upstream of Iron Gate Dam might be opened to additional colonization by BMIs through rapid dispersal by drift from upstream populations within current riverine reaches and/or dispersion of adult life stages. In addition, recolonization would occur rapidly from

established BMI populations within the many tributary rivers and streams of the Klamath River.

*The Proposed Action would have short term effects related to SSCs and bedload movement. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Proposed Action would be significant for macroinvertebrates in the short term.***

While a large proportion of macroinvertebrate populations in the Hydroelectric Reach and in the mainstem Klamath River downstream of Iron Gate Dam would be affected in the short term by the Proposed Action, their populations would be expected to recover quickly because of the many sources for recolonization and their rapid dispersion through drift or aerial movement of adults. *Dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional riverine habitat within the Hydroelectric Reach. **Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action on macroinvertebrates would be beneficial in the long term.***

#### Deconstruction

*As described below, disturbance to the river channel during construction could affect aquatic species.*

The Proposed Action would require relocation of the City of Yreka's water supply pipeline in Iron Gate Reservoir, demolition of the dams and their associated structures, power generation facilities, transmission lines, installation of cofferdams, road upgrading, hauling, reservoir restoration, and other activities (as described in Section 2.4.3.1). These actions would include the use of heavy equipment, and blasting as necessary, and as such, have the potential to disturb aquatic species. Activities at the J.C. Boyle, Copco 1, and Copco 2 Dams would affect the riverine and introduced resident species in the Hydroelectric Reach.

At Iron Gate Dam, anadromous species could also be affected. These effects could include shockwaves associated with breaking down the dam structure using explosives or heavy equipment, potential crushing of aquatic species from operation of heavy equipment in the river, sedimentation, and release of oil, gasoline, or other toxic substances from construction sites. Demolition of the dams and their associated structures, power generation facilities, installation of cofferdams, and other activities are scheduled to occur at Iron Gate Dam between January 10 and June 26, with cofferdam installation scheduled to occur between 2 January 2020 and 6 February 2020. Therefore, this activity would occur during the first month of reservoir drawdown and the peak of SSC associated with reservoir drawdown. As discussed above, any aquatic species within the vicinity of Iron Gate Dam tailrace during this time would also be subject to SSC during the reservoir drawdown that are estimated to range from 80 to >10,000 mg/L during the January 10 through June 26, 2020 period. These SSCs corresponds to Newcombe and Jensen (1996) severity ratings of from 8 to 12, which equate to sub-lethal and lethal effects aquatic species. It is anticipated that this release of sediment would result in the displacement of any individuals that are rearing in the mainstem into

tributaries or further downstream prior to deconstruction or cofferdam activities. Therefore, impacts associated with deconstruction would generally be of small magnitude, short duration, and low intensity when compared to those that would occur as a result of the changes in habitat structure and release of sediments stored behind the dams if they were removed.

To minimize these potential construction impacts, construction areas would be isolated from the active river where possible, and water would be routed around the construction area, allowing the flow to move down the other portion of the river, while the isolated portion of the dam is removed. After a work area is isolated, fish rescues to remove any native fish trapped in the work area would be conducted. Fish would be relocated to an area of suitable habitat within the Klamath River. Implementation of soil erosion and sedimentation control and stormwater pollution prevention would minimize soil erosion and water quality effects on anadromous fish downstream of the work area, during and after construction. **Because best management practices for construction incorporated into the Proposed Action will prevent substantial effects, construction activities associated with the Proposed Action would be less-than-significant.**

#### Coastal Zone Consistency Determination

The following section provides an analysis of the effects of the Proposed Action on each of the relevant policies of the California Coastal Management Program as outlined in the California Coastal Act of 1976. The deconstruction activities of the Proposed Action would begin approximately 190 miles from the mouth of the Klamath River. Therefore, this analysis focuses on impacts that would be evident many river miles downstream in the estuary and near shore. The policies identified as applicable are Article 4 Marine Environment Section 30231 and Section 30236 (see *italicized* text below). Articles 2, Article 3, Article 5, Article 6, and Article 7 are not applicable due to the distance of deconstruction activities from the near shore environment and will not be further addressed in this analysis. Also this is a phased Coastal Zone Management Act (CZMA) analysis. Additional implementation specific analysis will be completed as needed if the Secretary makes an Affirmative Determination.

*Section 30231 The biological productivity and the quality of coastal waters, streams, wetlands, estuaries and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow; encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alterations of natural streams.*

As described above, the Proposed Action would result in substantial short-term increases in suspended sediment during 2020 while the reservoirs are drawdown in preparation for facility removal. The effect of these short-term increases would be significant for some species within the Klamath River. However, as described above, aquatic species within the river would benefit from increased habitat availability and improved habitat

suitability in the long term. In addition, under a worst-case scenario, suspended sediment concentrations resulting from the Proposed Action would be elevated within the estuary and nearshore environment for approximately three months (January, February, and March) in 2020. As described in Section 3.2.4.3.2, SSC levels within the estuary and near-shore environment would not be substantially higher than under existing conditions, especially when compared with extreme winter conditions. Based on the short duration of poor water quality during reservoir drawdown in the estuary and near-shore environment, the Proposed Action would not be deleterious in the short-term, and would not likely affect the estuary and near-shore environment in the long term.

For all species analyzed, when the short-term deleterious effects occurring during reservoir drawdown in 2020 are weighed against the long-term benefits to the Klamath River, the systemic restoration espoused in the Proposed Action improves biological productivity and the quality of waters, streams, wetlands, estuaries, and lakes. Therefore the Proposed Action is consistent with the California Coast Act Policy 30231.

*Section 30236 Channelizations, dams or other substantial alterations of rivers and streams shall incorporate the best mitigation measures feasible and be limited to (1) necessary water supply projects, (2) flood control projects where no other method for protecting existing structure in the flood plain is feasible and where such protections is necessary for public safety or to protect existing development, or (3) developments where the primary function is the improvement of fish and wildlife habitat*

The primary function of the Proposed Action is to improve fish and wildlife habitat and water quality. For this reason, the Proposed Action deconstruction schedule was crafted with careful attention to the timing necessary to limit the impact of sediment release on aquatic resources and water quality. The timing in the Proposed Action is designed to limit the effects on water quality to one single large increase in suspended sediment and one single reduced dissolved oxygen event occurring within the winter and early spring of 2020. By limiting the duration of elevated suspended sediment and reduced dissolved oxygen, the Proposed Action avoids multiple years of effects to aquatic species and minimizes impacts to the sensitive juvenile rearing and smolt life stages of migratory fish. In addition to this built-in avoidance and minimization measure, the Proposed Action includes several required best management practices for the deconstruction activities including erosion and stormwater management, dust abatement, and hazardous spill prevention and response measures. To further address the alteration of rivers and streams and the effects of returning some of the natural processes to the Klamath River system, mitigation measures are being considered including AR 1: Protection of Mainstem Spawning, AR2: Protection of Outmigrating Juveniles, AR3: Fall Pulse Flows, AR-4: Hatchery Management, and AR-5 Pacific Lamprey Capture and Relocation.

Given the careful crafting of the Proposed Action, the required Best Management Practices and mitigation measures, and the fact that the primary function of the project is improvement of fish and wildlife habitat, the Proposed Action is consistent with the California Coast Act Policy 30236.

*The Proposed Action could require the relocation of the City of Yreka water supply pipeline.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and would have to be relocated prior to the decommissioning of the dam to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline would either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Bridge just downstream of Iron Gate Dam. Standard construction Best Management Practices would reduce the likelihood and extent of aquatic impacts. **Therefore, the relocation of the Yreka pipeline would have less-than-significant impacts to aquatic resources.**

#### **Keno Transfer**

*Implementation of the Keno Transfer could cause adverse aquatic resource effects.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on aquatic resources compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

#### **East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause adverse aquatic resource effects.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA would redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities, there would be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

#### **Interim Measures**

The Proposed Action includes IMs to be implemented prior to the initiation of dam removal in 2020 (as described in Section 2.4.3). As described below, two of these have the potential to affect aquatic resources, including:

- IM 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement, and
- IM 16: Water Diversions.

*Implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement could result in alterations to habitat availability and habitat quality, and affect aquatic species.* Under this IM, suitable spawning gravel would be placed in the J.C. Boyle Bypass and Peaking reaches following an Affirmative Determination and continuing through 2019. The first year would be before the Secretary makes a determination, and would therefore be included in the No Action/No Project Alternative. The following seven years would

be part of the Proposed Action. This measure would use a passive approach to place gravel before high flow periods, or develop for other habitat enhancement that would provide equivalent fishery benefits in the Klamath River upstream of Copco Reservoir. These actions would provide improvements in habitat quality for resident fish prior to dam removal, and for resident and anadromous species following dam removal. **Based on anticipated improvements in habitat availability and habitat quality, implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. These actions would also be beneficial for coho salmon from the Upper Klamath River Population Unit, and less-than-significant for all other population units in the basin. Effects on bull trout, freshwater mussels, shortnose and Lost River suckers would be less-than-significant. Effects on green sturgeon, eulachon, and Southern Resident Killer Whales would not change from existing conditions.**

*Implementation of IM 16 (Water Diversions) could result in alterations to habitat availability and habitat quality, and affect aquatic species.* Under this IM, PacifiCorp would seek to eliminate three screened diversions (the Lower Shovel Creek Diversion [7.5 cfs], Upper Shovel Creek Diversion [2.5 cfs], and Negro Creek Diversion [5 cfs]) from Shovel and Negro Creeks and would seek to modify its water rights to move the points of diversion from Shovel and Negro creeks to the mainstem Klamath River. If this were successful the screened diversions would be removed prior to dam removal in 2020. The intent of this measure is to provide additional water to Shovel and Negro creeks, thus increasing the quality and amount of suitable habitat for aquatic species within these tributaries, while not diminishing PacifiCorp's water rights. These actions would provide improvements in the quality and amount of suitable habitat for resident and anadromous aquatic species following dam removal. **Based on anticipated improvements in habitat availability and habitat quality with increased flow, implementation of IM 16 (Water Diversions) under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. These actions would also be beneficial for coho salmon from the Upper Klamath River Population Unit, and less-than-significant for all other population units in the basin. Effects on bull trout, freshwater mussels, shortnose and Lost River suckers would be less-than-significant. Effects on green sturgeon, eulachon, and Southern Resident Killer Whales would not change from existing conditions.**

#### **KBRA**

The KBRA, which is a component of the Proposed Action, encompasses several programs that could affect aquatic resources, including:

- Phases I and 2 Fisheries Restoration Plan
- Fisheries Monitoring Plan
- Fisheries Reintroduction and Management Plan - Phase I
- Water Diversion Limitations
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction
- Klamath River Tribes Interim Fishing Site
- Upper Klamath Lake and Keno Nutrient Reduction

The actions that would be taken under the KBRA would generally benefit aquatic resources by reducing the impacts of past and ongoing disturbance on aquatic habitats. Any undesirable impacts associated with the actions would be short-term in nature and could be largely avoided by employing Best Management Practices for construction activities in and near water. Individual components of the KBRA are described below.

**Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan**

*Implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could result in alterations to water quantity, water quality, habitat availability and habitat quality, and affect aquatic species.* The Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plans are designed to improve habitat for aquatic species and measure the efficacy of restoration actions. These plans prioritize restoration needs within the basin and establish a monitoring and adaptive management program to evaluate and optimize the success of restoration actions.

Measures that are ongoing in the basin or that have been identified for inclusion in the plans include floodplain rehabilitation, large woody debris emplacement, fish passage improvement, livestock exclusion fencing, riparian vegetation management, purchase of conservation easements, road decommissioning, and treatment of fine sediment sources. These activities were chosen to benefit native fish populations as well as the health of the aquatic and riparian ecosystems of the Klamath Basin. Fish passage improvements would be designed to increase access to historical habitat. Many of these activities would be constructed to reduce fine sediment supply to streams within the project area, improving spawning habitat and productive macroinvertebrate habitat.

Purchase of conservation easements or land could provide long-term protection to areas beneficial to the riverine ecosystem as a whole or specific areas of importance to fish species such as endangered suckers. It could also protect areas where restoration actions have been used to improve or restore habitats.

Some restoration activities under the Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could have short-term negative impacts, generally associated with construction and active management phases. Generally, these impacts would be localized and could be avoided through implementation of best management practices, such as control and containment of sediment and toxic discharge, isolation of work areas from the active channel of streams or rivers where possible, and rescuing fish where mortality may result from an action. The long-term water quality improvements

generated by implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan would contribute to the long-term improvements anticipated from hydroelectric facility removal. **Based on anticipated improvements in water quantity, water quality, habitat availability and habitat quality, implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units, where they would be less-than-significant. Effects on green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels would not change from existing conditions.**

### **Phase I Fisheries Reintroduction and Management Plan**

*Implementation of Phase I of the Fisheries Reintroduction and Management Plan could result in alterations to habitat availability (fish access), and could affect aquatic species.*

The Phase I Fisheries Reintroduction and Management Plan is intended to support the reintroduction and management of fish in the Upper Basin during and after implementation of the KHSA. The plan would include provisions for the continued operation of a fish hatchery at Fall Creek or in the Iron Gate Dam area and the construction of fish collection facilities to support primarily the transport of fall-run Chinook salmon around areas of poor water quality, when needed, on an interim basis.

The initial use of the hatchery facility at Iron Gate Dam or on Fall Creek would provide conservation of native salmon stocks during the impact period of dam removal. The development of guidelines for the use of the conservation hatchery at Iron Gate Dam or on Fall Creek outlined in the Phase I Fisheries Reintroduction and Management Plan would be to support the establishment of naturally producing populations in the Klamath River Basin following implementation of the KHSA. Additionally, it is anticipated that a smaller production facility would be constructed in the Upper Basin to provide necessary research stock and locally reared fish for the reintroduction.

Volitional upstream and downstream passage facilities would be developed for passage around areas of poor water quality and will provide for volitional passage during the majority of the year. In addition, the development of fish collection facilities upstream and downstream of Keno Impoundment/Lake Ewauna would be required to provide effective migration for fall-run Chinook salmon when water quality is poor during the period from June 15 to November 15. During the limited period of use, fish collection and release facilities would be operated to minimize any delay and stress and provide for adequate acclimation. For adult fall-run Chinook salmon, fish transport would be an effective fish passage method because transport would be for a short distance on a seasonal, interim basis<sup>4</sup>. For adult fall-run Chinook salmon, seasonal collection and

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<sup>4</sup> This seasonal, transport on an interim basis is not to be confused with permanent, year round trap and haul which does not provide equal benefits for the Klamath River when compared with the Services' fishway prescriptions (U.S. Department of the Interior (2007) The Department of the Interior's Filing of Modified Terms, Conditions, and Prescriptions (Klamath Hydroelectric Project, No. 2082). Sacramento,

transport mortality when water quality is poor would be minor compared to mortality associated with unaided passage through areas of poor water quality at this time of year.

In some instances, the collection and transport of fall-run Chinook salmon around areas of poor water quality could result in limited, seasonal mortality as follows:

1. Some juvenile federally listed suckers would likely be collected incidentally and may suffer related stress and mortality. However, regardless of any remediation at an upstream collection facility, nearly all these downstream migrant suckers would eventually die in the absence of lacustrine habitat below Keno Impoundment. There is little to no evidence of recruitment of suckers in downstream reservoirs currently and this habitat does not contribute significantly to the recovery of the species. Suckers may be collected and returned to habitat above Keno Impoundment.
2. Some redband trout may be collected incidentally resulting in displacement and incidental collection-related stress and mortality. Redband trout may be collected and returned to habitat above Keno Impoundment.
3. For fall-run Chinook salmon emigrants, the seasonal poor quality conditions are not expected to overlap with the peak migration period, thus the majority of juvenile Chinook salmon would not be affected. For those fall-run Chinook salmon emigrants collected and transported when during poor water quality conditions, transport related mortality would be minor compared to the mortality associated with unaided passage through areas of poor water quality at this time of year.
4. For steelhead trout and spring-run Chinook salmon, migration would likely occur primarily when water quality was adequate, thus, collection and transport of these fish would not be necessary or minimal. However, all anadromous salmonids would be collected and transported when water quality is poor during the period from June 15 through November 15. Transport related mortality would be minor compared to the mortality associated with unaided passage through areas of poor water quality at this time of year.

Limited, seasonal transport of fall-run Chinook salmon would provide a net benefit by allowing them migration to and from additional (historical) spawning habitat, by providing more effective migration, and by reducing the density of spawners below Keno Dam in certain poor water quality situations. The majority of fish transported would likely be fall-run Chinook salmon. However, the Phase I Fisheries Reintroduction and Management Plan may include seasonal, interim transport for a minor component of the spring-run Chinook, and steelhead migrants. Thus, these fish would also receive benefits from this program. Increased anadromous fish abundance, especially Chinook salmon, would result in more prey availability for Southern Resident Killer Whales when the whales are near the Oregon and California coasts.

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California: 650 p.; NOAA Fisheries Service (2007). NOAA Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis for the Klamath Hydroelectric Project (FERC Project No. 2082): 151 p.).

Other reintroduction activities under the Phase I Fisheries Reintroduction and Management Plan could have short-term impacts, generally associated with construction and active management phases. Generally, these impacts would be localized and could be avoided or minimized through implementation of best management practices, such as control and containment of sediment and toxic discharge, isolation of work areas from the active channel of streams or rivers where possible, and rescuing fish where mortality may result from an action. The habitat improvements generated by implementation of the Phase I Fisheries Reintroduction and Management Plan would contribute to the long-term improvements anticipated from hydroelectric facility removal. **Based on access to additional, historical habitat and the anticipated improvements in fish health, implementation of the Phase I Fisheries Reintroduction and Management Plan under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, and benthic macroinvertebrates. These actions would also be beneficial for coho salmon, except those Trinity River population units, through continued support from the fish hatchery. The Trinity River population units, would experience no change from existing conditions in the long-term. Effects on green sturgeon, bull trout, eulachon, and freshwater mussels would be no change from existing conditions. These actions would be less than significant for redband trout as well as for shortnose and Lost River suckers.**

#### **Water Diversion Limitations**

*Implementation of Water Diversion Limitations could result in reducing uncertainties associated with maintaining adequate ecological flows for aquatic species and their habitats, especially in low-flow years, and could alter water quality, and water temperatures in certain seasons and affect aquatic species.* This component of the KBRA would establish limits on specific diversions within Reclamation's Klamath Project to protect flows in the mainstem and ensure that adequate water supply is available for allocation to the wildlife refuges.

Reduced surface water deliveries associated with the diversion limitations could result in the increased use of groundwater for irrigation supply. A plan would be developed for monitoring groundwater in order to restrict pumping to no more than 6 percent of flows in the reach upstream of Copco 1 Dam that is fed predominantly by springs. This measure would protect an important resource that provides stable habitat conditions that may be critical to the survival of some species. This reliable source of cool inflow provides benefit to aquatic species by influencing temperature, dissolved oxygen, algal growth, and the dilution of contaminants or natural toxins, such as those produced by *M. aeruginosa*.

The long-term water quality and quantity improvements generated by implementation of diversion limitations would contribute to the long-term improvements anticipated from hydroelectric facility removal. **Based on anticipated improvements in water quantity and water quality, implementation of Water Diversion Limitations under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run**

**Chinook salmon, steelhead, Pacific lamprey, redband trout, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units, where they would be no change from existing conditions. Effects on green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates would be no change from existing conditions.**

#### **On-Project Plan**

*Implementation of the On-Project Plan could result in alterations to water quantity and water quality and affect aquatic species.* The On-Project Plan would include a groundwater monitoring plan that limits pumping so that flows from springs in the watershed upstream of Copco 1 Dam would not be reduced by more than 6 percent, protecting these important habitats that provide stable habitat conditions and often support rare or unique species. It would also provide a plan to implement the water diversion limitations described above. This measure would help protect flows in the mainstem with the benefits described above. The long-term water quality and quantity improvements generated by implementation of the On-Project Plan would contribute to the long-term improvements anticipated from hydroelectric facility removal. **Based on anticipated improvements in water quantity and water quality, implementation of Water Diversion Limitations under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units, where they would be no change from existing conditions. Effects on green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates would be no change from existing conditions.**

#### **Water Use Retirement Program**

*The Water Use Retirement Program could alter water quantity and water quality, and affect aquatic species.* This component of the KBRA would increase inflow to Upper Klamath Lake by 30,000 acre-feet per year on average. A variety of mechanisms would be used to achieve this objective, including acquisition of water rights, forbearance agreements, water leasing, changes in agricultural cropping patterns, land fallowing, juniper removal, and forest thinning. The additional water provided would increase flows in tributaries to Upper Klamath Lake improving habitat for redband trout, shortnose and Lost River suckers, and bull trout. Anadromous salmon and steelhead that would have access to these tributaries as a result of the Proposed Action would also be expected to benefit.

This additional water could be used for a variety of purposes downstream of Upper Klamath Lake, including augmenting the base flow or high flow components of the annual hydrograph. Maintaining base flows, particularly during extreme droughts, is critical for fish spawning, rearing, passage, and preventing excessively warm water temperatures for all life stages. High flows are critical for shaping stream and river channels, creating diverse habitats, and connecting these habitats to riparian zones, terraces, and flood plains that provide nutrients to the riverine ecosystem and shelter for fish and other aquatic organisms when conditions in the river are unsuitable. Periodic

springtime high flow events also have the potential of scouring the channel of fine-grained sediments and cladophora which harbor intermediate hosts for organisms that produce high mortality in juvenile salmon. High flows mobilize the streambed, which removes fine sediments and organic material that can reduce spawning success and macroinvertebrate production, as well as reduce interstitial habitat used as cover by small fish. They are also important drivers of riparian ecosystem functions, such as dispersing and germinating seeds of riparian plants, and creating new areas for vegetation colonization through erosion. Riparian ecosystems are important for filtering fine sediment from hillslope runoff, buffering streams from contaminants, providing shade and temperature regulation, bank stability, and nutrients to the stream. Augmenting low flows in some years may be critical due to temperature, water quality, or disease concerns.

The additional water flows generated by implementation of the Water Use Retirement Program would contribute to the long-term improvements anticipated from hydroelectric facility removal. **Based on anticipated improvements in water quantity, and water and stream channel quality, implementation of Water Use Retirement Program under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units, where there would be no change from existing conditions. Effects on green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates would be no change from existing conditions.**

### **Fish Entrainment Reduction**

*Implementation of the Fish Entrainment Reduction could result in alterations to potential alterations to mortality risk and affect aquatic species.* This KBRA action would involve designing and installing fish screens at Project Diversions, including the Lost River Diversion Channel and associated diversion points, North Canal, Ady Canal, and other Reclamation and Reclamation contractor diversions. This action would reduce mortality caused by entrainment of fish at these diversions, to the benefit of endangered shortnose and Lost River suckers, as well as to redband trout. Steelhead and fall- and spring-run Chinook salmon would also benefit from this action once they recolonize areas upstream of Keno Dam. The reductions in entrainment mortality generated by implementation of the Water Use Retirement Program would contribute to the long-term improvements in anadromous species health anticipated from hydroelectric facility removal. **Based on anticipated reductions in entrainment mortality, implementation of Fish Entrainment Reduction under the Proposed Action would be beneficial for shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey. These actions would also be beneficial for coho salmon from the Upper Klamath River population unit, and would be no change from existing conditions for all other coho salmon population units. Effects on green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates would be no change from existing conditions.**

### **Klamath River Tribes Interim Fishing Site**

*Implementation of the Klamath River Tribes Interim Fishing Site could result in alterations to managed harvest mortality of fish species that are culturally important to the Klamath River Tribes, including Chinook and coho salmon, steelhead, and Pacific lamprey.* The harvest, which would take place between Iron Gate Dam and Interstate 5, would be coordinated with harvest by other tribes and the commercial fishery to remain within the predicted sustainable limits for the fishery. The coordinated harvest at the Klamath River Tribes Interim Fishing Site would not be expected to contribute to any changes generated by the hydroelectric facility removal action. **Based on anticipated fisheries management coordination as part of the implementation of Klamath River Tribes Interim Fishing Site under the Proposed Action, this action would result in no change from existing conditions for aquatic species.**

### **Upper Klamath Lake and Keno Nutrient Reduction**

*Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.* KBRA (Appendix C-2, line 11) includes a program to study and reduce nutrient concentrations in the Keno Impoundment and Upper Klamath Lake in order to reduce dissolved oxygen problems and algal problems in both water bodies. Restoration actions to control nutrients have not been developed, and there are many diverse possibilities that could require construction of treatment wetlands, construction of facilities, or chemical treatments of bottom sediment, among other possibilities. A nutrient reduction program in the Keno Impoundment and Upper Klamath Lake would be designed to improve water quality (increasing dissolved oxygen and reducing algal concentration) and to provide fish passage through the Keno Impoundment in summer and fall months; however, implementation of this nutrient reduction program will require future environmental compliance investigations and a determination on significance cannot be made at this time.

The specific locations in which some of these KBRA actions would be undertaken are unknown at this time, but they would be implemented at different locations and times than KHSA actions. Many of these actions would require additional environmental documentation and permitting before being implemented, and are covered programmatically in this document. Generally, the KBRA actions described above would be expected to result in a net benefit for fisheries resources and the aquatic environment. Any potential deleterious effects identified could be avoided or mitigated through careful planning and management.

### **Alternative 3: Partial Facilities Removal of Four Dams Alternative**

The Partial Facilities Removal of Four Dams Alternative would include removal of enough of J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams to allow free-flowing river conditions and volitional fish passage at all times. Under this alternative, portions of each dam would remain in place along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes, all of which would be outside of the 100 year flood-prone width. Under this alternative, partial removal of the embankment/earth-filled dam and concrete dam structures would allow release of dam-stored sediment. The

retention of these structures would not be expected to result in any difference in the physical or biological effects of dam removal from those described for the Proposed Action. This alternative would include the transfer of the Keno Facility to the DOI and implementation of the KBRA.

### **Key Ecological Attributes**

Aquatic ecological attributes under the Partial Facilities Removal of Four Dams Alternative would have indistinguishable effects on aquatic species from the Proposed Action.

### **Species-Specific Impacts**

*Lowering the water surface elevation of the reservoirs associated with dam removal under this alternative could affect aquatic species. In addition, the removal of dams and reservoirs could alter the availability and quality of habitat, resulting in effects on aquatic species.* The impacts were considered for each of the following species and groups: fall-run Chinook salmon, spring-run Chinook salmon, coho salmon, steelhead, lamprey, green sturgeon, Lost River and shortnose suckers, redband trout, bull trout, eulachon, longfin smelt, introduced resident species, freshwater mussels and benthic macroinvertebrates. The effects of this Partial Facilities Removal of Four Dams Alternative on aquatic species would be indistinguishable from those described for the Proposed Action.

*The Proposed Action would require the relocation of the City of Yreka water supply pipeline.* Under the Partial Facilities Removal Alternative, the relocation of the Yreka water supply pipeline would have the same impacts as under the Proposed Action.

### **Keno Transfer**

*Implementation of the Keno Transfer could cause adverse aquatic resource effects.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on aquatic resources compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSAs Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

### **East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause adverse aquatic resource effects.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSAs would redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there would be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

### **Interim Measures**

*Implementation of IMs 7 (J.C. Boyle Gravel Placement and/or Habitat Enhancement) and 16 (Water Diversions) could result in alterations to habitat availability and habitat quality, and affect aquatic species.* These IMs would increase spawning gravel or habitat upstream of Copco Reservoir and would increase flows in Shovel and Negro Creeks. As described under the Proposed Action, these actions would provide improvements in habitat quality for resident fish prior to dam removal, and for resident and anadromous species following dam removal. **Based on anticipated improvements in habitat availability and habitat quality, implementation of IMs 7 and 16 under the Partial Facilities Removal would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. These actions would also be beneficial for coho salmon from the Upper Klamath River Population Unit, and less-than-significant for all other population units in the basin. Effects on bull trout, freshwater mussels, shortnose and Lost River suckers would be less-than-significant. Effects on green sturgeon, eulachon, and Southern Resident Killer Whales would not change from existing conditions.**

### **KBRA**

The KBRA would be implemented under the Partial Facilities Removal of Four Dams Alternative and would have indistinguishable effects on aquatic species from the Proposed Action.

### **Alternative 4: Fish Passage at Four Dams Alternative**

The Fish Passage at Four Dams Alternative would provide upstream and downstream fish passage at the Four Facilities, but would not include implementation of the KBRA. The ongoing restoration actions, described in the No Action/No Project Alternative, would continue. The alternative would incorporate the prescriptions from the Departments of Interior and Commerce imposed during the FERC relicensing process, including fishway installation for both upstream and downstream migrations at all facilities and barriers to prevent juvenile salmonid entrainment into turbines. In addition to the fishways, there are a series flow-related measures, including a condition that requires at least 40 percent of the inflow to the J.C. Boyle Reservoir to be released downstream. This alternative would limit generation of peaking power at J.C. Boyle Powerplant to one day per week as water supplies allow, and would include recreation flows one day a week.

Pursuant to the FERC's Licensing Regulations, the Department of Interior filed its comments regarding the impacts of facilities and operations of the Klamath Hydroelectric Project (FERC No. 2082) on public resources and recommended various terms and conditions to be incorporated into any new license to address these impacts. In addition, the Secretaries of Interior and Commerce filed fishway prescriptions under Section 18 of the Federal Power Act (FPA) to provide safe, timely, and effective fish passage, and, in doing so, specifically address the loss of fish habitat after the project was constructed.

Pursuant to the regulations of FERC (18 C.F.R. 385.604), many of the Parties to the FERC licensing proceeding undertook confidential settlement discussions to resolve

disputed issues in the licensing proceeding, resulting in the KHSA. Section 3.2.1 of the KHSA provides that the Secretary of Interior is to undertake National Environmental Policy Act analysis and other appropriate actions to determine whether to proceed with Facilities Removal. Chapter 1 of this EIS/EIR states the purpose of the proposed federal action “is to advance restoration of the salmonid fisheries in the Klamath Basin that is in the public interest, and is consistent with the KHSA and KBRA and their objectives.” Consistency with the KHSA and KBRA and their objectives thus underlies the alternatives and analyses presented in this document. The reader should note, however, that the FERC has not taken final action on PacifiCorp’s application for license. Therefore, the Department of Interior’s position in that proceeding, has not changed, including the various impacts of PacifiCorp’s dams on public resources and the need for and benefits of the fishways prescribed by the Secretaries. Fishways installed as part of fish passage alternatives in this EIS/EIR would need to comply with the Section 18 prescriptions for the construction, operation, and maintenance of upstream and downstream passage (DOI 2007). General prescriptions cover anadromous (fall- and spring-run Chinook salmon, coho salmon, steelhead, and Pacific lamprey) and resident (rainbow and redband trout, shortnose and Lost River suckers) fish passage at all Klamath Hydroelectric Project dams, and include implementing operation and maintenance plans and prescribing attraction flows for upstream migrants (DOI 2007). Specific provisions apply to individual dams and include performance standards for upstream and downstream passage facilities.

DOI and NOAA Fisheries Service passage prescriptions for Keno Dam include the collection of adult Chinook salmon for transport past Lake Ewauna during summer months when water quality is poor (DOI 2007). If dissolved oxygen concentrations are less than 6 mg/L and water temperatures are higher than 20°C, as measured at Miller Island (RM 246), trap and haul would occur from June 15 through November 15 until restoration efforts improve water quality to conditions suitable for anadromous fish (DOI 2007). Conditions in the reach from Keno Dam to Link River Dam are expected to eventually improve through implementation of TMDL water quality measures and imposition of state water quality certification conditions to allow year-round volitional passage.

Fish passage at Iron Gate Dam would provide fish with access to Scotch, Slide, Camp, Jenny, Fall, and Salt Creeks, and the Copco 2 Bypass Reach. Passage at Copco 1 Dam would provide access to 4.5 miles of reservoir habitat, 21 miles of mainstem habitat, and an additional 6 miles of tributary habitat. Passage would also allow access to cooler water in the J.C. Boyle Bypass Reach provided by springs (an estimated 200-250 cfs) (DOI 2007; FERC 2007). Passage at J.C. Boyle Dam would provide access to 4.7 miles of mainstem habitat, to Spencer Creek. Overall, passage would provide access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive anadromous fish habitat upstream of Iron Gate Dam (DOI 2007), including access to groundwater discharge areas resistant to effects of climate change (Hamilton et al. 2011). There would continue to be 22.4 miles of spawning and rearing habitat inundated by reservoirs (Cunanan 2009).

## **Key Ecological Attributes**

### Suspended Sediment

Under the Fish Passage at Four Dams Alternative, SSCs would be the same as under existing conditions. Therefore, this alternative would have no effects associated with suspended sediment transport relative to existing conditions for any aquatic species.

### Bedload Sediment

Under the Fish Passage at Four Dams Alternative, the dams would not be removed and sediment would continue to be stored behind Klamath Hydroelectric Project dams, similar to the No Action/No Project Alternative.

### Water Quality

Under the Fish Passage at Four Dams Alternative, water quality would be the same as under the No Action/No Project Alternative. Anadromous fish would be able to move through the Hydroelectric Reach and might be exposed to poor water quality during upstream and downstream migration. Dissolved oxygen concentrations within reservoirs can be stressful for anadromous fish from June to September (FERC 2007) and continued high rates of algal photosynthesis in the reservoirs would result in pH values that would not consistently meet applicable ODEQ and California Basin Plan water quality objectives (see Section 3.2.4.3). Implementation of water quality improvement measures under Oregon and California TMDLs (to address water quality impairments within the period of analysis) would improve conditions for migratory fish.

### Water Temperature

Under the Fish Passage at Four Dams Alternative, the effects on water temperature are predicted to be similar to those that are predicted for the No Action/No Project Alternative. Anadromous fish would be able to move through the Hydroelectric Reach and might be exposed to high temperatures during upstream and downstream migration. Water temperature in the reservoirs can be particularly high from June to September (see Section 3.2.3.2) and might exceed thermal tolerances for anadromous or resident fish.

Under existing conditions, there is a delay in the normal progression of water temperatures below Iron Gate Dam (or Phase Shift from historical timing) (Bartholow et al. 2005). Under this alternative, the current phase shift and lack of temporal diversity would persist, including current warm temperatures in late summer and fall. Current cooler temperatures in spring and early summer could benefit both adult and juvenile salmonids migrating during spring. However, juveniles and adults migrating later in the year would continue to experience warm temperatures in late summer and fall that could be deleterious to health and survival, including increased risk of disease, and high rates of delayed spawning and prespawn mortality (Hetrick et al. 2009).

### Fish Disease and Parasites

The incidence of fish disease in salmon may be reduced under the Fish Passage at Four Dams Alternative, or may remain similar to the No Action/No Project Alternative because many of the primary factors affecting fish infection and disease rates from *C. shasta* and *P. minibicornis* would remain unchanged (e.g., habitat conditions favorable

for the invertebrate hosts, sediment transport, and temperature would remain similar to existing conditions). Fish passage upstream by anadromous salmonids would increase under this alternative, which could reduce the concentration of salmon using the area immediately below Iron Gate Dam for spawning, potentially reducing the transfer of myxospores from fish to the polychaete hosts. However, concentrations of adults downstream of Iron Gate Dam may still be high while fish hold prior to ascending the fish ladder, and the continued operation of Iron Gate Hatchery. Overall, under this alternative, disease in salmon would be expected to continue because: (1) conditions promoting high densities of polychaetes and parasites would generally persist; (2) a small proportion of spawning salmon produce the bulk of the myxospores; and (3) infected salmon may be less likely to successfully utilize the ladders. Therefore, under this alternative, disease impacts would be reduced, but would continue to be detrimental to salmon.

### Algal Toxins

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** Under the Fish Passage at Four Dams Alternative, high nutrient inputs supporting the growth of toxin-producing nuisance algal species such as *M. aeruginosa* in Upper Klamath Lake would remain similar to existing conditions for decades into the future. This would result in continued bioaccumulation of microcystin in suckers in Upper Klamath Lake and could be deleterious to fish health. Upon full attainment of the TMDLs (implementation mechanism and timing currently unknown), nutrients and toxin-producing nuisance algal species would decrease (see Sections 3.2 and 3.4 for additional detail regarding TMDLs and algal growth). Accordingly, with full attainment of the TMDLs, improvements to microcystin tissue levels in suckers in the lake would occur.

**Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** Continued impoundment of water at the Four Facilities under the Fish Passage at Four Dams Alternative would support growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* in Copco 1 and Iron Gate Reservoirs, resulting in high seasonal concentrations of algal toxins in the Hydroelectric Reach for decades into the future. This would result in continued bioaccumulation of microcystin in fish tissue for species in the Hydroelectric Reach and could be deleterious to fish health. Upon full attainment of the TMDLs (implementation mechanism and timing currently unknown), nutrients and toxin-producing nuisance algal species would decrease in the Hydroelectric Reach (see Sections 3.2 and 3.4 for additional detail regarding TMDLs and algal growth). Accordingly, with full attainment of the TMDLs, improvements to microcystin tissue levels in fish in the Hydroelectric Reach would occur.

**Lower Klamath River: Downstream of Iron Gate Dam** Continued impoundment of water at the Four Facilities under the Fish Passage at Four Dams Alternative would support the seasonal transport of toxin-producing nuisance algae and microcystin to the Klamath River downstream of Iron Gate Dam. This would result in continued bioaccumulation of microcystin in fish tissue for species in the river and could be deleterious to fish health. Upon full attainment of the TMDLs (implementation mechanism and timing currently unknown), nutrients and toxin-producing nuisance algal

species would decrease in the Hydroelectric Reach (see Sections 3.2 and 3.4 for additional detail regarding TMDLs and algal growth). Accordingly, with full attainment of the TMDLs, improvements to microcystin tissue levels in fish in the Klamath River downstream of Iron Gate Dam would occur.

#### Aquatic Habitat

Under the Fish Passage at Four Dams Alternative, the hydrology of the Klamath River from Iron Gate Dam to the Klamath River Estuary would generally remain the same as under existing conditions, subject to the influence of climate change (discussed under Section 3.10, Greenhouse Gases/Global Climate Change). Activities currently underway to recover salmonid and sucker populations within the Klamath Basin would continue at their current levels. Fish would be able to migrate past the dams and would gain access to substantial areas of additional habitat; however, access could be delayed at the ladders and seasonally impaired by poor water quality conditions in the reservoirs.

In addition, juveniles and smolt traveling through the four hydroelectric reservoirs would be exposed to some level of predation by introduced resident fish including largemouth bass, catfish, and yellow perch, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rogers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids above Iron Gate Dam is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Fish traveling through reservoirs would be protected from entrainment at the hydroelectric intake by fish collection and routing facilities as required under the Section 18 prescriptions for the FERC relicensing of the Klamath Hydroelectric Project (DOI 2007). Under this alternative, there would be substantial changes to hydroelectric operations. J.C. Boyle Powerhouse would no longer generate in peaking mode, and higher flow releases would be made through the J.C. Boyle Bypass Reach than under existing conditions. Higher base flows would also be provided in the Copco 2 Bypass Reach. Peaking operations would only occur one day a week to coincide with recreation flows, at least 40 percent of flow would go into the Bypass Reach (and not enter the powerhouse), and ramping rates would be slower than they are currently. Seasonal high flows will contribute to improving the quality of riparian habitat in the J.C. Boyle Bypass Reach by increasing the sediment deposit within the channel and decreasing reed canary grass (Administrative Law Judge 2006). The more normative flow regime associated

with this alternative would provide these seasonal high flows. These modifications would benefit fish in this reach, including redband trout and anadromous fish.

### **Aquatic Resources Effects**

#### Critical Habitat

*As described below, continued impoundment of water within reservoirs and access to additional habitat under the Fish Passage at Four Dams Alternative could alter currently designated critical habitat.*

**Coho Salmon** Under the Fish Passage at Four Dams Alternative, coho salmon would be able to access habitat in the Hydroelectric Reach by ascending the fishways associated with each of the dams. The upstream boundary of critical habitat for coho salmon in the Klamath Basin is Iron Gate Dam; any newly accessible areas would be outside of their currently designated critical habitat. NOAA Fisheries Service may want to consider including the newly accessible reaches as critical habitat as part of their 5-year status review or in a separate decision (J. Simondet, NOAA Fisheries Service, pers. comm., 2011). Under this alternative, the KBRA would not be implemented. However, ongoing restoration activities will continue. The areas inundated by the reservoirs would not provide suitable spawning or rearing habitat for coho salmon, but they would gain access to the riverine reaches on the mainstem and to the tributaries, although the downstream ends of most of the tributaries would be inundated by the reservoirs. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows.

Water temperatures would continue to be affected by the reservoirs. They would be warmer in the summer and fall when adults are migrating upstream and would continue to be deleterious to adult migrants, downstream of Iron Gate Dam, upon entry into the reservoirs, and in bypass reaches. Many of the primary factors influencing salmon infection and disease rates from *C. shasta* and *P. minibicornis* would remain unchanged. The ongoing presence of the dams would continue to contribute to the stable, warm habitat conditions favorable for polychaetes and for *C. shasta* and *P. minibicornis* downstream of Iron Gate Dam. Fish passage upstream by anadromous salmonids would increase under this alternative, which could reduce the concentration of salmon using the area immediately below Iron Gate Dam for spawning, potentially reducing the transfer of myxospores from fish to the polychaete hosts. However, concentrations of adults downstream of Iron Gate Dam may still be high while fish hold prior to ascending the fish ladder, and the continued operation of Iron Gate Hatchery. Overall, under this alternative disease in salmon would be expected to continue because: (1) conditions promoting high densities of polychaetes and parasites would generally persist; (2) a small proportion of spawning salmon produce the bulk of the myxospores; and (3) infected salmon may be less likely to successfully utilize the ladders. Therefore, under this alternative, disease impacts would be reduced, but would continue to be detrimental to salmon.

In terms of Primary Constituent Elements of coho salmon critical habitat, this alternative would provide access to additional spawning habitat upstream of currently designated

critical habitat, including in Fall, Jenny, Shovel and Spencer Creeks, although the downstream ends of these streams would continue to be inundated by the reservoirs and would not provide suitable spawning or rearing habitat. The food resources in these tributaries would also become available to fry and juvenile coho salmon rearing in those streams. Water quality conditions in the Hydroelectric Reach and downstream of Iron Gate Dam would be expected to improve over time with TMDL implementation, but would not improve as quickly or to the same extent as under the Proposed Action. **Based on the current designation of critical habitat, the effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for coho salmon critical habitat in the short and long term.**

**Bull Trout** Under the Fish Passage at Four Dams Alternative, the physical and chemical components of critical habitat for bull trout would be improved by the Oregon TMDL processes, but the KBRA would not be implemented. However, ongoing restoration activities will continue to occur. Actions taken as part of the Fish Passage at Four Dams Alternative would not affect the physical or chemical components of critical habitat, but would allow Chinook salmon and steelhead to access areas they have not been able to access since the completion of the Copco 1 Development in 1918. These species could compete with and prey upon bull trout fry and juveniles. However, bull trout would also be expected to consume the eggs and fry of Chinook salmon and steelhead. Because these species co-evolved in the watershed together, it is anticipated that they would be able to co-exist in the future. **Based on the restricted distribution of bull trout, the Fish Passage at Four Dams Alternative would result in no change from existing conditions.**

**Southern Resident Killer Whale** Klamath River contributes to critical habitat for Southern Resident Killer Whales through its contribution of Chinook salmon to their food supply. The Proposed Action would not affect critical habitat for this species. Implementation of the Fish Passage at Four Dams Alternative, by providing anadromous salmonids with access to habitat upstream of Iron Gate Dam, is expected to increase production of wild Chinook salmon. The Iron Gate Hatchery would continue to operate, ensuring ongoing production of hatchery Chinook salmon and contribution to ocean stocks. Klamath River Chinook salmon likely represent only a very small proportion of the diet of this killer whale population because most of their feeding is on Fraser River and Puget Sounds stocks (Hanson et al. 2010); therefore, any increase in salmon production from the Proposed Action would not substantially affect this species. **Based on small influence of the Klamath River on PCEs of Southern Resident Killer Whales, the Fish Passage at Four Dams Alternative would result in no change from existing conditions.**

#### Essential Fish Habitat

*As described below, continued impoundment of water within reservoirs and access to additional habitat under the Fish Passage at Four Dams Alternative could alter the availability and suitability of Essential Fish Habitat (EFH).*

**Chinook and Coho Salmon EFH** Implementation of the Fish Passage at Four Dams Alternative would increase habitat for Chinook and coho salmon (upstream of currently

designated EFH) by providing access to habitat upstream of Iron Gate Dam. However, under this alternative, EFH for Chinook and coho salmon would be expected to remain similar to its current condition, as described for the No Action. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for Chinook and coho salmon EFH in the short and long term.**

**Groundfish EFH** Implementation of the Fish Passage at Four Dams Alternative would not affect groundfish EFH. SSCs and bedload would remain the same as under existing conditions, as would water quality. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for groundfish EFH in the short and long term.**

**Pelagic Fish EFH** Implementation of the Fish Passage at Four Dams Alternative would not affect pelagic fish EFH. SSCs and bedload would remain the same, as would water quality. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for pelagic fish EFH in the short and long term.**

#### Species-Specific Impacts

*A described below, fish ladders could alter the availability of habitat resulting in effects on aquatic species.*

#### **Fall-Run Chinook Salmon**

Upper Klamath Basin upstream of J.C. Boyle Reservoir Under the Fish Passage at Four Dams Alternative, fish passage facilities installed at the four dams within the Hydroelectric Reach would allow fall-run Chinook salmon to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. The access would expand the Chinook salmon's current habitat to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). This would be a potential increase in access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive habitat (DOI 2007), including access to groundwater discharge areas relatively resistant to effects of climate change (Hamilton et al. 2011). There would continue to be 22.4 miles of spawning and rearing habitat inundated reservoirs (Cunanan 2009). Implementation of the Fish Passage at Four Dams Alternative would not result in changes to the suspended sediments or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006).

Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011). However, evidence indicates that Upper Klamath Lake habitat is presently suitable to support Chinook salmon for at least the October through May period (Maule et al. 2009). Poor water quality conditions from Link Dam to Keno Dam during the late summer and fall could be detrimental to fish in this area, particularly anadromous salmonids. Therefore, the Fish Passage at Four Dams Alternative would include an

interim seasonal trap and haul operation that would involve capturing and trucking both upstream and downstream migrant fish around this area when water quality conditions would be prohibitively stressful. As adult fall-run Chinook salmon in the Klamath River migrate upstream from August through October, and juveniles migrate to the ocean from spring to early fall, stress-related mortality associated with seasonal, interim trap and haul activities would affect this species to some degree.

Some degree of stress and mortality of adult and juvenile salmon may result from the interim seasonal trap and haul operations (Buchanan et al. 2011b), especially between Link Dam and Keno Dam, and during periods with high water temperatures or poor water quality. The distance that fish would be transported under this alternative would be limited however, and trap and haul would only be used when fish would otherwise be exposed to stressful conditions.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam  
Implementation of the Fish Passage at Four Dams Alternative would restore fall-run Chinook salmon access to the Hydroelectric Reach. Passage through the reach would provide approximately 52 miles of additional habitat along the mainstem and within accessible tributaries (DOI 2007). Riverine habitat under the existing reservoirs would continue to be inaccessible. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows. Passage structures would provide access to thermal refugia created by 200 to 250 cfs of spring flow accretion in the J.C. Boyle Bypass Reach (DOI 2007; FERC 2007). Under this alternative, suspended and bedload sediment, water quality, water temperature, and the occurrence of fish disease and algal toxins would be the same as under existing conditions.

Similar to the No Action/No Project Alternative, fish migrating through reservoirs would continue to be exposed to more stressful water quality conditions including high temperatures with low dissolved oxygen in the summer and fall, changes in dissolved oxygen, pH, and ammonia associated with algal blooms, and exposure to microcystin from *M. aeruginosa* blooms (Dunsmoor and Huntington 2006; FERC 2007). These conditions can become severely stressful in June through September, contributing to lower resistance to disease, and potentially causing direct mortality. Springs beneath the reservoirs would not provide thermal refugia, as they would discharge into layers of water with low DO that occur at the bottoms of the reservoirs. These juveniles would also be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rogers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating

salmonids above Iron Gate Dam is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006). The combination and timing of effects (adults migrate from August through October, juveniles migrate from spring to early fall), could result in stress, migration delays, or mortality of fall-run Chinook salmon as they move through the Hydroelectric Reach.

Lower Klamath River: Downstream of Iron Gate Dam Under the Fish Passage at Four Dams Alternative, suspended sediment would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species. Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. The channel directly downstream of Iron Gate Dam would continue to be starved of fine sediment, but the effect would gradually decrease in the downstream direction as coarse sediment would be resupplied by tributary inputs (Hetrick et al. 2009; Stillwater Sciences 2010a). Coarsening of the bed could reduce spawning habitat for fall-run Chinook salmon below the dam over time, but this impact would be limited to the area upstream of Cottonwood Creek. Rearing habitat would be expected to remain similar to existing conditions.

Under the Fish Passage at Four Dams Alternative, the lower Klamath River downstream of Iron Gate Dam reach would continue to have poor water quality because of the continued presence of the reservoirs with their increased hydraulic residence time and thermal mass (Bartholow 2005). The delay in thermal signature would continue to delay the migration and spawning of fall-run Chinook salmon downstream of Iron Gate Dam, and prespawn mortality would remain high (Hamilton et al. 2011). Current cooler temperatures in spring and early summer could benefit rearing life history of anadromous species (Hamilton et al. 2011).

Many of the primary factors influencing salmon infection and disease rates from *C. shasta* and *P. minibicornis* would remain unchanged. The ongoing presence of the dams would continue to contribute to the stable, warm habitat conditions favorable for polychaetes and their parasites *C. shasta* and *P. minibicornis* downstream of Iron Gate Dam. Upstream fish passage would likely reduce salmon spawning density immediately downstream of Iron Gate Dam, which in turn is likely to reduce the transfer of myxospores from salmon to their polychaete hosts. However, concentrations of adults downstream of Iron Gate Dam may still be high while fish hold prior to accessing the fish ladder, and the continued operation of Iron Gate Hatchery. Therefore, under this alternative, disease impacts could be reduced, but continue to be detrimental to fall-run Chinook salmon.

Dissolved oxygen concentrations during July–October immediately downstream of Iron Gate Dam would continue to be low (less than 8 mg/L). In addition, the presence of microcystin, associated with the dense blooms of *M. aeruginosa* in Iron Gate and Copco Reservoirs, would continue to occur downstream of Iron Gate Dam.

Estuary The Fish Passage at Four Dams Alternative is not expected to substantially change or affect fall-run Chinook salmon estuarine habitat relative to existing conditions.

*Under this alternative, fish ladders could result in alterations in habitat availability for fall-run Chinook salmon in the long term.* Under the Fish Passage at Four Dams Alternative, fall-run Chinook salmon would gain access to mainstem and tributary habitat in the upper Klamath River and Hydroelectric Reach, and thermal refugia within the Hydroelectric Reach, which would benefit the population. Some degree of stress and mortality of adult and juvenile salmon may result from the interim seasonal trap and haul operations (Buchanan et al. 2011b), especially between Link Dam and Keno Dam, and during periods with high water temperatures or poor water quality. Poor water quality, high water temperature, low dissolved oxygen, algal blooms and toxins, and predation could result in low survival of fall-run Chinook salmon passing through the four reservoirs. The distance that fish would be transported under this alternative would be limited however, and trap and haul only used when fish would otherwise be exposed to stressful conditions.

This alternative would result in continuation of many of the stresses that currently affect Chinook salmon populations. The presence of dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality, and high late summer and early fall water temperatures, allowing many conditions favorable for the transmission of fish disease to persist. These conditions would continue to have negative short- and long-term impacts on fall-run Chinook salmon populations. Further, under the Fish Passage at Four Dams Alternative, the KBRA would not be implemented, so any potential habitat improvements from KBRA restoration projects would not be realized. However, ongoing restoration activities would continue to occur. Climate change could also increase the frequency and duration of stressful water temperatures for salmonids under the Fish Passage at Four Dams Alternative. It is anticipated that as a result of the Fish Passage at Four Dams Alternative the fall-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, population spatial structure, and genetic diversity. However, smolts produced from tributaries downstream of Iron Gate Dam would experience a continuation of existing deleterious effects. **Based on increased habitat availability, the effect of the Fish Passage at Four Dams Alternative would be beneficial for fall-run Chinook salmon in the short and long term.**

### **Spring-Run Chinook Salmon**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at Four Dams Alternative, fish passage facilities installed at the four dams within the Hydroelectric Reach would allow spring-run Chinook salmon to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. The access would expand the Chinook salmon's current habitat to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005, Butler et al. 2010). Passage at Keno Dam would provide access to 20 miles of reservoir habitat and 1.2 miles of riverine habitat between Keno and Link River Dams (FERC 2007). Overall, the Fish Passage at Four Dams Alternative would provide access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive anadromous fish habitat upstream of Iron Gate Dam

(DOI 2007), including access to groundwater areas resistant to climate change (Hamilton et al. 2011). There would continue to be 22.4 miles of spawning and rearing habitat inundated by reservoirs (Cunanan 2009). The Fish Passage at Four Dams Alternative is not expected to result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006).

Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011). However, evidence indicates that Upper Klamath Lake habitat is presently suitable to support Chinook salmon for at least the October through May period (Maule et al. 2009). Poor water quality conditions, particularly in Lake Ewauna during the late summer and early fall, could be detrimental to fish in this area, particularly anadromous salmonids. Therefore, an interim seasonal trap and haul operation would be implemented to capture and truck migrant fish around Lake Ewauna during stressful water quality conditions (from June 15th to November 15th, see Section 3.3.2). As adult spring-run Chinook salmon in the Klamath River migrate upstream from April through June, and most juveniles migrate from April through May or October through November, trap and haul activities would be expected to have only minor effects on this run of Chinook salmon.

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Fish Passage at Four Dams Alternative would include restoring spring-run Chinook salmon access to the Hydroelectric Reach. Passage through the Reach would provide approximately 52 miles of additional habitat along the mainstem and within accessible tributaries (DOI 2007). Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows. Further, passage structures would provide fish with some refuge from high temperatures because the cooler water from tributaries would flow directly into the mainstem Klamath River, in addition to that provided by 200 to 250 cfs of accretion from springs in the J.C. Boyle Bypass Reach (DOI 2007; FERC 2007; Hamilton et al. 2011). Under this alternative, suspended and bedload sediment, water quality, water temperature, and the occurrence of fish disease and algal toxins would be the same as under existing conditions.

This alternative would result in continuation of many of the stresses that currently affect Chinook salmon populations. The presence of J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality, and high late summer and early fall water temperatures, allowing conditions favorable for the transmission of fish disease to persist. Adult spring-run Chinook salmon in the Klamath River migrate upstream from April through June, and most juveniles migrate from April through May or October through November, as such, similar to trap and haul, poor water quality in reservoirs would have minor effects on the fitness of this species. Juveniles would be subject to some level of predation by

introduced resident species including largemouth bass, catfish, and yellow perch, resulting in mortality rates that would depend largely on their size (larger migrants would do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rogers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids above Iron Gate Dam is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam Under the Fish Passage at Four Dams Alternative, suspended sediment would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species. Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Under the Fish Passage at Four Dams Alternative, the lower Klamath River downstream of Iron Gate Dam would continue to have poor water quality because of the continued presence of the reservoirs, with their increased hydraulic residence time and thermal mass (Bartholow et al. 2005). Current cooler temperatures in spring and early summer could benefit both adult and juvenile migrant spring-run Chinook salmon; however, juveniles migrating later in the year would experience warm temperatures in late summer and fall that could be deleterious to health and survival.

Many of the primary factors influencing salmon infection and disease rates from *C. shasta* and *P. minibicornis* would remain unchanged. The ongoing presence of the dams would continue to contribute to the stable, warm habitat conditions favorable for polychaetes and their parasites *C. shasta* and *P. minibicornis* downstream of Iron Gate Dam. The Iron Gate Hatchery would continue to operate and would discharge its nutrient-rich effluent to the river. Upstream fish passage would likely reduce salmon spawning density immediately downstream of Iron Gate Dam, which in turn is likely to reduce the transfer of myxospores from salmon to their polychaete hosts. Therefore, under this alternative, disease impacts would be reduced, but would continue to be detrimental to spring-run Chinook salmon.

Dissolved oxygen concentrations during July–October immediately downstream of Iron Gate Dam would continue to be low (less than 8 mg/L). In addition, the presence of microcystin, associated with the dense blooms of *M. aeruginosa* in Iron Gate and Copco Reservoirs, would continue to occur downstream of Iron Gate Dam.

Estuary The Fish Passage at Four Dams Alternative is not expected to substantially change or affect spring-run Chinook salmon estuarine habitat relative to existing conditions.

*Under this alternative, fish ladders could result in alterations in habitat availability which could affect spring-run Chinook salmon in the long term.* Under the Fish Passage at Four Dams Alternative, spring-run Chinook salmon would gain access to mainstem and tributary habitat in the upper Klamath River and Hydroelectric Reach and thermal refugia within the Hydroelectric Reach. Stress to migrating adults and juveniles associated with potential interim seasonal trap and haul operation and poor reservoir water quality would likely be minor. Predation could result in reduced survival of spring-run Chinook salmon juveniles passing through the reservoirs. Cooler water temperatures (similar to existing conditions) during the spring would continue to benefit upstream migrating adult and downstream migrant juvenile spring-run Chinook salmon. Warmer water temperatures in the fall would continue to be detrimental to juveniles migrating at that time. These effects would be most pronounced for fish migrating through areas upstream of the Scott River.

This alternative would result in continuation of many of the stresses that currently affect Chinook salmon populations. The presence of J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality, and high late summer and early fall water temperatures, allowing conditions favorable for the transmission of disease for salmon to persist. These conditions would continue to have negative short- and long-term impacts on spring-run Chinook salmon populations. Further, under the Fish Passage at Four Dams Alternative, the KBRA would not be implemented, so any potential habitat improvements from KBRA restoration projects would not be realized. However, ongoing restoration activities will continue to occur. Climate change could also increase the frequency and duration of stressful water temperatures for salmonids under the Fish Passage at Four Dams Alternative. It is anticipated that as a result of the Fish Passage at Four Dams Alternative the spring-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, population spatial structure, and genetic diversity. However, smolts produced from the Salmon River and tributaries downstream of Iron Gate Dam would experience a continuation of existing deleterious effects. **Based on increased habitat availability the effect of the Fish Passage at Four Dams Alternative would be beneficial for spring-run Chinook salmon in the short- and long term.**

### **Coho Salmon**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Hamilton et al. (2005) states that historically coho salmon occurred at least to Spencer Creek (J.C. Boyle Reservoir). The Fish Passage at Four Dams Alternative may not affect coho salmon in the Upper Klamath Basin upstream of J.C. Boyle Reservoir Reach.

### Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam

Coho salmon below Iron Gate Dam belonging to the Upper Klamath River Population Unit would migrate above the dam if access was provided by fishways (Administrative Law Judge 2006). Over time, access to habitat above Iron Gate Dam would benefit the Upper Klamath River Population Unit by: a) extending the range and distribution of the species thereby increasing the coho salmon's reproductive potential; b) increase genetic

diversity in the coho stocks; c) reduce the species vulnerability to the impacts of degradation; and d) increase the abundance of the coho salmon population (Administrative Law Judge 2006). Implementation of the Fish Passage at Four Dams Alternative would restore Upper Klamath River Population Unit access to the Hydroelectric Reach, thereby expanding their distribution to include historical habitat along the mainstem Klamath River not inundated by reservoirs (although these areas would continue to be affected by the reservoirs) and all tributaries upstream at least to Spencer Creek, including Jenny, Shovel, and Fall creeks (Hamilton et al. 2005). Passage through the reach would provide approximately 48 miles of additional habitat within the mainstem and accessible tributaries (DOI 2007). Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows. Furthermore, upstream passage would provide fish with some refuge from high temperatures because the cooler water from tributaries would flow directly into the mainstem Klamath River, in addition to the 200 to 250 cfs provided by coldwater springs in the J.C. Boyle Bypass Reach (DOI 2007; FERC 2007; Hamilton et al. 2011).

Under this alternative, suspended and bedload sediment, water quality, water temperature, and the occurrence of fish disease and algal toxins would be the same as under existing conditions.

This alternative would result in continuation of many of the stresses that currently affect coho salmon populations. The presence of J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality, and high late summer and early fall water temperatures, allowing conditions favorable for the transmission of fish disease to persist. Although water temperature in the summer above Iron Gate Dam is an issue, the record evidence shows that water temperature would not preclude coho salmon from successfully utilizing the habitat within the Project area (Administrative Law Judge 2006). Adult coho salmon enter the Klamath River between late September and mid-December, with peak upstream migration occurring between late October and mid-November, and fry outmigrate to the ocean beginning in late February, with most outmigration occurring in April and May, as such, poor water quality in reservoirs would have minor affect on this species. Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rodgers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids above Iron Gate Dam is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, coho salmon and other

anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam Under the Fish Passage at Four Dams Alternative, suspended sediment would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species. Klamath Hydroelectric Project Dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Most spawning and rearing takes place within tributaries. But for the few coho salmon from the Upper Klamath River Population Unit that spawn in the mainstem, coarsening of the bed could reduce spawning habitat for coho salmon between Iron Gate Dam and Cottonwood Creek over time. Rearing habitat would be expected to remain similar to existing conditions.

Under the Fish Passage at Four Dams Alternative, the lower Klamath River downstream of Iron Gate Dam would continue to have poor water quality because of the continued presence of the reservoirs, with their increased hydraulic residence time and thermal mass (Bartholow et al. 2005). The delay in thermal signature would continue to delay anadromous spawning downstream of Iron Gate Dam, and pre-spawn mortality would remain high (Hamilton et al. 2011).

Many of the primary factors influencing salmon infection and disease rates from *C. shasta* and *P. minibicornis* would remain unchanged. The ongoing presence of the dams would continue to contribute to the stable, warm habitat conditions favorable for polychaetes and their parasites *C. shasta* and *P. minibicornis* downstream of Iron Gate Dam. The Iron Gate Hatchery would continue to operate and would discharge its nutrient-rich effluent to the river. Upstream fish passage would likely reduce salmon spawning density immediately downstream of Iron Gate Dam, which in turn is likely to reduce the transfer of myxospores from salmon to their polychaete hosts. Therefore, under this alternative, disease impacts would be reduced, but continue to be detrimental to coho salmon.

Dissolved oxygen concentrations during July–October immediately downstream of Iron Gate Dam would continue to be low (less than 8 mg/L). In addition, the presence of microcystin, associated with the dense blooms of *M. aeruginosa* in Iron Gate and Copco Reservoirs, would continue to occur downstream of Iron Gate Dam.

Estuary The Fish Passage at Four Dams Alternative is not expected to substantially change or affect spring-run Chinook salmon estuarine habitat relative to existing conditions.

*Under this alternative, fish ladders could result in alterations in habitat availability which could affect coho salmon in the long term.* Under the Fish Passage at Four Dams Alternative, coho salmon would gain access to mainstem and tributary habitat in the Hydroelectric Reach, and thermal refugia within the Hydroelectric Reach. Stress to migrating adults and juveniles associated with poor reservoir water quality and predation would occur, but would likely be minor.

As the presence of dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality, and high late summer and early fall water temperatures, allowing conditions favorable for the transmission of fish disease to persist. These conditions would continue to have negative short- and long-term impacts on coho salmon populations. Further, under the Fish Passage at Four Dams Alternative, the KBRA would not be implemented, so any potential habitat improvements from KBRA restoration projects would not be realized. However, ongoing restoration activities will continue to occur. Climate change could also increase the frequency and duration of stressful water temperatures for salmonids under the Fish Passage at Four Dams Alternative. It is anticipated that as a result of the Fish Passage at Four Dams Alternative the Upper Klamath River Population Unit would have an increase in abundance, population spatial structure, and genetic diversity. It is anticipated that as a result of the Fish Passage at Four Dams Alternative the Mid-Klamath River, Shasta River, Scott River, Salmon River population units would experience a continuation of existing deleterious effects, and the three Trinity River population units, and the lower Klamath River population units would not be affected. **Based on increased habitat availability the effect of the Fish Passage at Four Dams Alternative would be beneficial for coho salmon from the Upper Klamath River population unit in the short- and long term. Based on the continuation of existing conditions for populations downstream of Iron Gate Dam, this alternative would be no change from existing conditions for the coho salmon from the Mid-Klamath River, Shasta River, Scott River, and Salmon River, three Trinity River population units, and the Lower Klamath River population units in the short- and long term.**

### **Steelhead**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at Four Dams Alternative, steelhead would gain access to the Upper Klamath Basin upstream of J.C. Boyle Reservoir. This would expand the population's distribution to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005, Butler et al. 2010). Huntington (2006) estimated that the amount of potential new habitat for steelhead could be 500 miles; only perennial streams were counted in this estimate, but steelhead are also known to spawn in intermittent streams. Current redband trout distribution within areas that would become accessible to steelhead has been estimated at 496 miles by ODFW (W. Tinniswood, pers. comm., 2011). Because steelhead have habitat requirements similar to those of redband trout, this can be used as a rough estimate of habitat that may also be available to steelhead. Reservoirs would continue to inundate 22.4 miles of potential spawning and rearing habitat (Cunanan 2009). This alternative would not result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011).

Poor water quality conditions, particularly in Lake Ewauna during the late spring and early summer could be detrimental to fish in this area, particularly anadromous salmonids. Therefore, the Fish Passage at Four Dams Alternative includes interim seasonal trap and haul to capture and transport migrant fish around the Keno Impoundment/Lake Ewauna when water quality conditions would be prohibitively stressful. Long distance trap and haul could potentially increase stress on summer steelhead (entering the Klamath River from March to June) and winter steelhead (entering the river and migrating from August to March), potentially causing direct mortality as well as post-release pre-spawning mortality (Steward and Associates 2007; Buchanan et al. 2011b).

#### Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam

Fish Passage at Four Dams would provide steelhead with access to the Hydroelectric Reach, which would expand the population's distribution to include historical habitat in the mainstem Klamath River and its tributaries, including Jenny, Shovel, and Fall creeks (Hamilton et al. 2005). Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows. Overall, because of their greater capacity for ascending potential obstacles to migration that might exclude Chinook and coho salmon, the Fish Passage at Four Dams Alternative would provide steelhead with access to approximately 59 miles of additional habitat in the mainstem and accessible tributaries, comprising hundreds of miles of additional potentially productive anadromous fish habitat upstream of Iron Gate Dam (DOI 2007), including access to groundwater discharge areas more resistant to effects of climate change (Hamilton et al. 2011). There would continue to be 22.4 miles of spawning and rearing habitat inundated by reservoirs (Cunanan 2009).

Poor water quality conditions in reservoirs, such as high temperatures with low dissolved oxygen, fluctuations in dissolved oxygen, pH, ammonia associated with algal blooms, and microcystin from *M. aeruginosa* blooms would continue to be severely stressful to fish from June through September (Dunsmoor and Huntington 2006; FERC 2007). Summer steelhead enter the Klamath River from March to June, while winter steelhead enter and migrate from August to March; thus, poor water quality could have an effect on these fish as they move through reservoirs. Steelhead spawn in tributaries, and juveniles typically outmigrate from April through November, but the peak occurs from April through June, so most individuals would be likely to avoid poor reservoir water quality. Juveniles would be subject to some predation by introduced resident species such as largemouth bass, catfish, and yellow perch, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rogers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir

dynamics and the predator population that currently occurs, predation of outmigrating salmonids above Iron Gate Dam is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous salmonid juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam Under the Fish Passage at Four Dams Alternative, suspended sediment would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species. Klamath Hydroelectric Project Dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Current summer steelhead distribution extends from the mouth of the Klamath River upstream to Empire Creek, while winter steelhead are distributed throughout the lower Klamath River up to Iron Gate Dam (Stillwater Sciences 2010b). Summer and winter steelhead do not spawn in the mainstem Klamath River, nor are they expected to in the future, so spawning habitat would not be affected by alterations to bedload composition downstream of Iron Gate Dam under the Fish Passage at Four Dams Alternative. Changes to bedload sediment would not be expected to affect juvenile rearing and migration.

Under the Fish Passage at Four Dams Alternative, the lower Klamath River downstream of Iron Gate Dam Reach would continue to have poor water quality because of the continued presence of the reservoirs, with their increased hydraulic residence time and thermal mass (Bartholow et al. 2005). Current cooler temperatures in spring and early summer may benefit both adult and juvenile migrant steelhead; however, juveniles migrating later in the year would be deleteriously affected by warm temperatures in late summer and fall.

Dissolved oxygen concentrations during July–October immediately downstream of Iron Gate Dam would continue to be low (less than 8 mg/L). In addition, the presence of microcystin, associated with the dense blooms of *M. aeruginosa* in Iron Gate and Copco Reservoirs, would continue to occur downstream of Iron Gate Dam.

Estuary The Fish Passage at Four Dams Alternative is not expected to substantially change or affect steelhead estuarine habitat relative to existing conditions.

*Under this alternative, fish ladders could result in alterations in habitat availability which could affect steelhead in the long term.* Under the Fish Passage at Four Dams Alternative, steelhead would gain access to mainstem and tributary habitat in the Hydroelectric Reach, and thermal refugia within the Hydroelectric Reach. Stress to migrating adults and juveniles associated with poor reservoir water quality would likely be minor. Survival during migration through reservoirs could be negatively affected at some level by predation.

This alternative would result in continuation of many of the stresses that currently affect steelhead populations. The presence of dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality, and high late summer and early fall water temperatures, allowing conditions favorable for the transmission of fish disease

to persist. These conditions would continue to have negative short- and long-term impacts on steelhead populations. Further, under the Fish Passage at Four Dams Alternative, the KBRA would not be implemented, so any potential habitat improvements from KBRA restoration projects would not be realized. However, ongoing restoration activities will continue to occur. Climate change could also increase the frequency and duration of stressful water temperatures for salmonids under the Fish Passage at Four Dams Alternative. It is anticipated that as a result of the Fish Passage at Four Dams Alternative the summer and winter steelhead within the Klamath River watershed would have an increase in abundance, population spatial structure, and genetic diversity. **Based on increased habitat availability, the Fish Passage at Four Dams Alternative would be beneficial for summer and winter steelhead in the short- and long term.**

### **Pacific Lamprey**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Pacific lamprey did not historically occur upstream of J.C. Boyle Reservoir (Hamilton et al. 2005) and are not anticipated to occupy this reach after implementation of this alternative.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam The Fish Passage at Four Dams Alternative would provide Pacific lamprey with access to the Hydroelectric Reach and to the mainstem Klamath River and all its tributaries upstream as far as Spencer Creek, including Jenny, Shovel, and Fall Creeks (Hamilton et al. 2005). Passage through the reach would provide additional habitat along the mainstem and within accessible tributaries (DOI 2007). Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows. In addition, passage would provide fish with some refuge from high temperatures by allowing cooler tributaries to flow directly into the mainstem Klamath River, adding to the 200 to 250 cfs provided by coldwater springs in the J.C. Boyle Bypass Reach (DOI 2007; FERC 2007; Hamilton et al. 2011). Under this alternative, suspended and bedload sediment, water quality, water temperature, and the occurrence of algal toxins would continue to be the same as under existing conditions.

Poor water quality conditions in reservoirs, such as high temperatures with low dissolved oxygen, changes in dissolved oxygen, pH, and ammonia associated with algal blooms, and microcystin from *M. aeruginosa* blooms would continue to be severely stressful from June to September (Dunsmoor and Huntington 2006; FERC 2007). Pacific lamprey adults migrate from winter through spring, while juveniles (age 2 to age 10) outmigrate year-round, with peaks during late spring and fall. Poor reservoir quality would likely not affect migrating adults, but could affect juveniles. Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch (FERC 2007). Volitional passage for Pacific lamprey has been designed and is in place in other river systems (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam Under the Fish Passage at Four Dams Alternative, Klamath Hydroelectric Project Dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Suspended sediment

would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species. The channel directly downstream of Iron Gate Dam would continue to be starved of fine sediment. Coarsening of the bed could reduce spawning habitat for lamprey downstream of the dam over time, but this impact would be limited to the area upstream of Cottonwood Creek, as coarse sediment was resupplied by tributary inputs (Hetrick et al. 2009; Stillwater Sciences 2010a).

Under the Fish Passage at Four Dams Alternative, the lower Klamath River downstream of Iron Gate Dam reach would continue to have poor water quality. Water quality would continue to be influenced by reservoirs, with increased hydraulic residence time and thermal mass (Bartholow et al. 2005). Finally, the KBRA would not be implemented, so any potential habitat improvements from KBRA restoration projects would not be realized. However, ongoing restoration activities will continue to occur.

Estuary The Fish Passage at Four Dams Alternative is not expected to substantially change or affect Pacific Lamprey estuarine habitat relative to existing conditions.

*Under this alternative, fish ladders could result in alterations in habitat availability which could affect Pacific lamprey in the long term.* Under the Fish Passage at Four Dams Alternative, lamprey would gain access to mainstem and tributary habitat in the upper Klamath River and Hydroelectric Reach, and thermal refugia within the Hydroelectric Reach. Poor reservoir quality would likely not affect migrating adults, but could affect juveniles. Juveniles would also be exposed to predation from nonnative resident fish.

This alternative would result in continuation of many of the stresses that currently affect lamprey populations. The presence of dams under the Fish Passage at Four Dams Alternative would continue to cause poor water quality and high late summer and early fall water temperatures. Climate change could also increase the frequency and duration of stressful water temperatures for lamprey under the Fish Passage at Four Dams Alternative. It is anticipated that as a result of the Fish Passage at Four Dams Alternative the Pacific lamprey population within the Klamath River watershed would have an increase in abundance, population spatial structure, and genetic diversity (Administrative Law Judge 2006). However, lamprey downstream of Iron Gate Dam would experience a continuation of existing deleterious effects. **Based on increased habitat availability, the Fish Passage at Four Dams Alternative would be beneficial for Pacific lamprey in the short- and long term.**

**Green Sturgeon** *Under this alternative, fish ladders could result in alterations in habitat availability which could affect Pacific lamprey in the long term.* Under the Fish Passage at Four Dams Alternative, conditions in the area occupied by green sturgeon are unlikely to change relative to existing conditions as green sturgeon occur downstream of Ishi Pishi Falls, and the effects of this alternative are not anticipated to extend that far downstream.

It is anticipated that as a result of the Fish Passage at Four Dams Alternative the green sturgeon population within the Klamath River watershed would experience a continuation of deleterious effects. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for green sturgeon in the short- and long term.**

**Shortnose and Lost River Sucker** Upper Klamath River: The KBRA would not be implemented under this alternative. However, ongoing restoration activities will continue to occur.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam  
*Construction of fishways could affect shortnose and Lost River Sucker populations by continuing poor water quality and high rates of predation.* Shortnose and Lost River suckers would continue to be subject to poor water quality and high rates of predation within reservoirs. But with little or no successful reproduction (Buettner et al. 2006), populations downstream of Keno Dam contribute minimally to conservation goals and insignificantly to recovery (Hamilton et al. 2011). Fish passage was not prescribed for sucker species at Iron Gate, J.C. Boyle, Copco 1, or Copco 2 Dams.

Under the Fish Passage at Four Dams Alternative, existing efforts to restore habitat for shortnose and Lost River sucker and improve water quality conditions would continue. These actions would be expected to improve conditions for these species over time and their populations would be expected to increase. **The effect of the Fish Passage at Four Dams Alternative would be less-than-significant for Lost River and shortnose sucker populations in the short and long term.**

### **Redband Trout**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at Four Dams Alternative, redband trout would be able to migrate more successfully from the Hydroelectric Reach to the Upper Klamath Basin (Hamilton et al. 2011) than under existing conditions. Fish passage facilities would improve connectivity to Spencer Creek, which provides important spawning habitat and temperature refugia for redband trout (DOI 2007; Buchanan et al. 2011b). Upstream fish passage would also restore connectivity of resident redband populations in the mainstem Klamath River to those in Lake Ewauna, the Link River, and Upper Klamath Lake (DOI 2007). The Fish Passage at Four Dams Alternative is not expected to result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease.

Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to redband trout above Iron Gate Dam (Administrative Law Judge 2006). Redband could be affected by increased predation from reintroduced salmonids, but this loss might be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Hamilton et al. 2011). Adult salmon moving into the upper basin would likely bring with them genotypes of *C. shasta* that had previously been restricted to the lower river. While the effects of these introductions are uncertain, at least some degree of host specificity appears to exist (Atkinson and Bartholomew 2010), indicating that newly exposed

species, such as redband trout, might not be susceptible to the new genotypes. Additionally, the changes in habitat that could result from dam removal (fewer areas of slow-flowing, stable habitat) would likely reduce the density of polychaete populations, resulting in reduced disease exposure for fish. The close similarities between anadromous steelhead trout and resident rainbow/redband trout suggest these species historically co-existed. The distribution and resistance of rainbow/redband trout in Upper Klamath Lake to *C. Shasta* lends additional support that the two species co-existed and intermingled prior to the construction of Copco 1 Dam in 1917. There are many examples from nearby river systems in the Pacific Northwest that show wild anadromous salmon and resident rainbow/redband trout can co-exist and maintain abundant populations without deleterious consequences. The Deschutes River in Oregon, the Yakima River in Washington, and the river systems in Idaho are examples (Administrative Law Judge 2006).

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Fish passage resulting from the Fish Passage at Four Dams Alternative would allow redband trout to express the seasonal movements and migration patterns that were historically in place, restore population connectivity and genetic diversity, and allow greater utilization of existing habitat and refugia. Fish passage at Copco 1 and Copco 2 Dams would restore connectivity throughout the Hydroelectric Reach to Shovel Creek, which provides spawning habitat and temperature refugia (DOI 2007). Passage at Iron Gate Dam would restore connectivity between populations in the mainstem Klamath River and those in the Copco 2 bypass channel and in Slide, Scotch, Camp, Jenny, Salt, and Fall Creeks, which also provide spawning habitat and temperature refugia (DOI 2007). The current fish screen and ladder at the J.C. Boyle Dam do not meet current state and federal fish passage criteria and the ladder impairs upstream migration (Administrative law Judge 2006). Improvements in efficiency to the fishway at J.C. Boyle Dam would result in significant trout population migration above the dam over time (Administrative Law Judge 2006). Habitat in the J.C. Boyle bypass and peaking reaches and the Copco 2 Bypass Reach would be improved through reduced (but not eliminated) peaking operations and increasing base flows.

Populations of nonnative species within the reservoirs of the Hydroelectric Reach would continue to prey on smaller redband trout rearing in those reservoirs. Water quality would continue to be poor, although TMDL implementation would improve water quality conditions from existing conditions throughout the basin through time, benefiting this species. Climate change would result in warmer conditions, which would reduce the suitability of habitat.

*Under this alternative, fish ladders and changes in operations could result in alterations in habitat availability and suitability which could affect redband trout in the long term.* The Fish Passage at Four Dams Alternative would improve habitat connectivity throughout the Hydroelectric Reach and to the upper Klamath River in the long term, increasing access to spawning habitat and temperature refugia. Redband trout would still be subject to poor water quality, and predation within the reservoirs, but increases in connectivity and reduced effects of hydropower operations would likely provide a benefit

to reband trout populations. **Based on increased habitat connectivity, the effect of the Fish Passage at Four Dams Alternative would be beneficial for reband trout in the short- and long term.**

### **Bull Trout**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Bull trout upstream of J.C. Boyle Reservoir could be affected by increased predation from reintroduced salmonids, but this loss could be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Buchanan et al. 1997).

*Fish ladders could alter habitat access for anadromous fish, which could affect bull trout.* **Based on the restricted distribution of bull trout, the Fish Passage at Four Dams Alternative would have a less-than-significant impact on bull trout in the short- and long term.**

**Eulachon** Under the Fish Passage at Four Dams Alternative, the extent and quality of eulachon habitat would be expected to remain similar to that under existing conditions. Because eulachon occur far downstream in the river, mixing and inflows from intervening tributaries would reduce poor water quality conditions originating in the dams. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for eulachon in the short and long term.**

**Longfin Smelt** Under the Fish Passage at Four Dams Alternative, the extent and quality of longfin smelt habitat would be expected to remain similar to that under existing conditions. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for longfin smelt in the short and long term.**

**Introduced Resident Species** *The Fish Passage at Four Dams Alternative would not affect introduced resident species upstream of J.C. Boyle Reservoir.* Under the Fish Passage at Four Dams Alternative, dams in the Hydroelectric Reach would not be removed, allowing reservoir habitat to remain similar to existing conditions. Connectivity between the reservoirs could increase available habitat area for these species if they are able to migrate through passage facilities. Over time the total volume of habitat would diminish, as sediment accumulates in the reservoirs. TMDL implementation would be expected to improve water quality conditions over time, but climate change would cause temperatures to increase. These species are adapted to warm-water conditions, and are not expected to be affected by these changes. **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for introduced resident species population.**

**Freshwater Mussels** *Under the Fish Passage at Four Dams Alternative, suspended sediment would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species.* **The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for mussels in the short and long term.**

**Benthic Macroinvertebrates** *Under the Fish Passage at Four Dams Alternative, suspended sediment would be the same as under existing conditions, thus having no suspended sediment effects relative to existing conditions for any aquatic species. The effect of the Fish Passage at Four Dams Alternative would be no change from existing conditions for macroinvertebrates in the short and long term.*

#### **Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could affect aquatic species.* Trap and haul measures would pass upstream and downstream migrating fish around Keno Impoundment and Link River during periods of poor water quality. The measures would provide effective migration for fall-run Chinook salmon when water quality is poor during the period from June 15 to November 15. During the limited period of use, fish collection and release facilities would be operated to minimize any delay and stress and provide for adequate acclimation. For adult fall-run Chinook salmon, fish transport would be an effective fish passage method because transport would be for a short distance on a seasonal, interim basis<sup>5</sup>. For adult fall-run Chinook salmon, seasonal collection and transport mortality when water quality is poor is likely to be minor compared to mortality associated with unaided passage through areas of poor water quality at this time of year.

In some instances, the collection and transport of fall-run Chinook salmon around areas of poor water quality could result in limited, seasonal mortality as follows:

1. Some juvenile federally listed suckers would likely be collected incidentally and may suffer related stress and mortality. However, regardless of any remediation at an upstream collection facility, nearly all these downstream migrant suckers would eventually die in the absence of lacustrine habitat below Keno Impoundment. There is little to no evidence of recruitment of suckers in downstream reservoirs currently and this habitat does not contribute significantly to the recovery of the species. Suckers may be collected and returned to habitat above Keno Impoundment.
2. Some redband trout may be collected incidentally resulting in displacement and incidental collection-related stress and mortality. Redband trout may be collected and returned to habitat above Keno Impoundment.
3. For fall-run Chinook salmon emigrants, the seasonal poor quality conditions are not expected to overlap with the peak migration period, thus the majority of juvenile Chinook salmon would not be affected. For those fall-run Chinook salmon emigrants collected and transported when water quality is poor, transport related mortality would be minor compared to the mortality

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<sup>5</sup> This seasonal, transport on an interim basis is not to be confused with permanent, year round trap and haul which does not provide equal benefits for the Klamath River when compared with the Services' fishway prescriptions (U.S. Department of the Interior (2007) The Department of the Interior's Filing of Modified Terms, Conditions, and Prescriptions (Klamath Hydroelectric Project, No. 2082). Sacramento, California: 650 p.; NOAA Fisheries Service (2007). NOAA Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis for the Klamath Hydroelectric Project (FERC Project No. 2082): 151 p.).

associated with unaided passage through areas of poor water quality at this time of year.

4. For steelhead trout and spring-run Chinook salmon, migration would primarily be expected to occur when water quality was adequate, thus, collection and transport of these fish would not be necessary or minimal. However, all anadromous salmonids would be collected and transported when water quality is poor during the period from June 15 through November 15. Transport related mortality would be minor compared to the mortality associated with unaided passage through areas of poor water quality at this time of year.

Limited, seasonal transport of fall-run Chinook salmon would provide a net benefit by allowing them migration to and from additional (historical) spawning habitat, by providing more effective migration, and by reducing the density of spawners below Keno Dam in certain poor water quality situations.

In the short-term, constructing fish handling facilities could have localized construction-related impacts; however, they could be avoided or minimized through implementation of best management practices, such as control and containment of sediment and toxic discharge, isolation of work areas from the active channel of streams or rivers where possible, and rescuing fish where mortality may result from an action. In the long term, trap and haul would benefit fish because of the access to additional habitat and avoidance of areas with poor water quality. **Based on access to additional, historical habitat and the anticipated improvements in fish health, implementation of trap and haul measures in the Fish Passage at Four Dams Alternative would be beneficial for fall-run Chinook salmon.**

#### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative proposes to remove the two largest dams in the Hydroelectric Reach (Copco 1 and Iron Gate Dams) and install fishways for volitional fish passage on the remaining installations (J.C. Boyle and Copco 2). The prescriptions and conditions would still apply to the remaining dams, including flow requirements, the specific provisions and performance standards for both upstream and downstream fish passage facilities at the remaining dams, and the interim seasonal trap and haul trap actions at Keno Dam as described above under the Fish Passage at Four Dams Alternative.

Because the four dams would not be removed as required under the KHSRA, the KBRA would not be implemented. The ongoing restoration actions described in the No Action/No Project Alternative would continue. Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, peaking power would not be generated due to limits on flow regulation at J.C. Boyle and Copco 2 Reservoirs. Similar to the Fish Passage at Four Dams Alternative, 40 percent of the inflow to J.C. Boyle Reservoir would be passed through to the Bypass Reach, except in periods when inflow

to J.C. Boyle Reservoir falls below 470 cfs, at which point outflow to the Bypass Reach is required to equal reservoir inflow.

### **Key Ecological Attributes**

#### Suspended Sediment

Under this alternative, SSCs have not been modeled, but would be very similar to those under the Full Facilities Removal of Four Dams Alternative described in Section 3.3.4.3, because most stored sediment affecting downstream resources is stored in Copco 1 and Iron Gate Reservoirs. Therefore, this alternative would have very similar effects on aquatic species associated with suspended sediment transport as the Proposed Action.

#### Bedload Sediment

Under this alternative, J.C. Boyle Dam would continue to store sediment, but the storage capacity of Copco 2 Dam would likely be filled by the release of sediments during the Copco 1 Dam removal, and then bedload would likely pass through Copco 2. This scenario has not been modeled, but the effects of bedload sediment movement under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to, but of slightly lesser magnitude, than under the Proposed Action.

#### Water Quality

Under this alternative, the effects on water quality would have results intermediate between the Proposed Action and Fish Passage at Four Dams Alternatives. As Copco 1 and Iron Gate Reservoirs are the largest of the four reservoirs, they have the greatest impact on water quality (FERC 2007), and their removal would result in water quality conditions similar to those of the Proposed Action. Because of their small size and short residence times, the retention of J.C. Boyle and Copco 2 Dams would not result in the same poor water quality conditions as occur under current conditions.

Since Alternative 5 would include no peaking power generation or release of flow for recreation at J.C. Boyle, water temperature effects in the J.C. Boyle Bypass and Peaking Reaches would be the same as under the Proposed Action, i.e., warmer and more variable water temperatures in the bypass reach during summer and early fall, and cooler temperatures in late fall and winter; and, slightly cooler and less variable water temperatures in the peaking reach during summer and early fall. Further downstream, at the Oregon-California state line, water temperatures would be similar to those under the No Action/No Project Alternative since large temperature effects of the peaking operations do not extend this far downstream. Within the remainder of the Hydroelectric Reach, effects on water temperature under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as effects for the Hydroelectric Reach under the Proposed Action, i.e., long-term increases in spring water temperatures and decreases in late summer/fall water temperatures (see Section 3.2.4.3.5.1).

#### Fish Disease and Parasites

Under this alternative, there would be fewer deleterious effects in terms of fish disease as compared to the No Action/No Project Alternative. Although it would not result in the

same level of reduction in fish disease as the Proposed Action, removal of Iron Gate and Copco 1 Dams would result in water quality improvements and would reduce favorable habitat for polychaete worms below Iron Gate Dam. The removal of the two dams would likely increase the availability of nutrients and physical habitat (i.e., periphyton mats) favorable to the polychaete host for *C. shasta* and *P. minibicornis* in the Hydroelectric Reach and downstream of Iron Gate Dam, although to a slightly lesser extent than under the Proposed Action because J.C. Boyle Dam would not be removed. Flow variability and scouring in the Hydroelectric Reach and downstream of Iron Gate Dam will be increased similar to the Proposed Action, with the exception of downstream of J.C. Boyle Dam where peaking flows will be eliminated. Removal of the two dams would likely result in more favorable water temperature for salmonids than under existing conditions as well as improve water quality and reduce instances of algal toxins (see Section 3.2.4.3.5).

Under this alternative, spawning fish would be expected to disperse more fully throughout the watershed than under the Fish Passage at Four Dams Alternative, as the remaining dams would be relatively small, and the ladders would, therefore, be easier to ascend. Fish passage conditions would not be as good as those under the Proposed Action.

As described for the Proposed Action, fish passage upstream by anadromous salmonids could be increased under this alternative, but would not be expected to be deleterious to aquatic resources in the Upper Basin through spread of the disease (Administrative Law Judge 2006).

#### Algal Toxins

**Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir** This region is upstream of any proposed dam removal; therefore, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would not affect fish health as related to algal toxins. Any changes in algal toxin production in this region would be a result of other factors, including TMDL implementation. The effects in this area would be similar to those described for the No Action/No Project Alternative.

**Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam** The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would eliminate growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* in the Hydroelectric Reach, alleviating high seasonal concentrations of algal toxins and associated bioaccumulation of microcystin in fish tissue for species in this reach. While some microcystin may be transported downstream from large blooms occurring in Upper Klamath Lake, the levels would not be as high as those currently experienced due to the prevalence of seasonal in-reservoir blooms. Overall, bioaccumulation of algal toxins in fish tissue would be expected to decrease in the Hydroelectric Reach and would be beneficial.

**Lower Klamath River: Downstream of Iron Gate Dam** The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would eliminate growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa*, alleviating the transport of high seasonal concentrations of algal toxins to the Klamath River downstream of Iron Gate Dam. This would also decrease the associated bioaccumulation of microcystin in fish tissue for species downstream of the dam. While some microcystin may be transported downstream from large blooms occurring in Upper Klamath Lake, the levels would not be as high as those currently experienced due to the prevalence of seasonal in-reservoir blooms. Overall, bioaccumulation of algal toxins in fish tissue would be expected to decrease in the Klamath River downstream of Iron Gate Dam and would be beneficial.

#### Aquatic Habitat

Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, flow increases would provide more habitat than under existing conditions for redband/rainbow trout and other resident riverine species, as well as any anadromous fish or lamprey that reestablish in the Hydroelectric Reach, but habitat gains would be less than under the Proposed Action. The removal of the two dams would eliminate existing habitat in Copco 1 and Iron Gate Reservoirs for adult shortnose and Lost River suckers, as well as nonnative species, while habitat within J.C. Boyle Reservoir would remain. This Alternative would restore 22.4 miles of riverine habitat (Cunanan 2009) for resident and anadromous fish through removal of reservoirs.

The alternative would incorporate barriers to prevent juvenile salmonid entrainment into turbines. There would also be substantial changes to hydroelectric operations. J.C. Boyle would no longer generate in peaking mode, and higher flow releases would be made through the J.C. Boyle Bypass Reach than under existing conditions. Higher base flows would also be provided in the Copco 2 Bypass Reach, and ramping rates would be slower than they are currently. These modifications would benefit fish in this reach, including redband trout and anadromous fish. Seasonal high flows will contribute to improving the quality of riparian habitat in the J.C. Boyle bypass reach by increasing the sediment deposit within the channel and decreasing reed canary grass (Administrative Law Judge 2006). The more normative flow regime associated with this alternative would provide these seasonal high flows. Similar to the Proposed Action, under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, flow-related habitat changes for species downstream of Iron Gate Dam would increase over the No Action/No Project Alternative and historical conditions (Hetrick et al. 2009).

Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed reservoir sediment. No short-term effects are anticipated from these reservoir restoration efforts; however, aquatic habitat may be improved from restored riparian vegetation in the long term.

## **Aquatic Resources Effects**

### Critical Habitat

*As described below, lowering the water surface elevation of the reservoirs associated with dam removal under this alternative could alter the quality of critical habitat. In addition, the removal of two dams and two reservoirs could alter the availability and quality of critical habitat.*

**Coho Salmon** The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would increase the amount of habitat available to coho salmon (currently upstream of designated critical habitat) and the quality of the existing critical habitat by improving water quality in the mainstem Klamath River. NOAA Fisheries Service may consider whether to designate the newly available habitat as critical habitat as part of its 5 year status review or as a separate reconsideration of the critical habitat designation for the species (J. Simondet, NOAA Fisheries Service, pers. comm., 2011). The effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative on critical habitat for coho salmon would be similar to those for the Proposed Action, but somewhat reduced by the ongoing presence of Copco 2 and J.C. Boyle Reservoirs. The same habitat expansion expected under the Proposed Action would occur, with the exception of habitat under Copco 2 and J.C. Boyle Reservoirs and the downstream portion of Spencer Creek, which would continue to be inundated by J.C. Boyle Reservoir and may be designated as critical habitat in the future. Fish passage would be provided past the remaining dams, and because only two fishways would need to be negotiated instead of four and are considerably smaller than Iron Gate or Copco 1, passage through the ladders would be improved. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through elimination of peaking operations and higher baseflows.

The NOAA Fisheries Service (2010a) current biological opinion for Reclamation's Klamath Project, specifies flows downstream of Iron Gate Dam, and this biological opinion would likely need to be revised to reflect flows that would need to be provided below Copco 2 Dam if this alternative were adopted. Copco 1 and Iron Gate Reservoirs also cause the majority of the water temperature and water quality issues in the Hydroelectric Reach, so these conditions would be more similar to the Proposed Action than to the Fish Passage at Four Dams Alternative. These water quality improvements would accrue to areas downstream of Iron Gate Dam as well. Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle and Copco 2 Reservoirs, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rogers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based

on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Although upstream of current designated critical habitat, implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would expand the geographic extent of habitat available to coho salmon. Water quality within currently designated critical habitat is anticipated to improve relative to existing conditions. **Based on reduced habitat quality during reservoir drawdown affecting PCEs, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a significant effect on coho salmon critical habitat in the short term. Based on benefits to the PCEs downstream of Iron Gate Dam, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a beneficial effect on critical habitat for coho salmon in the long term.**

**Bull Trout** The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be expected to have a similar effect on critical habitat for bull trout as the Fish Passage at Four Dams Alternative. **Based on the restricted distribution of bull trout, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a less-than-significant impact on critical habitat for bull trout in the short- and long term.**

**Southern Resident Killer Whales** The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be expected to have a similar impact on critical habitat for Southern Resident Killer Whales as the Proposed Action. Chinook salmon would be provided access to areas upstream of Iron Gate Dam and into the upper watershed, boosting natural production. Water quality issues would be improved both in the Hydroelectric Reach and in the lower Klamath River. Fish parasitism would decrease as conditions became less favorable for the polychaetes host of *C. shasta* and *P. minibicornis*. However, because Chinook salmon from the Klamath River make up a very small proportion of the Southern Resident Killer Whale diet, this benefit to Southern Resident Killer Whales is expected to be small. **Based on small influence of the Klamath River on PCEs of Southern Resident Killer Whales, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a less-than-significant impact on critical habitat for Southern Resident Killer Whales in the short- and long term.**

**Essential Fish Habitat** *As described below, lowering the water surface elevation of the reservoirs associated with dam removal under this alternative could alter the quality of Essential Fish Habitat (EFH). In addition, the removal of two dams and two reservoirs could alter the availability and quality of EFH.*

**Chinook and Coho Salmon EFH** The effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative on EFH for Chinook and coho salmon would be similar to those for the Proposed Action, but would be somewhat

reduced by the ongoing presence of Copco 2 and J.C. Boyle Reservoirs. Water quality in the mainstem Klamath River is expected to be improved. Most of the habitat expansion expected (upstream of currently designated EFH) under the Proposed Action would occur, with the exception of habitat under Copco 2 and J.C. Boyle Reservoirs and the downstream portion of Spencer Creek, which would continue to be inundated by J.C. Boyle Reservoir. Fish passage would be provided past the remaining dams, and because only two fishways would need to be negotiated instead of four and these remaining dams are considerably smaller than Iron Gate or Copco 1 dams, passage through the ladders would be improved over existing conditions.

The NOAA Fisheries Service (2010a) current biological opinion for Reclamation's Klamath Project, specifies flows downstream of Iron Gate Dam, and this biological opinion would likely need to be revised to reflect flows that would need to be provided below Copco 2 Dam if this alternative were adopted. Copco 1 and Iron Gate reservoirs also cause the majority of the water temperature and water quality issues in the Hydroelectric Reach, so these conditions would be more similar to the Proposed Action than to the Fish Passage at Four Dams Alternative. These water quality improvements would accrue to areas downstream of Iron Gate Dam as well.

**Based on a substantial reduction in EFH quality during reservoir drawdown, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a significant effect on EFH for Chinook and coho salmon in the short term. Based on benefits to the habitat quality, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a beneficial effect on EFH for Chinook and coho salmon in the long term.**

**Groundfish EFH** The effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to those of the Proposed Action Alternative, with similar effects on SSCs, bedload and water quality.

**Based on short duration of poor water quality during reservoir drawdown in the estuary, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a less-than-significant effect on EFH for groundfish in the short- and long term.**

**Pelagic Fish EFH** The effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative on pelagic fish EFH would be similar to those described for the Proposed Action.

**Based on short duration of poor water quality during reservoir drawdown in the estuary, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a less-than-significant effect on EFH for pelagic fish in the short- and long term.**

#### Species-Specific Impacts

*As described below, lowering the water surface elevation of the reservoirs associated with dam removal under this alternative could affect aquatic species. In addition, the*

*removal of two dams and two reservoirs could alter the availability and quality of habitat, resulting in effects on aquatic species.*

### **Fall-Run Chinook Salmon**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, dam removal and the addition of fish passage facilities at J.C. Boyle and Copco 1 Dams would allow fall-run Chinook salmon to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. The access would expand the Chinook salmon's current habitat to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). This would be a potential increase in access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive habitat (DOI 2007), including access to groundwater discharge areas resistant to effects of climate change (Hamilton et al. 2011).

The removal of the two dams would likely reduce the availability of physical habitat favorable to the polychaete host for *C. shasta* and *P. minibicornis*. Flow variability would not be as great as under the Proposed Action; therefore, although removal of the two reservoirs would reduce the amount of lentic habitat available, some low-velocity habitats favorable to polychaetes might persist. Removal of the two dams would likely result in more favorable water temperature for salmonids than under existing conditions as well as improve water quality and reduce instances of algal toxins.

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would restore fall-run Chinook salmon access to the Hydroelectric Reach. Suspended and bedload sediment effects would be similar to those described for the Proposed Action.

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would include removal of Copco 1 and Iron Gate Reservoirs, with continued power generation at J.C. Boyle and Copco 2 hydroelectric plants. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through elimination of peaking operations and higher baseflows. The reservoir drawdowns would allow tributaries and springs such as Fall and Shovel creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). Spencer Creek would continue to flow into J.C. Boyle Reservoir at its upstream end. Anadromous fish provided access to these reaches would have access to the tributaries as well.

Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle and Copco 2 Reservoirs, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rodgers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile

salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in the release of sediment stored within Copco 1 and Iron Gate Reservoirs downstream to the lower Klamath River. Of the reservoirs in the Hydroelectric Reach, J.C. Boyle Reservoir stores the least amount of sediment, less than 10 percent of the total amount. As such, suspended and bedload sediment conditions and effects on fall-run Chinook salmon in the lower Klamath River reach would be similar to those described for the Proposed Action, but would be of slightly lesser magnitude.

The removal of two dams and restoration of free flowing sections of river would likely result in more favorable water temperatures for salmonids than under existing conditions. As it would be under the Proposed Action, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to reduced water quality from increased suspended sediment concentrations, but these effects would be short term. Flow variability likely would not be as great as under the Proposed Action, but would still likely reduce habitat conditions favorable for polychaetes and algal toxins.

Estuary The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect fall-run Chinook salmon estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and bedload sediment transport and deposition and affect fall-run Chinook salmon. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for fall-run Chinook salmon in the short term.***

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect fall-run Chinook salmon. As stated above, dam removal would also restore connectivity to 420 miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach. **Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at***

**J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for fall-run Chinook salmon in the long term.**

**Spring-Run Chinook Salmon**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, dam removal and the addition of fish passage facilities at J.C. Boyle and Copco 1 Dams would allow spring-run Chinook salmon to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. The access would expand the spring-run Chinook salmon's current habitat to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood Rivers (Hamilton et al. 2005). This would be a potential increase in access to 49 significant tributaries in the Upper Klamath Basin, comprising 420 miles of additional potentially productive habitat (DOI 2007), including access to groundwater discharge areas resistant to effects of climate change (Hamilton et al. 2011). Similar to the Proposed Action, this alternative is not expected to result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011). However, evidence indicates that UKL habitat is presently suitable to support Chinook salmon for at least the October through May period (Maule et al. 2009).

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would restore spring-run Chinook salmon access to the Hydroelectric Reach. Suspended and bedload sediment effects would be similar to those described for the Proposed Action.

Habitat in the J.C. Boyle bypass and peaking reaches and the Copco 2 Bypass Reach would be improved through eliminating peaking operations and increasing base flows. The reservoir drawdowns would allow tributaries and springs such as Fall and Shovel creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). Spencer Creek would continue to flow into J.C. Boyle Reservoir at its upstream end. Anadromous fish provided access to these reaches would have access to the tributaries as well.

The removal of the two dams would likely reduce the availability of physical habitat favorable to the polychaete host for *C. shasta* and *P. minibicornis*, although to a lesser extent than under the Proposed Action. Flow variability would not be as great as under the Proposed Action; therefore, although removal of the two reservoirs would reduce the amount of lentic habitat available, some low-velocity habitats favorable to polychaetes might persist. Removal of the two dams would likely result in more favorable water

temperature for salmonids than under existing conditions as well as improve water quality and reduce instances of algal toxins.

Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rodgers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in the release of sediment stored within Copco 1 and Iron Gate reservoirs downstream to the lower Klamath River. Of the reservoirs in the Hydroelectric Reach, J.C. Boyle stores the least amount of sediment, less than 10 percent of the total amount. As such, suspended and bedload sediment conditions and effects on spring-run Chinook salmon in the lower Klamath River reach would be similar to those described for the Proposed Action, but of slightly lesser magnitude.

The removal of two dams and restoration of free flowing sections of river would likely result in more favorable water temperatures for salmonids than under existing conditions. As it would be under the Proposed Action, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to reduced water quality, but these effects would be short term. Flow variability likely would not be as great as under the Proposed Action, but would still likely reduce habitat conditions favorable for polychaetes and algal toxins.

Estuary The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect spring-run Chinook salmon estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and bedload sediment transport and deposition and affect spring-run Chinook salmon. **Based on minimal reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2,***

**Remove Copco 1 and Iron Gate Alternative would be less-than-significant for spring-run Chinook salmon in the short term.**

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect spring-run Chinook salmon. **Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for spring-run Chinook salmon in the long term.***

**Coho Salmon**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Coho salmon did not historically occur upstream of J.C. Boyle Reservoir, and are not anticipated to occupy this reach after implementation of this alternative. Implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative may not affect coho salmon in the Upper Klamath Basin upstream of J.C. Boyle Reservoir Reach.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam

Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, coho salmon access to the Hydroelectric Reach would be restored, which would expand the population's current range to include historical habitat within the mainstem Klamath River and all tributaries upstream as far as Spencer Creek, including Jenny, Shovel, and Fall Creeks (Hamilton et al. 2005). Spencer Creek flows into the upstream end of J.C. Boyle Reservoir and would still be partially inundated under this alternative, but suitable habitat in the Spencer Creek would be accessible to coho salmon. Suspended and bedload sediment effects would be similar to those described for the Proposed Action. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through eliminating peaking operations and increasing base flows.

The removal of the two dams would likely reduce the availability of physical habitat favorable to the polychaete host for *C. shasta* and *P. minibicornis*, although to a lesser extent than under the Proposed Action. Flow variability would not be as great as under the Proposed Action; therefore, although removal of the two reservoirs would reduce the amount of lentic habitat available, some low-velocity habitats favorable to polychaetes might persist. Removal of the two dams would likely result in more favorable water temperature for salmonids than under existing conditions as well as improve water quality and reduce instances of algal toxins.

Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rodgers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the

seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in the release of sediment stored within Copco 1 and Iron Gate Reservoirs downstream to the lower Klamath River. Suspended and bedload sediment conditions and effects on coho salmon in the lower Klamath River reach would be similar to those described for the Proposed Action, but of slightly lesser magnitude.

The removal of two Dams and restoration of free flowing sections of river would likely result in more favorable water temperatures for salmonids than under current conditions. As it would be under the Proposed Action, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to reduced water quality, from increased suspended sediment concentrations, but these effects would be short term. Flow variability likely would not be as great as under the Proposed Action, but would still likely reduce habitat conditions favorable for polychaetes and algal toxins.

Estuary The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect coho salmon estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and bedload sediment transport and deposition and affect coho salmon. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, and Salmon River population units in the short term. Based on indistinguishable effects predicted to occur during reservoir drawdown, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less-than-significant for the coho salmon from the three Trinity River population units, and the Lower Klamath River Population Unit in the short term.***

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect coho salmon. Dam removal would restore connectivity to habitat on the mainstem Klamath River up to and*

including Spencer Creek and would create additional habitat within the Hydroelectric Reach. It is anticipated that as a result of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative the upper Klamath River, mid-Klamath River, lower Klamath River, Shasta River, Scott River, and Salmon River coho salmon population units would have an increase in abundance, productivity, population spatial structure, and genetic diversity. It is anticipated that as a result of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative the three Trinity River population units would have increased productivity. **Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for the coho salmon from the Upper Klamath River, Mid-Klamath River, Lower Klamath River, Shasta River, Scott River, and Salmon River population units in the long term. Based on improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less-than-significant for the coho salmon from the three Trinity River population units in the long term.**

### **Steelhead**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at Two Dams Alternative, dam removal and the addition of fish passage facilities at J.C. Boyle and Copco 1 would allow steelhead to gain access to the upper Klamath River upstream of J.C. Boyle Reservoir. This would expand the population's distribution to include historical habitat along the mainstem Klamath River upstream to the Sprague, Williamson, and Wood rivers (Hamilton et al. 2005). Steelhead are known to use intermittent tributaries for spawning, and because redband trout have habitat requirements similar to those of steelhead, this can be used as a rough estimate of habitat that may also be available to steelhead. Current distribution of redband trout within areas that would be accessible to steelhead has been estimated at 496 miles by ODFW (W. Tinniswood, pers. comm., 2011). Similar to the Proposed Action, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to result in changes to suspended or bedload sediment, flow-related habitat, or algal toxins and disease. Facilitating the movement of anadromous fish presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). Poor water quality (e.g., severe hypoxia, temperatures exceeding 25°C, high pH) in the reach from Keno Dam to Link Dam might prevent fish passage at any time from late June through mid-November (Sullivan et al. 2009; USGS 2010; both as cited in Hamilton et al. 2011). However, evidence indicates that UKL habitat is presently suitable to support salmonids for at least the October through May period (Maule et al. 2009).

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would restore steelhead access to the Hydroelectric Reach. Suspended and bedload sediment effects would be similar to those described for the Proposed Action.

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would include removal of Copco 1 and Iron Gate reservoirs, with continued power generation at J.C. Boyle and Copco 2 hydroelectric plants. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through eliminating peaking operations and increasing base flows. The reservoir drawdowns would allow tributaries and springs such as Fall and Shovel creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). Spencer Creek would continue to flow into J.C. Boyle Reservoir at its upstream end. Anadromous fish provided access to these reaches would have access to the tributaries as well.

The removal of the two dams would be likely to reduce the availability of physical habitat favorable to the polychaete host for *C. shasta* and *P. minibicornis*, although to a lesser extent than the Proposed Action. Flow variability would not be as great; therefore, although removal of the two reservoirs would reduce the amount of lentic habitat available, some low-velocity habitats favorable to polychaetes might persist. Steelhead are not as susceptible to these parasites, as Chinook salmon or coho salmon, but may still receive some benefit. Removal of the two dams would likely result in more favorable water temperature for salmonids, as well as improved water quality and reduced instances of algal toxins.

Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rodgers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Based on the reservoir dynamics and the predator population that currently occurs, predation of outmigrating salmonids is anticipated to be low (Administrative Law Judge 2006). In restoration efforts elsewhere in the Pacific Northwest, anadromous juveniles successfully pass through reservoirs under similarly difficult circumstances (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in the release of sediment stored within Copco 1 and Iron Gate reservoirs downstream to the lower Klamath River. Of the reservoirs in the Hydroelectric Reach, J.C. Boyle Reservoir stores the least amount of sediment, less than 10 percent of the total amount. As such, suspended and bedload sediment conditions and effects on steelhead in the lower Klamath River reach would be similar to those described for the Proposed Action, but of slightly lesser magnitude.

The removal of two dams and restoration of free flowing sections of river would likely result in more favorable water temperatures for salmonids than under current condition. As it would be under the Proposed Action, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to reduced water quality from increased suspended sediment concentrations, but these effects would be short term. Flow variability likely would not be as great as under the Proposed Action, but would still likely reduce habitat conditions favorable for polychaetes and algal toxins.

Estuary The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect steelhead estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and bedload sediment transport and deposition and affect steelhead. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for summer and winter steelhead in the short term.***

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect steelhead. Implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would restore connectivity to 496 miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach (W. Tinniswood, pers. comm., 2011). **Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for summer and winter steelhead in the long term.***

### **Pacific Lamprey**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Pacific lamprey did not historically occur upstream of J.C. Boyle Reservoir (Hamilton et al. 2005) and are not anticipated to occupy this reach after implementation of this alternative.

### Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam

Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, dam removal and the addition of fish passage facilities at J.C. Boyle and Copco 1 Dams would provide Pacific lamprey access to the Hydroelectric Reach, which would expand the population's current range to include habitat within the mainstem Klamath River and its tributaries upstream at least as far as Spencer Creek, including Jenny, Shovel, and Fall Creeks (Hamilton et al. 2005). Spencer Creek flows into the upstream end of J.C. Boyle Reservoir and would still be potentially accessible to

lamprey. Pacific lamprey below Iron Gate Dam would migrate above the dam if access was provided through fishways (Administrative Law Judge 2006). Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through eliminating peaking operations and increasing base flows. Suspended and bedload sediment effects would be similar to those described for the Proposed Action. The reservoir drawdowns would allow tributaries and springs such as Fall and Shovel Creeks and Big Springs to flow directly into the mainstem Klamath River, creating patches of cooler water that could be used as temperature refugia by fish (Hamilton et al. 2011). Removal of the two dams would likely result in more favorable water temperature for native fishes, and would improve water quality.

Juveniles would be subject to some level of predation by introduced resident species including largemouth bass, catfish, and yellow perch in J.C. Boyle Reservoir, resulting in mortality rates that will depend largely on their size (larger migrants will do better) (Administrative Law Judge 2006). Predation rates on juvenile salmonids in reservoirs and near dams is partially determined by water temperature, prey availability and size, prey condition, predator abundance, and the behavior of predatory fish species (Rodgers and Burley 1991, Vigg et al. 1991). Predation risk for juvenile salmon during the seaward migration can be minimized when flows reduce the exposure time to predatory fish. Effective passage at dams is key to minimizing prey because aggregation of juvenile salmonids near passage facilities or in the dam tailrace can increase predation rates (Rieman et al. 1991). Volitional fish passage for Pacific lamprey has been designed and is in place in other river systems (Administrative Law Judge 2006).

Lower Klamath River: Downstream of Iron Gate Dam The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would release sediment stored within Copco 1 and Iron Gate Reservoirs downstream to the lower Klamath River. Of the reservoirs in the Hydroelectric Reach, J.C. Boyle Reservoir stores the least amount of sediment—less than 10 percent of the total. As such, suspended and bedload sediment conditions and effects on Pacific lamprey in the lower Klamath River reach would be similar to those described for the Proposed Action, but of slightly lesser magnitude.

The removal of two dams and restoration of free flowing sections of river would likely result in water temperature more favorable for Pacific lamprey occurring in the mainstem, as well as improve water quality. As it would be under the Proposed Action, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to reduced water quality from increased suspended sediment concentrations, but these effects would be short term.

Estuary The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect Pacific lamprey estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and bedload sediment transport and deposition and Pacific*

*lamprey*. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for Pacific lamprey in the short term.**

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect Pacific lamprey. Dam removal would restore connectivity to usable habitat in the Hydroelectric Reach and would create additional spawning and rearing habitat within the Hydroelectric Reach. Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for Pacific lamprey in the long term.*

### **Green Sturgeon**

Upper Klamath River Green sturgeon did not historically occur upstream of Iron Gate Dam (Hamilton et al. 2005) and are not anticipated to occupy this reach after implementation of this alternative. The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would not affect green sturgeon upstream of Iron Gate Dam.

Lower Klamath River: Downstream of Iron Gate Dam The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in the release of sediment stored within Copco 1 and Iron Gate reservoirs downstream to the lower Klamath River. Of the reservoirs in the Hydroelectric Reach, J.C. Boyle stores the least amount of sediment, less than 10 percent of the total amount. As such, suspended and bedload sediment conditions and effects on green sturgeon in the lower Klamath River reach would be similar to those described for the Proposed Action, but of slightly lesser magnitude.

Bedload sediment effects related to dam-released sediment or sediment resupply would likely extend as far as the Cottonwood Creek. Current green sturgeon distribution extends from the mouth of the Klamath River upstream to the Ishi Pishi Falls (Moyle 2002; FERC 2007), with some observed migrating into the Salmon River. Short- and long-term changes to bedload sediment under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative are not expected to affect green sturgeon.

The removal of two dams and restoration of free flowing sections of river would likely result in water temperature more favorable for green sturgeon occurring in the mainstem, as well as improve water quality and reduce instances of algal toxins. As with SSCs, migrating adults and juveniles rearing or migrating in the mainstem after dam removal would be exposed to poor water quality due to dam removal, but these effects would be short term.

Estuary The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect estuarine habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and affect green sturgeon. **Based on substantial reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for green sturgeon in the short term.***

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in flow regime, water quality, temperature variation, and algal toxins which could affect green sturgeon. **Based on small improvements in habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less-than-significant for green sturgeon in the long term.***

### **Shortnose and Lost River Sucker**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Shortnose and Lost River suckers upstream of Keno Dam would not be affected by the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. Effects on populations downstream of Keno Dam are detailed below in the description of the Hydroelectric Reach. The KBRA would not be implemented under this alternative. However, ongoing restoration activities will continue to occur.

Hydroelectric Reach: From Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Federally endangered shortnose and Lost River suckers are found within reservoirs in Hydroelectric Reach, but in lower abundance than in reservoirs and lakes upstream. Similar to the Proposed Action, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would eliminate reservoir habitat as dams within the Hydroelectric Reach were removed and sediment was allowed to move downstream. Adult Lost River and shortnose suckers in reservoirs downstream of Keno Dam would be captured and relocated to Upper Klamath Lake (Buchanan et al. 2011a). Those not relocated to the Upper Basin would likely be lost, but with little or no successful reproduction (Buettner et al. 2006), the populations downstream of Keno Dam contribute minimally to conservation goals and insignificantly to recovery (Hamilton et al. 2011). Lost River and shortnose suckers are listed as fully protected species under California Fish and Game; thus any take of these species is prohibited. However, a component of this alternative would include legislation to permit the take of some individuals during implementation.

Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). Generally, with the exception of *F. columnaris* and Ich, pathogens associated with anadromous fish do not impact non-salmonids (e.g. suckers) (Administrative Law Judge 2006).

**Based on the low occurrence of suckers within Iron Gate and Copco 1 reservoirs, only a small reduction in abundance could occur, and therefore the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less-than-significant for Lost River and shortnose sucker populations in the short- and long term.**

### **Redband Trout**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, dam removal and the addition of fish passage facilities at J.C. Boyle and Copco 1 dams would allow redband trout to migrate more successfully from the Hydroelectric Reach to the Upper Klamath Basin (Hamilton et al. 2011) than under existing conditions.

Under this alternative, a flow regime that more closely mimics natural conditions would not be established downstream of Keno Dam; therefore, the increases in stream habitat upstream of J.C. Boyle Dam might not be realized under this alternative. Habitat in the J.C. Boyle Bypass and Peaking Reaches and the Copco 2 Bypass Reach would be improved through eliminating peaking operations and increasing base flows.

Facilitating the movement of anadromous fish via prescribed fishways presents a relatively low risk of introducing pathogens to resident fish above Iron Gate Dam (Administrative Law Judge 2006). Redband could be affected by increased predation from reintroduced salmonids, but this loss might be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Hamilton et al. 2011). Adult salmon moving into the upper basin would likely bring with them genotypes of *C. shasta* that had previously been restricted to the lower river. While the effects of these introductions are uncertain, at least some degree of host specificity appears to exist (Atkinson and Bartholomew 2010), indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes. Additionally, the changes in habitat that could result from dam removal (fewer areas of slow-flowing, stable habitat) would likely reduce the density of polychaete populations, resulting in reduced disease exposure for fish. The close similarities between anadromous steelhead trout and resident rainbow/redband trout suggest these species historically co-existed. The distribution and resistance of rainbow/redband trout in Upper Klamath Lake to *C. Shasta* lends additional support that the two species co-existed and intermingled prior to the construction of Copco 1 Dam in 1917. There are many examples from nearby river systems in the Pacific Northwest that show wild anadromous salmon and resident rainbow/redband trout can co-exist and maintain abundant populations without deleterious consequences. The Deschutes River in Oregon, the Yakima River in Washington, and the river systems in Idaho are examples (Administrative Law Judge 2006).

### Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam

Similar to the Proposed Action, dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would allow redband trout to migrate between tributaries and reservoirs to complete their lifecycle, and would restore 22.4 miles of reservoir habitat to riverine habitat (Cunanan 2009). Suspended and

bedload sediment effects would be similar to those described for the Proposed Action. However, sediment would continue to be trapped in J.C. Boyle, and spawning habitat would not likely improve for redband trout in the mainstem.

*As described for the Proposed Action, reservoir drawdown associated with dam removal under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and affect redband trout. **Based on a small proportion of the population with a potential to be exposed to short-term effects, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less-than-significant for redband trout in the short term.***

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability and flow regime, which could affect redband trout. As described for the Proposed Action, dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional habitat within the Hydroelectric Reach. **Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for redband trout in the long term.***

#### **Bull Trout**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Similar to the Proposed Action, under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative bull trout upstream of J.C. Boyle Reservoir could be affected by increased predation from reintroduced salmonids, but this loss might be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Buchanan et al. 1997).

**Based on the restricted distribution of bull trout, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a less than significant impact on bull trout in the short- and long term.**

#### **Eulachon**

Lower Klamath River: Downstream of Iron Gate Dam Under this alternative, suspended sediment conditions and effects on eulachon in the lower Klamath River would be similar to those described for the Proposed Action, but of slightly lesser magnitude. Short-term decreases in water quality might also be associated with this alternative and would affect adults and larvae in the mainstem Klamath River. As with SSCs, these effects could be muted by tributary inputs.

Estuary Similar to the Proposed Action, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect estuarine habitat.

**Based on short duration of poor water quality during reservoir drawdown in the estuary, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

**Alternative would have a less-than-significant effect on eulachon in the short-and long term.**

**Longfin Smelt** The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would release dam-stored sediment downstream to the lower Klamath River, but would not be expected to reach the area potentially used by longfin smelt. Longfin smelt using the lower Klamath River after January 2020 could be exposed to high SSCs for a portion of their migration period. SSCs would decrease in the downstream direction from Iron Gate Dam due to dilution from tributaries, so the magnitude of the effect would likely be low. Short-term decreases in water quality could also affect adults and larvae in the mainstem Klamath River. As with SSCs, these effects could be muted by tributary inputs.

Estuary Similar to the Proposed Action, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative is not expected to substantially change or affect estuarine habitat.

**Based on short duration of poor water quality during reservoir drawdown in the estuary, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have a less-than-significant effect on longfin smelt in the short-and long term.**

**Introduced Resident Species**

Upper Klamath River: Upstream of the Influence of J.C. Boyle Reservoir Introduced resident species upstream of J.C. Boyle Reservoir would not be affected by the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative.

Hydroelectric Reach: from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam Similar to the Proposed Action, implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would eliminate reservoir habitat associated with the two largest reservoirs Copco 1 and Iron Gate Dam, but would retain the habitat associated with the smaller J.C. Boyle and Copco 2 reservoirs. This would be detrimental to nonnative fishes upstream of Iron Gate Dam. Abundance of these species would decline substantially as the majority of their preferred reservoir habitat would be eliminated (Buchanan et al.2011a).

*The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would reduce habitat for introduced resident species in the Hydroelectric Reach.*

**Because these species were introduced and they occur in other nearby water bodies, their loss would not be considered important from a biological perspective, and would benefit native species. This impact would be less than significant from a biological perspective. Their loss would, however, decrease opportunities for recreational fishing for these species, as discussed in Section 3.20, Recreation.**

**Freshwater Mussels**

Suspended Sediment Concentrations Most stored sediment that would affect downstream Klamath River resources is stored in Iron Gate Reservoir, and SSCs resulting from

implementation of this alternative would be the same as, or very similar to, those levels described previously for the Proposed Action. Therefore, SSCs resulting from the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would have the same effects on freshwater mussels, as previously described for the Proposed Action.

Changes in Bed Elevation Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, free-flowing river conditions would be restored through most of the mainstem Klamath River. The release of sediment currently stored behind Iron Gate and Copco 1 Dams would occur and changes in streambed elevation downstream of Iron Gate Dam would be similar, but slightly smaller in magnitude than those of the Proposed Action because the J.C. Boyle and Copco 2 Dams would remain in place and the sediment stored behind them would not be removed. Therefore, the effects of this alternative on bedload elevation changes would be similar, but perhaps slightly smaller in magnitude, than those associated with the Proposed Action.

Changes in Bed Substrate Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, changes in bed substrate would be similar as those described for the Proposed Action. Therefore, this alternative would have similar effects on freshwater mussels in the mainstem Klamath River as the Proposed Action.

**Based on substantial reduction in the abundance of multiple year classes in the short term and the slow recovery time of freshwater mussels, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for freshwater mussels in the short term.**

**Based on increase in habitat availability, the effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial to freshwater mussels in the long term.**

#### **Benthic Macroinvertebrates**

Suspended Sediment Concentrations Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the release of sediment currently stored behind Iron Gate and Copco 1 Dams would occur. The effects of SSCs on BMIs would be the same as, or very similar to, those described for the Proposed Action.

Changes in Bed Elevation Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the effects on BMIs resulting from bedload elevation changes are expected to be similar, if not the same as, those associated with the Proposed Action.

Changes in Bed Substrate Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the effects on BMIs resulting from changes in bed substrate in the mainstem Klamath River would be similar to those described for the Proposed Action.

*As described for the Proposed Action, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative could alter SSCs and bedload sediment transport and deposition and affect benthic macroinvertebrates. Based on substantial reduction in the abundance of a year class in the short term, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant for macroinvertebrates in the short term.*

*As described for the Proposed Action, in the long term, removal of dams under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect macroinvertebrates. While a large proportion of their populations in the Hydroelectric Reach and in the mainstem Klamath River downstream of Iron Gate Dam would be affected, their populations would be expected to recover quickly because of the many sources for recolonization and their rapid dispersion through drift or aerial movement of adults. Based on increased habitat availability and improved habitat quality, the effect of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative on macroinvertebrates would be beneficial in the long term.*

#### **Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could affect aquatic species. The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. Based on access to additional, historical habitat and the anticipated improvements in fish health, implementation of trap and haul measures in the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be beneficial for fall-run Chinook salmon.*

#### **3.3.4.4 Mitigation Measures**

##### **AR-1: Protection of Mainstem Spawning**

It is anticipated that short-term effects of the Proposed Action (SSCs and bedload movement) will result in up to 100% mortality of fall Chinook and coho salmon embryos and pre-emergent alevin within redds that were constructed in the mainstem in the fall of 2019. In addition, any steelhead or Pacific lamprey migrating within the mainstem Klamath River after December 30<sup>th</sup> could be directly affected. As described in Appendix E, around 4,600 fall-Chinook salmon redds are predicted to be affected, and around 13 redds from the Upper Klamath River Population Unit for coho salmon.

Deleterious short-term effects of the Proposed Action on mainstem spawning could be reduced by capturing migrating adult fish (Chinook, coho, steelhead, or Pacific lamprey) in the mainstem Klamath River and relocating them to suitable habitat. Capture of adult fish could be accomplished with the use of an Alaskan-style weir and box trap, similar to that currently used at the Willow Creek and Trinity River site. The most suitable location

for the trap appears to be directly upstream of the Shasta River, where the mainstem Klamath River is small enough to effectively trap, and would ensure that fish returning to key tributaries downstream of, and including the Shasta River would not be interrupted. The weir would be installed at the beginning of the fall migration and continue past the initial dam drawdown period until high flows require the trap to be dismantled. Captured fish would periodically be transported to receiving tributaries. Fish could be released either in under-seeded tributaries downstream of Iron Gate Dam (e.g., Scott River), or in tributaries upstream of Iron Gate Dam if that were consistent with post-dam removal management goals. The relocated fish would then spawn naturally in the tributary streams and their progeny would not be affected by the SSCs and bedload movement during the dam removal process. In addition, the trap would only be operated periodically, so that some violotional passage upstream of the Shasta River would occur, allowing fish to return to Bogus Creek and the hatchery during 2019.

Additional surveys in the mainstem downstream of Shasta River could be conducted to locate coho salmon spawning in the mainstem. Any identified adult coho, Chinook, steelhead, or Pacific lamprey could be captured using dip-nets, electrofishing, or seines and transported to tributary habitat. Surveys should be conducted in December 2019, immediately prior to the first release of sediment associated with facilities removal. A detailed plan describing capture techniques, release locations, and monitoring methods would be developed by the Dam Removal Entity (DRE) prior to 2019.

### **Effectiveness of Mitigation in Reducing Impacts**

The effectiveness of the measure will depend on how effectively adults can be captured with the weir. Based on operation of similar traps in other rivers, it is anticipated that when operational the trap could capture nearly all upstream migrants. However, it is the intention to allow a portion of the adult to migrate violotionally to access Bogus Creek or the hatchery. Therefore it is assumed some fall Chinook salmon will continue to spawn within the mainstem during 2019. Depending on the condition of captured adults, some may be injured during transport, or may not spawn when released. However, the progeny of these adults is predicted to suffer 100% mortality if they spawn in the mainstem, so relocation is considered worth the risk of reduced spawning success. Overall effectiveness of the adult relocation operation would be measured by using radio-tagged individuals to track the -tagged fish to determine spawning success and location.

### **AR-2: Protection of Outmigrating Juveniles**

It is anticipated that short-term effects of the Proposed Action (SSC) will result in mostly sublethal, and in some cases lethal impacts to a portion of the juvenile Chinook, coho, steelhead, and Pacific lamprey that are outmigrating from tributary streams to the Klamath River upstream of Orleans during late winter and early spring of 2020 (Appendix E).

Deleterious short term effects on outmigrating juveniles could be reduced by capturing juveniles outmigrating from tributaries prior to their entry into the mainstem. This

measure includes the installation of downstream migrant traps on up to 13 key tributary streams downstream of Iron Gate Dam including Bogus Creek, Dry Creek, Walker Creek, Shasta River, Seiad Creek, Oneil Creek, Scott River, Grider Creek, Tom Martin Creek, Horse Creek, Beaver Creek, Cottonwood Creek, and Humbug Creek. Results of spawning surveys in fall 2019 could be used to focus trapping efforts within these or other tributaries. Trapping on all of these streams is proposed to help preserve the genetic integrity and varied life history tactics that are represented by this group of streams that have a high diversity with respect to size, channel types, water temperature regimes, geographic distribution, and other attributes.

The trapping would involve the standard CDFG/USFWS rotary screw trap/fyke net/pipe trap methods currently in use. However, placement of a second trap downstream of the first would increase the number of captures. Captured fish could then be placed in aerated tank trucks and transported to a release site downstream of the Trinity River or other locations that have suitable water quality.

The procedures of trapping, handling, trucking, and releasing outmigrating salmonids could result in harm or mortality to some individuals, and releasing fish at downstream locations could reduce natal cues and increase stray rates. Therefore fish will be captured and transported only if conditions within the mainstem are as poor as predicted. Due to the uncertainties with suspended sediment modeling, water quality monitoring during spring 2020 would be used to trigger the initiation and cessation of the capture program and inform suitable release locations. Release locations should be varied to prevent predators from congregating at release locations. Alternatively, in a portion of tributaries juveniles could be held in temporary facilities within tributaries and released when SSC in the mainstem were non-stressful. This would prevent any decrease in the natal cue, as well as any potential associated effects of fish transport.

A detailed plan describing trapping techniques, release locations, and monitoring methods would be developed by the DRE prior to 2019.

### **Effectiveness of Mitigation in Reducing Impacts**

The effectiveness of this measure depends on the efficiency of trapping efforts. Trap efficiency varies with species and tributary. Current trapping efforts in the Shasta River and Scott River typically have trap efficiencies between around 5 and 30 percent, averaging around 15 percent (Underwood et al. 2010). It is anticipated that trapping efficiency could be increased over current efforts by more aggressive trapping efforts using either multiple traps and/or increased weir panels. However, not all tributaries with outmigrating juveniles will be trapped, and within trapped tributaries some individuals will avoid traps and migrate to the mainstem (particularly during high flows). Overall, it is assumed 50 percent of juveniles outmigrating to the mainstem could be captured. Current predictions of mortality estimate a total of 2,668 to 6,536 smolts for an impact of 9 to 22 percent from the upper Klamath River, mid-Klamath River, Scott River, and Shasta River population units depending on a most-likely-to-occur or worst case scenario. Assuming 50 percent capture efficiency this mitigation measure would reduce mortality a

total of 1,334 to 3,268 smolts for an impact of 4 to 11 percent depending on a most-likely-to-occur or worst-case scenario. To evaluate the effectiveness of the mitigation measure, the trapping procedures would need to assess trap efficiency that would lead to the development of estimates of stream production and numbers of fish assumed missed by trapping effort.

### **AR-3: Fall Flow Pulses**

It is anticipated that short-term effects of the Proposed Action (SSC) will result in sublethal effects for green sturgeon adults remaining in the mainstem Klamath River during fall 2019, mortality for mainstem spawning fall-run Chinook salmon, mortality for migrating adult winter steelhead, and sublethal effects for adult coho salmon remaining in mainstem prior to entering tributaries.

Deleterious short-term effects on adults could be reduced by augmented flows during fall 2019 prior to dam removal. It has been observed that fall pulse flows result in the downstream migration of post-spawned green sturgeon out of the Klamath River (Benson et al. 2007), and increased flows during fall prior to dam removal may increase the rate and proportion of fall-run Chinook salmon, steelhead, and coho salmon spawning in tributaries, and thus reducing the proportion of the population spawning in the mainstem or being exposed to SSC in the mainstem during migration (Stillwater Sciences 2009a).

Water releases in the fall prior to dam removal should mimic the natural hydrograph that would have existed in the Klamath River during a “wet year” prior to the Reclamation project, consistent with recommendations in NRC (2004). However, if the water year during dam removal is dry, managers will need to balance the benefits of increased flows during fall with the risk of impacts to the basin if less water is available during the following spring (during smolt outmigration). Increases in fall flows would likely be most successful if conducted synchronously with increased flows in unregulated tributaries, to help create enough of a pulse of water to encourage migration. Doing so will also ensure that adults that are attracted up the mainstem by increasing fall flows are not blocked from accessing their natal streams due to natural low flow conditions.

A detailed plan describing target flows and monitoring methods would be developed by the DRE prior to 2019.

### **Effectiveness of Mitigation in Reducing Impacts**

It is anticipated that this measure will be effective for reducing deleterious short-term effects on adult green sturgeon during fall 2019. Benson et al. (2007) reported that the majority of adult green sturgeon outmigrating during the first major flow event of the fall. Analysis of the mainstem natural spawner fraction versus flow suggests that, generally, increased numbers of naturally produced fall-run Chinook salmon adults spawn in the mainstem during years when fall flows are low (Stillwater Sciences 2009a). The minimum proportion of fall-Chinook salmon spawning in the mainstem is 5.3%, suggesting that if fall-pulse flows are successful at increasing tributary spawning the

proportion of fall-run Chinook salmon spawning in the mainstem could be reduced to this level.

Currently on average less than 4 percent of coho salmon migrate into monitored tributaries after December 15<sup>th</sup>, and in many years no fish are observed migrating after this date (Appendix E). Migration of coho salmon adults into tributaries also appears to be affected by flow, with earlier tributary entrance times observed in Blue Creek, Shasta River, Bogus Creek and other tributaries during years with high flows during fall (Stillwater Sciences 2009a). A fall pulse-flow is anticipated to be effective at ensuring nearly all adult coho salmon migrate into tributaries prior to initiation of reservoir drawdown on December 15. The effectiveness of the measure could be monitored with spawning surveys during 2019. The proportion of steelhead migrating upstream after December 15<sup>th</sup> is highly variable (USFWS 1998). Although no analysis has been conducted, it is possible that increased fall flows could result in a greater proportion of steelhead migrating upstream and into tributaries prior to dam removal, as is observed in some years (USFWS 1998).

#### **AR-4: Hatchery Management**

It is anticipated that short-term effects of the Proposed Action (SSC) will result in mostly sublethal, and in some cases lethal impacts to a portion of the juvenile Chinook, coho, and steelhead smolts outmigrating from tributary streams to the Klamath River upstream of Orleans during late winter and early spring of 2020 (Appendix E).

Deleterious short-term effects on outmigrating hatchery Chinook and coho salmon smolts could be reduced by adjustments to hatchery management. Hatchery managers could adjust the timing of hatchery releases during spring 2020. Although it would be out of synch with natural life history timing, if smolts are released later in the spring (e.g., mid-May), survival is anticipated to be higher based on current conditions (Beeman et al. 2008), as well as avoiding the peak in spring release of sediment in the year following dam removal.

An alternative to adjusting the hatchery release timing would be to allow the sub-yearling and yearling smolts to imprint at the hatchery and then truck them to release locations downstream where SSC effects may be muted by tributary accretion flow. Trucking could be accomplished during the normal releasing timing period.

The implementation of this mitigation measure is dependent on the hatchery remaining open and having a suitable water supply. A detailed plan describing adjustments to hatchery management would be developed by the DRE prior to 2019.

#### **Effectiveness of Mitigation in Reducing Impacts**

It is anticipated that this measure will effectively reduce short-term lethal effects on hatchery released smolts to sublethal effects.

### **AR-5: Pacific lamprey Capture and Relocation**

Based on predictions of low dissolved oxygen and the analysis of SSC that was conducted (Appendix E), high rates of mortality are predicted in the short term as a result of the Proposed Action. An action to mitigate this deleterious short term effect would be to salvage and relocate lamprey ammocoetes from preferred habitat areas where dissolved oxygen levels would be particularly low, including pools, alcoves, backwaters, and channel margins that experience low water velocities and sand and silt deposition (Streif 2009) from areas downstream of Iron Gate Dam. The focus of relocation efforts would be within 3 km of Iron Gate Dam, where SSC is predicted to be highest, and dissolved oxygen levels the lowest. However, the density of lamprey within this reach is not known, and reconnaissance surveys should be conducted prior to the implementation of this measure to assess if enough ammocoetes are present to warrant mitigation.

The salvage operation, if implemented, would be conducted by first identifying preferred (and high risk) areas and then utilize a specialized electrofisher to capture ammocoetes. Collection of lamprey ammocoetes has been demonstrated in the Klamath River (Karuk Tribe and USFWS unpublished data). Captured individuals would be transported to suitable locations (with current low occurrences of lamprey) within tributaries upstream or upstream of Keno Dam. A detailed plan describing lamprey capture and relocation would be developed by the DRE prior to 2019.

### **Effectiveness of Mitigation in Reducing Impacts**

It is expected that implementation of this mitigation measure would reduce dissolved oxygen and SSC-related stress or mortality for a proportion of lamprey ammocoetes. An unknown number of lamprey ammocoetes remaining in the mainstem Klamath River downstream of Iron Gate Dam would still experience stress and mortality resulting from elevated SSC and bedload movement. Mitigation effectiveness monitoring would consist of reporting the number of individuals captured, release location, and their condition upon release.

### **AR-6: Sucker Rescue and Relocation**

It is anticipated that short-term effects of the Proposed Action will result in mostly sublethal, and in some cases lethal impacts to Lost River and shortnose suckers within reservoirs in Hydroelectric Reach. Under this measure adult Lost River and shortnose suckers in reservoirs downstream of Keno Dam could be captured and relocated to Upper Klamath Lake (Buchanan et al. 2011a).

If deemed feasible in 2019 prior to dam removal, Klamath smallscale suckers will be collected directly downstream of J.C. Boyle Dam and terminating approximately 2 miles downstream in the approximate area of the current powerhouse. Fish will be collected using electro-fishing techniques. Salvaged Klamath smallscale sucker will be relocated to Spencer Creek immediately downstream of the Spencer Creek hook up road (upper limits for sucker in Spencer creek). Smallscale suckers will not be relocated upstream of Keno Dam.

Lost River and shortnose suckers can also be captured using electrofishing and trammel nets. It is recommended that these and other approved capture techniques be utilized for this relocation effort. Captured Lost River and shortnose suckers could then be placed in aerated tank trucks and transported to suitable release sites in Upper Klamath Lake. A detailed plan describing sucker rescue and relocation would be developed by the DRE prior to 2019.

### **Effectiveness of Mitigation in Reducing Impacts**

It is expected that implementation of this mitigation measure would reduce the deleterious short-term effects from the Proposed Action. However, it is not known how many suckers inhabit the Hydroelectric Reach reservoirs, therefore it is unknown what proportion of the population would be captured and successfully relocated. Those Lost River and shortnose suckers not relocated to the Upper Basin would likely be lost, but with little or no successful reproduction (Buettner et al. 2006), and no connection to upstream populations, the individuals downstream of Keno Dam contribute minimally to conservation goals or recovery (Hamilton et al. 2011).

### **AR-7: Freshwater Mussel Relocation**

Freshwater mussels in the Hydroelectric Reach and in the lower Klamath River, downstream of Iron Gate Dam, are likely to be deleteriously affected by prolonged SSCs and bedload movement during the later part of reservoir drawdown and subsequent dam removal. Freshwater mussels cannot move to avoid these impacts, and some species are very long lived, and may not reproduce successfully (or at all) each year. An action to mitigate this effect is to relocate freshwater mussels prior to drawdown. Freshwater mussels could be relocated to tributary streams or upstream of the Hydroelectric Reach, then moved back to their approximate location or to other suitable habitat in the river after dam removal has been completed.

Freshwater mussel relocation success depends on a variety of factors including the availability of suitable habitat (for juveniles, adults, reproduction, feeding, growth, and host fish), population density at the relocation site, and handling during relocation (Hamilton et al. 1997; Bolden and Brown 2002). While many (and still unknown) factors influence the survival and reproduction of freshwater mussels in their natural environment, relocation adds an additional stress. Thus, the variables associated with the characteristics of freshwater mussel habitat at the source and destination sites as well as with the relocation methods should be as similar as possible for all life stages (Cope and Waller 1995; Cope et al. 2003). Previous studies indicate varied success of freshwater mussel relocation projects, with most mortality observed within one year (Thomas 2008). Habitat selection is important for success, as changes in habitat (e.g., substrate size) from the original site appear to influence mortality (Cope and Waller 1995; Bolden and Brown 2002). As such, the presence of existing freshwater mussel populations should guide site selection. Cope et al. (2003) found that proper handling and transport and selection of suitable habitat improved survivorship of relocated freshwater mussels.

Luzier and Miller (2009) developed some general guidelines for freshwater mussel relocation projects, including 1) an initial evaluation of freshwater mussel populations to identify species, estimate abundance, and sex ratio and age distribution (if possible), 2) site evaluation for relocation to determine (among other factors) habitat quality and presence of appropriate fish hosts, 3) careful and quick transport to minimize stress, and 4) monitoring relocated populations to determine initial survival, recruitment, and persistence through the range of environmental conditions at the site. Following these guidelines, prior to drawdown (e.g., fall 2019 or before) surveys would be conducted to evaluate current freshwater mussel species and habitat below Iron Gate Dam and to identify potential sites for relocation. Freshwater mussels would be relocated to suitable habitats and monitored over the duration of high SSCs. After dissipation of effects, original locations could be resurveyed to determine habitat suitability. If suitable, then the relocated freshwater mussels could be returned to their source location. Most relocation projects are conducted during warm periods when reproductive stress is presumably low for most species, and their metabolic rates are sufficient for burrowing in the substrate (Cope and Waller 1995).

If suitable in-stream habitat cannot be found for the time period of increased SSCs, it may be possible to temporarily house relocated freshwater mussels in fish hatchery raceways at facilities near to the removal sites. This was apparently performed on the Elwha during dam removal (no citation available) using river water so they could filter feed. However, many freshwater mussels need to burrow to reduce the energy needs of holding their valves closed for extended periods. Thus, such artificial holding areas should not be used for long periods. Aquaculture ponds have sometimes been used as well (Cope et al. 2003).

This mitigation measure would benefit from a pilot program prior to initiation, to assess the success and potential levels of mortality associated with relocation. Relocation should also consider the potential for transmission of disease or interbreeding between genetically distinct populations. A detailed plan describing freshwater mussel rescue and relocation would be developed by the DRE prior to 2019.

### **Effectiveness of Mitigation in Reducing Impacts**

With the proposed mitigation, these impacts freshwater mussels would be reduced.

### **Summary of Mitigation Measures**

The DRE would be responsible for implementation of Mitigation Measures AR-1 through AR-7. Although all proposed mitigation measures would reduce short-term deleterious effects of the Proposed Action, significant effects would continue to occur for some species, as described in detail in the Proposed Action Species-Specific impacts analysis provided in Section 3.3.4.3 and detailed in Tables 3.3-11 through 3.3-18.

**Table 3.3-11. Comparison of Short-term SSC Effects from the Proposed Action with and without Mitigation Measures; Most-likely Scenario (i.e., 50%Exceedance Probabilities) for Fall- and Spring-Chinook and Coho Salmon.**

Species/Run	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Fall Chinook Salmon	<b>Proposed Action</b>				
	No effects	Up to 100% mortality of the progeny of mainstem spawners (about 8% of escapement)	No juvenile progeny anticipated rearing in mainstem due to impacts during incubation. Most other juveniles assumed to rear in tributaries prior to outmigration.	N/A	<b>Type I:</b> Major stress and reduced growth for Type I fry (about 60% of production)
					<b>Type II:</b> No effects
					<b>Type III:</b> Major stress, reduced growth, and up to 20% mortality for Type III outmigrants (less than 1% of production)
	<b>Proposed Action with Mitigation Measures AR-1, 2, 3, and 4</b>				
	Increased escapement into tributaries due to augmented attraction flows	Reduced effects due to increased hatchery production, trapping and relocation of adult spawners and additional redds being constructed in tributaries	Reduced effects due to mainstem progeny now rearing in hatchery and tributary streams.	N/A	<b>Type I:</b> Major stress on smolts not rescued and relocated; Growth-related effects for non-hatchery smolt; reduced effects on hatchery smolts due to delayed release
<b>Type II:</b> Same as above for naturally spawned progeny. Reduced effects for hatchery-reared fish due to release timing modification. Reduced effects for rescued and relocated smolts.					
<b>Type III:</b> Major stress, reduced growth, and up to 20% mortality for Type III outmigrants. Reduced effects for rescued and relocated smolts.					

**Table 3.3-11. Comparison of Short-term SSC Effects from the Proposed Action with and without Mitigation Measures; Most-likely Scenario (i.e., 50%Exceedance Probabilities) for Fall- and Spring-Chinook and Coho Salmon.**

Species/Run	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
<b>Spring Chinook Salmon</b>	<b>Proposed Action</b>				
	Spring Migration: Major stress, impaired homing for adults returning to Salmon R. (about 5% of run)	Most spawning takes place in tributaries; no effects predicted	Juveniles primarily rear in tributaries; no effects predicted	Juveniles primarily rear in tributaries; no effects predicted	Type I: Major stress for Type I fry from Salmon R. (about 80% of Salmon R. production)
	Summer Migration: No effects				Type II: Major to moderate stress for 1 to 3 days
					<b>Type III:</b> Major stress, reduced growth, but no mortality
	<b>Proposed Action with Mitigation Measures AR- 2 and 3</b>				
	Spring Migration: Same as above	Same as above	Same as above	Same as above	Type I: Major stress on smolts not rescued and relocated
Summer Migration: Same as above	Type II: Same as above for non-rescued and relocated fish.				
	Type III: 20-40% mortality (about 31 smolts)				

**Table 3.3-11. Comparison of Short-term SSC Effects from the Proposed Action with and without Mitigation Measures; Most-likely Scenario (i.e., 50%Exceedance Probabilities) for Fall- and Spring-Chinook and Coho Salmon.**

Species/Run	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Coho Salmon	<b>Proposed Action</b>				
	Major stress and impaired homing	Up to 100% mortality of progeny of mainstem spawners (typically <1% of run)	<b>Age 0+ summer:</b> Reduced growth for age 0+ from 2020 cohort in upper mainstem (<50% of fry). No effect on juveniles rearing in tributaries	<b>Age 1+ winter:</b> Major stress, reduced growth, and up to 60% mortality for age 1+ juveniles from 2019 cohort in mainstem (assume <1% of juveniles). No effect on juveniles rearing in tributaries	<b>Early spring outmigration:</b> Major stress, reduced growth, and up to 20% mortality for smolts coming from tributaries in upper mainstem in early spring (about 44% of production) <b>Late spring outmigration:</b> Major stress and reduced growth for smolts coming from tributaries in the upper mainstem in late spring (about 56% of production)
	<b>Proposed Action with Mitigation Measure AR-2 and 3</b>				
	Same as above	Reduced effects due to relocation of adult spawners and additional redds being constructed in tributaries upstream of Hydroelectric reach	<b>Age 0+ summer:</b> Same as above	<b>Age 1+ winter:</b> Same as above	<b>Early spring outmigration:</b> Major stress, reduced growth, and up to 4% mortality; <b>Reduced mortality</b> <b>Late spring outmigration:</b> Major stress and mortality on smolts not rescued and relocated; Growth-related effects

**Table 3.3-12. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Most-likely scenario (i.e., 50% Exceedance Probabilities) for Steelhead and Pacific Lamprey.**

Species/Run	Life History Stage					
	Adult migration	Runbacks/Half-pounder residency	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
<b>Summer and Winter Steelhead</b>	<b>Proposed Action</b>					
	<p>Summer run: Major stress and impaired homing for fish spawning in mid- and upper-Klamath tributaries (about 45% of escapement)</p> <p>Winter run: Major stress, impaired homing, and up to 36% mortality for fish spawning in mid- and upper-Klamath tributaries (about 1,008 adults)</p>	<p>Adult runbacks: Major stress; depending on time spent in mainstem</p> <p>Half-pounder residency: Most assumed to remain in tributaries; major stress for any remaining in mainstem</p>	<p>Most spawning takes place in tributaries; no effects predicted</p>	<p>Major stress resulting in reduced growth and up to 100% mortality for juveniles in that migrate from tributaries to the mainstem</p>	<p>Age 1+ rearing: Major stress, reduced growth, and up to 100% mortality for juveniles in that migrate from tributaries to the mainstem</p> <p>Age 2+ rearing: Reduced growth and up to 60% mortality for juveniles in mainstem</p>	<p>Major stress and reduced growth; about 57% outmigrate from Trinity R. and would have less exposure</p>

**Table 3.3-12. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Most-likely scenario (i.e., 50% Exceedance Probabilities) for Steelhead and Pacific Lamprey.**

Species/Run	Life History Stage					
	Adult migration	Runbacks/Half-pounder residency	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Summer and Winter Steelhead	<b>Proposed Action with Mitigation Measure AR-2</b>					
	Summer run: Same as above  Winter run: Same as above	Adult runbacks: Same as above  Half-pounder residency: Same as above	Same as above	Reduced effects for those migrating fish that are captured and relocated. Same effects as above for non-relocated fish.	Age 1+ rearing: Reduced effects for those migrating fish that are captured and relocated. Same effects as above for non-relocated fish.  Age 2+ rearing: Reduced effects for those migrating fish that are captured and relocated. Same effects as above for non-relocated fish.	Major stress and reduced growth for that portion of the population not captured by the outmigrant rescue program.

**Table 3.3-12. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Most-likely scenario (i.e., 50% Exceedance Probabilities) for Steelhead and Pacific Lamprey.**

Species/Run	Life History Stage					
	Adult migration	Runbacks/Half-pounder residency	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Pacific Lamprey	<b>Proposed Action</b>					
	Major stress, reduced growth, and up to 36% mortality; later-returning adults and those returning to lower tributaries would have less exposure	N/A	See adult migration	<b>Ammocoete rearing:</b> Major stress, reduced growth, and up to 52% mortality for multiple year classes of ammocoetes in mainstem; majority rear in tributaries and would not suffer mortality		<b>Spring outmigration:</b> Major stress
						<b>Fall and winter outmigration:</b> Moderate stress
	<b>Proposed Action with Mitigation Measure AR-5</b>					
Same as above	N/A	Same as above	<b>Ammocoete rearing:</b> Reduced effects for ammocoetes that are captured and relocated. Major stress, reduced growth, and up to 52% mortality for lamprey not captured and relocated.		<b>Spring outmigration:</b> Same as above	
					<b>Fall and winter outmigration:</b> Same as above	

**Table 3.3-13. Comparison of Short-term SSC Effects from the Proposed Action with and without Mitigation Measures; Most-Likely Scenario (i.e., 50% Exceedance Probabilities) for Green Sturgeon and Suckers.**

Species/Run	Life History Stage			
	Adult migration	Adult Post-spawning Holding	Spawning through larvae	Juvenile Rearing (year-round) and Outmigration
Green Sturgeon	<b>Proposed Action</b>			
	Major stress; 75% of adults not expected to migrate in 2020	No effects	76% mortality for all mainstem production; about 30% that spawn in Trinity R. would be unaffected (based on salmonid literature; effects likely overestimated)	Reduced growth and up to 20% mortality; about 30% of juveniles rear in Trinity R. and would be unaffected (based on salmonid literature; effects likely overestimated)
	<b>Proposed Action with Mitigation Measure AR-4</b>			
	Reduced effects due to fall flow pulse moving adults downstream; 75% of adults not expected to migrate in 2020.	Same as above	Same as above	Same as above
Suckers (spp)	<b>Proposed Action</b>			
	NA	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach.
	<b>Proposed Action with Mitigation Measure AR-6</b>			
	NA	Beneficial in upper Klamath Lake due to more habitat area. Loss of all adults within the Hydroelectric Reach that were not captured and relocated.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach since larvae and juveniles will not be captured and relocated.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach since larvae and juveniles will not be captured and relocated.

**Table 3.3-14. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measure AR-8 for Freshwater Mussels.**

Species/Run	Adults	Spawning	Larvae
Freshwater mussels	<b>Proposed Action</b>		
	Major physiological stress and substantial mortality	Major physiological stress and substantial mortality during the spawning season	Major adult physiological stress and mortality will significantly reduce larval production. No information on effects of SSC on larvae. Larvae produced in downstream reaches or tributaries may contribute to population recovery.
	<b>Proposed Action with Mitigation Measure AR-8</b>		
	Major physiological stress and substantial mortality. Some individuals would be relocated and would assist in reseeding the population.	Major physiological stress and substantial mortality during the spawning season. Relocated individuals may spawn in upstream reaches.	Major adult physiological stress and mortality will significantly reduce larval production. No information on effects of SSC on larvae. Larvae produced by relocated individuals, in downstream reaches, or in tributaries may contribute to population recovery.

**Table 3.3-15. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-Case Scenario (10% Exceedance Probabilities) for Fall- and Spring-run Chinook Salmon.**

Species/Run	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Fall-run Chinook Salmon	<b>Proposed Action</b>				
	No effect	Up to 100% mortality of the progeny of mainstem spawners (about 8% of escapement)	No juvenile progeny anticipated rearing in mainstem due to impacts during incubation. Most other juveniles assumed to rear in tributaries prior to outmigration.	N/A	<b>Type I:</b> Major stress and reduced growth for the about 40% of fry entering mainstem in April/May
					<b>Type II:</b> Moderate to major stress for the about 60% of Type II juveniles entering mainstem in Sept/Nov
					<b>Type III:</b> Major stress, reduced growth, and up to 71% mortality for about 0.18% of all juveniles entering mainstem in Feb-April
	<b>Proposed Action with Mitigation Measures AR-1, 2, 3, and 4</b>				
	Increased escapement into tributaries due to augmented attraction flows	Reduced effects due to increased hatchery production, relocation of adult spawners and additional redds being constructed in tributaries	Reduced effects due to mainstem progeny now rearing in hatchery and tributary streams	N/A	<b>Type I:</b> Major stress on smolts not rescued and relocated; Growth-related effects for non-hatchery smolt; reduced effects on hatchery smolts due to delayed release
				<b>Type II:</b> Same as above for naturally spawned progeny. Reduced effects for hatchery-reared fish due to release timing modification.	
				<b>Type III:</b> Major stress, reduced growth, and up to 60% mortality; <b>Reduced mortality</b>	

**Table 3.3-15. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-Case Scenario (10% Exceedance Probabilities) for Fall- and Spring-run Chinook Salmon.**

Species/Run	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
<b>Spring-run Chinook Salmon</b>	<b>Proposed Action</b>				
	Spring Migration: Major stress and impaired homing	Most spawning takes place in tributaries; no effects predicted	Juveniles primarily rear in tributaries; no effects predicted	Juveniles primarily rear in tributaries; no effects predicted	Type I: Major stress for Type I fry from Salmon R. (about 80% of Salmon R. production)
	Summer Migration: Impaired homing				Type II: Moderate stress for Type II juveniles from Salmon R. (about 20% of Salmon R. production)
					Type III: Major stress for Type III juveniles from Salmon R. (<1% of Salmon R. production)
	<b>Proposed Action with Mitigation Measure s AR- 2</b>				
	Spring Migration: Same as above	Same as above	Same as above	Same as above	Type I: Reduced impacts for those fish that are rescued and relocated. Same impacts as above for fish not rescued.
Summer Migration: Same as above	Type II: Reduced impacts for those fish that are rescued and relocated. Same impacts as above for fish not rescued.				
	Type III: Reduced impacts for those fish that are rescued and relocated. Same impacts as above for fish not rescued.				

**Table 3.3-16. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-Case Scenario (10% Exceedance Probabilities) for Coho Salmon and Steelhead.**

Species/Run	Life History Stage					
	Adult migration	Runbacks/Half-pounder residency	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Coho Salmon	<b>Proposed Action</b>					
	Major stress and impaired homing	N/A	Up to 100% mortality of progeny of mainstem spawners (typically <1% of run)	<b>Age 0+ summer:</b> No growth for 2020 cohort rearing in upper mainstem (< 50% of fry). No effect on juveniles rearing in tributaries	<b>Age 1+ winter:</b> Major stress, reduced growth and up to 52% mortality for 2018 age-1+ cohort in mainstem (assume <1% of juveniles). No effect on juveniles rearing in tributaries	<b>Early spring outmigration:</b> Major stress, reduced growth, and up to 49% mortality for smolts coming from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring (approximately 44% of the run outmigrates in early spring). (Mortality for approximately 8% of total population)  <b>Late spring outmigration:</b> Major stress and reduced growth for smolts coming from tributaries in the upper mainstem in late spring (about 56% of production)
	<b>Proposed Action with Mitigation Measures AR-2 and 3</b>					
	Same as above	N/A	Same as above	<b>Age 0+ summer:</b> Same as above	<b>Age 1+ winter:</b> Same as above	<b>Early spring outmigration:</b> Major stress, reduced growth, and up to 11% mortality; <b>Reduced mortality</b>  <b>Late spring outmigration:</b> Reduced impacts for those fish that are rescued and relocated.

**Table 3.3-16. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-Case Scenario (10% Exceedance Probabilities) for Coho Salmon and Steelhead.**

Species/Run	Life History Stage					
	Adult migration	Runbacks/Half-pounder residency	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Summer and Winter Steelhead	<b>Proposed Action</b>					
	<p>Summer run: Major stress, impaired homing, and up to 20% mortality (From 0 to 130 adults, or from 0 to 9 percent of the basin-wide escapement).</p> <p>Winter run: Major stress, impaired homing, and up to 71% mortality. The proportion migrating prior to January would not be affected. (Up to 1,988 adults, or up to 28 percent of the basin-wide escapement).</p>	<p>Adult runbacks: Major stress; exposure dependant on time it takes runbacks to return to sea</p> <p>Half-pounder residency: Major stress and reduced growth for any in mainstem; Most assumed to remain in tributaries;</p>	Most spawning takes place in tributaries; no effects predicted	Major stress and reduced growth for age 0+ juveniles in mainstem (about 60% of juveniles)	<p>Age 1+ rearing: Stress, reduced growth, and up to 71% mortality Up to 11,207 juveniles or around 19% of total age 1 production).</p> <p>Age 2+ rearing: Stress, reduced growth and up to 71% mortality (Up to 9,412 juveniles or around 18% of total age 2 production).</p>	Major stress resulting in reduced growth, about 57% outmigrate from Trinity R. and will have less exposure
	<b>Proposed Action with Mitigation Measures AR-2</b>					
	<p>Summer run: Same as above</p> <p>Winter run: Same as above</p>	<p>Adult runbacks: Same as above</p> <p>Half-pounder residency: Same as above</p>	Same as above	Same as above	<p>Age 1+ rearing: Same as above</p> <p>Age 2+ rearing: Same as above</p>	Major stress and reduced growth for that portion of the population not captured by the outmigrant rescue program.

**Table 3.3-17. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-case Scenario (10% Exceedance Probabilities) for Pacific Lamprey, Green Sturgeon, and Suckers.**

Species	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Pacific Lamprey	<b>Proposed Action</b>				
	Major stress, reduced growth, and up to 71% mortality; later-returning adults and those returning to lower tributaries would have less exposure	See adult migration	<b>Ammocoete rearing:</b> Major stress, reduced growth, and up to 71% mortality for multiple year classes of ammocoetes in mainstem; majority rear in tributaries and would not suffer mortality		<b>Spring outmigration:</b> Moderate to major stress and reduced growth
					<b>Fall and winter outmigration:</b> Major stress
	<b>Proposed Action with Mitigation Measure AR-5</b>				
	Same as above	Same as above	<b>Ammocoete rearing:</b> Same as above for any ammocoetes not captured and relocated		<b>Spring outmigration:</b> Same as above
<b>Fall and winter outmigration:</b> Same as above					

**Table 3.3-17. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-case Scenario (10% Exceedance Probabilities) for Pacific Lamprey, Green Sturgeon, and Suckers.**

Species	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Green Sturgeon	<b>Proposed Action</b>				
	Major stress; about 25% of adults expected to be exposed in 2020	<b>Adult Post-spawning Holding:</b> Short period (<1 wk) of relatively low SSCs, not expected to result in deleterious effects; about 75% of adults hold in mainstem after spawning; remainder return to ocean	95% mortality for all mainstem production; about 30% that spawn in Trinity R. would be unaffected (based on salmonid literature; effects likely overestimated)	<b>Juvenile Rearing (year-round) and Outmigration:</b> Reduced growth and up to 36% mortality; about 30% of juveniles rear in Trinity R. and would be unaffected	N/A
	<b>Proposed Action with Mitigation Measure AR-3</b>				
	Reduced effects due to fall flow pulse moving adults downstream	<b>Adult Post-spawning Holding:</b> Reduced effects due to fall flow pulse moving adults downstream	Same as above	<b>Juvenile Rearing (year-round) and Outmigration:</b> Same as above	N/A

**Table 3.3-17. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-case Scenario (10% Exceedance Probabilities) for Pacific Lamprey, Green Sturgeon, and Suckers.**

Species	Life History Stage				
	Adult migration	Spawning through fry emergence	Age 0+ rearing	Age 1+ rearing	Outmigration
Suckers (spp)	<b>Proposed Action</b>				
	NA	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach.	NA
	<b>Proposed Action with Mitigation Measure AR-6</b>				
	NA	Beneficial in upper Klamath Lake due to more habitat area. Loss of all adults within the Hydroelectric Reach that will not be captured and relocated.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach since larvae and juveniles will not be captured and relocated.	Beneficial in upper Klamath Lake due to more habitat area. Loss of all individuals within the Hydroelectric Reach since larvae and juveniles will not be captured and relocated.	NA

**Table 3.3-18. Comparison of Short-term SSC effects from the Proposed Action with and without Mitigation Measures; Worst-Case Scenario (i.e., 10% Exceedance Probabilities) for Freshwater Mussels.**

Species	Adults	Spawning	Larvae
<b>Freshwater mussels</b>	<b>Proposed Action</b>		
	Major physiological stress and substantial mortality	Major physiological stress and substantial mortality during the spawning season	Major adult physiological stress and mortality will significantly reduce larval production. No information on effects of SSC on larvae. Larvae produced in downstream reaches or tributaries may contribute to population recovery.
	<b>Proposed Action with Mitigation Measure AR-8</b>		
	Major physiological stress and substantial mortality. Some individuals would be relocated and would assist in reseeded the population.	Major physiological stress and substantial mortality during the spawning season. Relocated individuals may spawn in upstream reaches.	Major adult physiological stress and mortality will significantly reduce larval production. No information on effects of SSC on larvae. Larvae produced by relocated individuals, in downstream reaches, or in tributaries may contribute to population recovery.

### 3.3.5 References

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## 3.4 Algae

### 3.4.1 Area of Analysis

This section of the Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) analyzes potential effects of the Proposed Action and alternatives on algal communities in the Klamath River Watershed, excluding the Lost River watershed, Tule Lake watershed, and most of the Trinity River.

The area of analysis for algae is generally the same as for Aquatic Resources (Section 3.3, Aquatic Resources, Figure 3.3-1). Potential impacts were assessed within and across reaches of the Klamath Basin, as separated by changes in physiography (e.g., Upper and Lower Klamath Basins), the presence of the Four Facilities under analysis, and degree of marine influence. The area of analysis for algae has the following reaches:

1. Upstream of the influence of J.C. Boyle Reservoir, including the following:
  - a. Upper Klamath Lake and Agency Lake
  - b. Tributaries to Upper Klamath Lake (Sprague, Sycan, Wood and Williamson Rivers)
  - c. Reclamation's Klamath Project facilities (e.g., Link River Dam, Keno Impoundment /Lake Ewauna)
2. Hydroelectric Reach: from the upstream end of J.C. Boyle Reservoir to Iron Gate Dam, including all sections categorized as mainstem, bypassed, and peaking reaches and including tributaries to the Klamath River (examples include Jenny, Spencer, Slate, Shovel, and Fall creeks).
3. Lower Klamath River: downstream of Iron Gate Dam, including the following:
  - a. Major tributaries to the Klamath River (Shasta, Scott, and Salmon Rivers)
  - b. Minor tributaries to the Klamath River (examples include Bogus, Beaver, Humbug, and Cottonwood creeks)
4. Klamath Estuary
5. Pacific Ocean marine nearshore environment (see Figure 3.2-1)

### 3.4.2 Regulatory Framework

Beneficial uses and water quality objectives for Oregon, California, the United States Environmental Protection Agency (USEPA), and the Hoopa Valley, Yurok and Karuk Tribes provide the regulatory framework for algae listed below. These uses and objectives are described in detail in Section 3.2.2. Oregon includes a narrative nuisance algae growth objective in which impairment of beneficial uses by algal growth is not allowed. Additionally, for natural lakes that do not thermally stratify, reservoirs, rivers and estuaries, the numeric average of 0.015 mg/l chlorophyll-*a* identifies Oregon water bodies where phytoplankton may impair the recognized beneficial uses (Table 3.2-3). California has a narrative biostimulatory water quality objective that limits nutrients to the extent that such growths cause nuisance or adversely affect beneficial uses (Table

3.2-3). Additionally, the algal concentration “targets” for the California Klamath River Total Maximum Daily Loads (TMDLs) were developed from an interpretation of the biostimulatory substances objective, using the California Nutrient Numeric Endpoint guidelines (North Coast Regional Water Quality Control Board [NCRWQCB] 2010a). For water column chlorophyll-*a* concentrations (i.e., phytoplankton) the California Klamath River TMDL target is 10 µg/L. For attached algal biomass (i.e., periphyton), the target is 150 µg/m<sup>2</sup> of chlorophyll-*a*. The Hoopa Valley Tribe also uses 150 µg/m<sup>2</sup> of chlorophyll-*a* as the water quality objective for nuisance periphyton growth (Table 3.2-6), which is applicable for River Mile (RM) ≈45-46 of the mainstem Klamath River.

#### **3.4.2.1 Federal Authorities and Regulations**

- Clean Water Act (Title 33 U.S.C. §1313 [1972])
- Safe Drinking Water Act (Title 42 U.S.C. CHAPTER 6A §300f-j [1973 as amended])
- Coastal Zone Management Act

#### **3.4.2.2 State Authorities and Regulations**

- Oregon Administrative Rules for Water Pollution Control (OAR 340-041)
- North Coast Region Basin Plan (as required by Sections 13240–13247 of California Porter-Cologne Water Quality Act)
- Oregon Administrative Rules for Water Pollution Control (OAR 340-041)
- California Ocean Plan

#### **3.4.2.3 Tribal Authorities and Regulations**

- Hoopa Valley Tribe Water Quality Control Plan

### **3.4.3 Existing Conditions/Affected Environment**

Two algal communities are predominate in the Klamath Basin. The lakes and reservoirs are dominated by phytoplankton, small algae that float in the water column. Particular phytoplankton species (i.e., blue-green algae or cyanobacteria) frequently reach nuisance levels within the lakes and reservoirs. In addition, there are portions of the riverine reaches (e.g., backwater eddies and near shore shallows) that have become inoculated with phytoplankton from upstream lakes and reservoirs, which can also support nuisance levels of blue-green algae under certain conditions. The riverine portions of the Klamath River are dominated by periphyton (i.e., attached algae) or algae, fungi, and bacteria that attach to the stream bed and/or periphyton mats. Periphyton is generally dominated by diatoms and green algae. Submerged aquatic macrophytes may also be present in quite backwater areas in the Klamath River; however, no known quantitative or species-specific information has been collected. No surveys have been conducted to determine the relative distribution or biomass of aquatic macrophytes in the Klamath River. This section focuses on the potential impacts of the Proposed Action and the alternatives on the phytoplankton and periphyton communities.

#### **3.4.3.1 Phytoplankton**

A number of different groups contribute to the phytoplankton community, including diatoms, green algae, and cyanobacteria (i.e., blue-green algae). The phytoplankton

community shifts seasonally in response to changing temperature, light and nutrient levels. Phytoplankton forms the base of the food web in the reservoirs. Phytoplankton is consumed by zooplankton, insects and some small fish, which are fed upon by larger fish, birds, mammals, and humans. Diatoms and green algae are generally considered to be beneficial components of the phytoplankton based on their important role in the food web. When phytoplankton communities reach higher levels of concentration in the water column (e.g., greater than 10-15 µg/L), the species composition shifts from the more beneficial green algal species to blue-green algal species. This happens quickly as biomass in the water column begins to increase exponentially, which results in nuisance conditions including: extreme diurnal dissolved oxygen (DO) and pH fluctuations due to the effect of photosynthesis and respiration of the algal biomass, high concentrations of cyanotoxins produced by toxigenic blue-green algal species (see also Section 3.2.3.7), DO crashes due to the decomposition of decaying algal biomass, and in extreme conditions, disruption of food webs from light limitation. Typically these nuisance conditions are dominated by blue-green algae species, most notably in Upper Klamath Lake, Copco 1 Reservoir, and Iron Gate Reservoir. Nuisance blooms of green algae are less common in the Klamath Basin. Blue-green algae reach very high densities in the summer months. Some blue-green algae, *Anabaena flos-aquae*, and *Microcystis aeruginosa*, produce toxins that are harmful to fish, mammals and humans (see Section 3.2.3.7).

The stable lacustrine<sup>1</sup> environment created at the Four Facilities, particularly in the larger Copco 1 and Iron Gate Reservoirs, coupled with high nutrient availability and high water temperatures in summer to fall, provides ideal conditions for phytoplankton growth. Blue-green algal species in particular thrive under warm water temperature, high nutrient, and stable water column conditions (Konopka and Brock 1978, Kann 2006), and out-compete other algal species such as diatoms in areas characterized by these conditions (Stillwater Sciences 2009).

In general, blooms of floating, or planktonic, algae (i.e., phytoplankton) can have important implications for water quality in freshwater systems, causing seasonal and daily fluctuations in nutrients, DO, and pH cycles. Within the Klamath Basin, blue-green algal productivity is locally and seasonally associated with extreme daily fluctuations in DO levels (high during the day and low at night), and elevated pH and free ammonia concentrations, which do not meet Oregon water quality standards during the summer months (Section 3.2.2.3). In California, the Klamath River watershed was listed for nutrient and temperature impairment from Iron Gate Reservoir to the Scott River, and the Klamath River mainstem was listed for organic enrichment/low DO in the reaches upstream of Iron Gate Reservoir and downstream of the Scott River in 1998. These listings were confirmed in the Klamath River TMDL (NCRWQCB 2010b). The factors contributing to ammonia toxicity (i.e., high ammonia concentrations, high pH, and elevated temperatures) have been documented independently, but concurrent measurements of these conditions are not available to demonstrate ammonia toxicity in California (Creager, pers. comm., 2011). Organic enrichment and DO depressions are

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<sup>1</sup> Pertaining to a lake or other calm water types.

particularly of issue during the summer and fall months when water temperatures are relatively high.

Nuisance algal blooms that occur in the Klamath Basin are primarily composed of three species of blue-green algae: *Aphanizomenon flos-aquae*, *Anabaena flos-aquae*, and *M. aeruginosa*. Large blooms of *Aphanizomenon flos-aquae* and *Anabaena flos-aquae* can strongly influence pH, free ammonia, and DO concentrations as described above. As nitrogen fixers, these species can provide a source of inorganic nitrogen for additional primary production in reservoirs (Federal Energy Regulatory Commission [FERC] 2007), which allows them to outcompete other algal species when nitrogen becomes scarce in a lake or reservoir. In addition to its role as a nitrogen fixer, *Anabaena flos-aquae* produces a neurotoxin (i.e., anatoxin), which can cause irritation, muscle twitching, paralysis, and death.

Although *M. aeruginosa* is not a nitrogen fixer, there are also frequent instances of bloom densities that also create conditions that negatively influence diurnal pH and DO conditions. *M. aeruginosa* produces microcystin, a liver toxin that can have detrimental effects on the health of exposed vertebrates, including humans. These toxins can cause irritation, sickness, or in extreme cases, death.

Studies suggest that the presence of *M. aeruginosa* blooms could result in acute and chronic effects on fish including increased mortality, reduced fertility, reduced feeding; and habitat avoidance (Interagency Ecological Program 2007, Fetcho 2008, CH2M Hill 2009, Fetcho 2009, Teh et al. 2010) including potential adverse affects to endangered juvenile suckers in Upper Klamath Lake (VanderKooi et al. 2011; see Section 3.3.3.2 Physical Habitat Descriptions - Water Quality - Algal Toxins). The World Health Organization (WHO) guidelines for exposure to microcystin have been exceeded in Upper Klamath Lake (VanderKooi et al. 2011) and the middle and lower Klamath River on several occasions (Chorus and Bartram 1999, Fetcho 2006, Fetcho 2007, Fetcho 2008, Kann 2008, Kann and Corum 2009), and the Klamath River from Copco 1 Reservoir (RM 203.1) to Iron Gate Dam (RM 190.1) is listed as impaired for toxicity due to the presence of microcystin in the reservoirs (Section 3.2.2.3). Large *Anabaena flos-aquae* blooms occur in the Klamath Hydroelectric Project reservoirs, along with *M. aeruginosa*, and their toxin has been documented in the reservoirs and downstream (Raymond 2009).

#### **3.4.3.2 Periphyton**

Periphyton is generally dominated by diatoms and green algae. Blue-green algae can also occur in the periphyton community, but are a small component of the community and do not reach nuisance levels. Like phytoplankton in the reservoirs, periphyton also contributes substantially to the base of the food web in riverine systems. Periphyton in the Klamath River also plays an important role in nutrient dynamics, affecting nutrient fluxes and resulting in short-term changes in DO and pH. Monitoring at multiple locations along the mainstem Klamath River indicates that DO and pH patterns over a 24-hour period are driven by photosynthesis and respiration of large colonies of periphyton. Excessive swings in DO and pH can be stressful to aquatic biota, thus too much periphyton can adversely affect water quality and aquatic resources.

Benthic<sup>2</sup> algae documented within the Klamath Basin include nuisance filamentous green algae species such as *Cladophora* (FERC 2007), which can form dense mats in some places in the lower Klamath River. These mats tend to be patchy and occur in lower velocity areas. They are not a dominant feature of the river, but are an important habitat for the polychaete worm that is the intermediate host of the important fish parasites, *Ceratomyxa shasta* and *Parvicapsula minibicornis*. Periphyton abundance and community composition appears to be controlled in large part by nutrient availability and flow rates, with high flow rates frequently corresponding to low periphyton abundance, and nutrient enrichment corresponding to an increased abundance of *Cladophora*. However, data regarding the distribution, community composition, and biomass of periphyton in the Klamath River is limited.

### **3.4.3.3 Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir**

#### **Phytoplankton**

Sediment core studies indicate that Upper Klamath Lake was likely a historically biologically productive lake (i.e., the lake produced abundant fish and blue-green algae blooms) as indicated by high nutrient concentrations (particularly phosphorus) in the sediments for the last thousand years (Eilers et al. 2001). Additional analysis of sediment cores suggests that Upper Klamath Lake water quality has changed substantially over the past 100 years as consumptive water use practices (e.g., irrigation, municipal uses, wetland diking and draining [i.e., conversion of wetlands to agricultural land]) and accompanying changes in land use practices throughout the upper Klamath and Lost River watersheds have increased (Walker 2001). Specifically, it appears that mobilization of phosphorus from agriculture and other nonpoint sources has pushed the lake from a naturally eutrophic state into its current hypereutrophic<sup>3</sup> state, allowing algal blooms to reach or approach their theoretical maximum (Walker 2001).

Evaluation of temporal and spatial patterns of algal community composition in Upper Klamath Lake reveals shifts between blue-green algae and diatom-dominated communities. Phytoplankton biovolumes in Upper Klamath Lake are dominated by beneficial diatoms in the spring (Kann 1997, Oregon Department of Environmental Quality [ODEQ] 2002, Sullivan et al. 2009), while summer and fall (June–October) algal blooms in Upper Klamath Lake are strongly dominated by noxious blue-green algal species (primarily *Aphanizomenon flos-aquae*) (Eilers et al. 2004, FERC 2007).

Downstream from the Link River to Keno Dam, temporal and spatial patterns of algal community composition are driven by blooms originating in Upper Klamath Lake. In 2008, a total of 141 algae species were identified in this reach, with most of these algae (98.8 percent) belonging to one of four algal groups: blue-green, cryptophytes, diatoms, and green (Sullivan et al. 2009). *Aphanizomenon flos-aquae* possessed the highest average density (61 percent) when present. As in Upper Klamath Lake, algal group composition in

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<sup>2</sup> Relating to the bottom of a sea, stream, or lake or to the organisms that live there.

<sup>3</sup> Hypereutrophic: a state of water quality characterized by excessive concentrations of nutrients such as nitrogen and phosphorous and resulting in extremely high productivity. Such waters are often shallow, with intense algal blooms and periods of oxygen deficiency and high pH.

this reach is dominated by diatoms in the spring (56 percent of the total algal biovolume at mainstem sites), while in summer and fall blue-green algae represent the dominant species (76-80 percent of the total algae biovolume) (Sullivan et al. 2009). High mean algal abundances have been documented in the Klamath River at the Keno Bridge (Highway 66), Link River, and Upper Klamath Lake (at Freemont St. Bridge) (Raymond 2005, Sullivan et al. 2009). The prevalence of beneficial diatoms increases relative to noxious blue-green algal species (including nitrogen-fixing and bloom-forming blue-green algae) moving downstream (Kann and Asarian 2006). However, diatoms decrease again in abundance relative to blue-green algae within the Copco/Iron Gate Reservoir complex, as described in the Section 3.4.3.4.

The reach from Link River to Keno Dam has extremely poor water quality, especially during summer months, with water temperature exceeding 25°C, pH approaching 10 units, dense algal blooms, and DO concentrations below 4 mg/L (National Research Council 2004, Deas and Vaughn 2006). Decomposition of the algae and organic matter transported from Upper Klamath Lake to this reach is largely responsible for the low DO concentration (see Section 3.2.3.5 and Appendix C, Section C.4.1.3 for more detail).

#### **Periphyton**

Periphyton is abundant in portions of the upper Klamath River. In the Klamath Basin, one periphyton species that can reach nuisance levels is *Cladophora*, which are common in nutrient enriched waters (Dodds 1991, FERC 2007), particularly with abundant nitrogen. Periphyton is of particular concern in the Sprague River, where the dominance of these species results in dramatic diurnal fluctuations in DO and pH (ODEQ 2002). Because *Cladophora* provide an ideal habitat for the polychaete host of both *C. shasta* and *P. minibicornis*, the presence of these species may result in an increased abundance of the polychaete host populations, potentially resulting in increased exposure to and incidence of fish disease (see Section 3.3.3.3).

#### **3.4.3.4 Klamath River from Upstream End of J.C. Boyle Reservoir to Iron Gate Dam**

##### **Phytoplankton**

Excluding patterns of algal growth within the reservoirs, blue-green algae dominance and biovolume decrease from sites upstream of J.C. Boyle Reservoir (RM 224.7 to 228.3) downstream through this area of analysis (Kann and Asarian 2006). However; this decreasing trend is interrupted by large blooms of blue-green algae in Copco 1 and Iron Gate Reservoirs (Kann and Asarian 2006, Asarian et al. 2009). In these two reservoirs, a bloom of diatoms generally occurs in March, followed by a period of low chlorophyll-*a* concentrations (FERC 2007). Blue-green algae dominate the algal community during the late summer to fall months, with large blooms of *Anabaena flos-aquae* and *M. aeruginosa* in the reservoirs (Kann 2006, FERC 2007). The incidence and magnitude of *M. aeruginosa* in the reservoirs is high relative to stations upstream, where blooms of *Aphanizomenon flos-aquae* are more prevalent (Kann and Asarian 2006).

The documented presence of algal toxins in water and fish tissue corresponds with spatial and temporal patterns in the distribution of blue-green algal blooms within this reach. Recent data indicate that microcystin toxin occurs at undetectable or very low levels in

the Klamath River directly upstream of J.C. Boyle Reservoir and reaches high concentrations in the Copco 1 and Iron Gate Reservoirs from July through October (Kann and Corum 2009). Since 2007, high levels of microcystin have prompted the posting of public health advisories around the reservoirs and along the length of the Klamath River during summer months (see Appendix C, Section C.6 for more detail). In 2010, the Klamath Hydroelectric Project reservoirs and the entire river downstream of Iron Gate Dam (including the estuary) were posted to protect public health due to elevated cyanobacteria cell counts and cyanotoxin concentrations. High toxin concentrations in the water column have significant implications for accumulation of microcystin toxin in muscle and/or liver tissues of yellow perch, hatchery salmon, and freshwater mussels (Kann 2008, Kann and Corum 2009). Section 3.3.3.3 Algal Toxins presents a discussion of algal toxins as related to fish health.

Moreover, the reservoirs serve as the primary source of blue-green algae and associated toxins for the areas downstream of Iron Gate Dam, as described in Section 3.4.3.5 and Appendix C, Section C.6.

#### **Periphyton**

Nuisance blooms among the periphyton have not been documented in the riverine portions of this reach. In the J.C. Boyle peaking reach, it has been noted that periphyton tends to be absent from the margins of the river that are alternately dried and wetted during peaking operations (Asarian, pers. comm., 2011).

#### **3.4.3.5 Klamath River downstream of Iron Gate Dam**

##### **Phytoplankton**

Although both *Anabaena flos-aquae* and *M. aeruginosa* have been observed just downstream of Iron Gate Dam and as far downstream as the Klamath Estuary, this area does not provide suitable habitat for species that generally only thrive in reservoir and lake environments. Accordingly, these species are generally documented at lower abundances in this area relative to the diatom species observed in the middle and lower Klamath River (Kann and Asarian 2006). Despite this relatively low abundance, however, algal toxins are a critical concern in this reach because they are released from the reservoirs in dissolved phase, as well as in intact algal colonies that can remain viable along the low-velocity margins of the river where little mixing occurs (Kann and Corum 2009). This creates problems associated with toxin bioaccumulation and toxicity in areas beyond those that provide suitable conditions for growth of blue-green algae (Kann and Corum 2009). Data collected from 2004 through 2009 indicate high levels of microcystin in Copco 1 and Iron Gate Reservoirs, with measured concentrations exceeding the California State Water Resources Control Board (SWRCB)/Office of Environmental Health and Hazard Assessment (OEHHA) public health threshold of 8 µg/L by over 1000 times in Copco Reservoir in 2006, 2007, 2008, and 2009 (see Appendix C, Section C.6.1.4) (Kann 2007a–2007d, Kann and Corum 2007 and 2009, Kann et al. 2010, Jacoby and Kann 2007) (see Appendix C, Section C.6.1.4). Data from 2007 also indicate microcystin bioaccumulation in juvenile salmonids reared in Iron Gate hatchery (Kann 2008; see Section 3.3.3.3 Algal Toxins for a discussion of algal toxins as related to fish health). Annual peaks in *M. aeruginosa* biovolume occur in the late summer to fall

months (e.g., August and September) of most recent years directly downstream of Iron Gate Dam (Kann and Asarian 2006). The degree to which reservoir production of nitrogen-fixing blue-green algae contribute to overall nitrogen levels in the middle and lower Klamath River remains poorly understood (Stillwater Sciences 2009).

### **Periphyton**

Sampling of periphyton in the Klamath River downstream of Iron Gate Dam revealed a shift in community composition, where nitrogen-fixing species are not present directly downstream of Iron Gate Dam but begin to appear by Seiad Valley and then make up an increasing percent of periphyton biomass at sites downstream. Nitrogen-fixing species are dominant at sites between Orleans and Turwar (Asarian et al. 2010; E. Asarian, pers. comm., 2011). The increased prevalence of nitrogen-fixing periphyton coincides with very low levels of inorganic nitrogen (ammonia and nitrate) concentrations in water samples.

In a single survey downstream of Iron Gate Dam, Eilers (2005) documented high periphyton coverage (near 80 percent) on stream rocks and periphyton chlorophyll content (near 50 micrograms per square centimeter [ $\mu\text{g}/\text{cm}^2$ ]) immediately downstream of Iron Gate Dam (RM 189.7), and relatively low periphyton coverage (near 10 percent) on stream rocks several miles downstream near the Collier Rest Area at the I-5 bridge (RM 178).

Downstream of the Collier Rest Area, both periphyton coverage and chlorophyll content increased gradually to peak levels in the Klamath River near the mouth of the Salmon River (RM 67). *Cladophora* dominated the Shasta River site, where it made up one half of the periphyton community by biovolume; however, these species were not documented at any of the other tributary or mainstem Klamath River sites surveyed (Eilers 2005). As discussed previously, *Cladophora* provide suitable habitat for the polychaete worm that is the intermediate host for fish parasites. Periphyton biomass was generally found to be low to moderate in this study; however, it is believed that increased discharge (i.e., a doubling of flow from about 600 cfs around August 15 to about 1,200 cfs near the end of the month, settling at about 800 cfs by September 1, the start of the study) may have dislodged filamentous algae that had proliferated under the previous lower flow regime (Eilers 2005, FERC 2007). However, data regarding *Cladophora* biomass is limited, making it difficult to determine the primary factors that control the biomass and distribution of these species (E. Asarian, pers. comm., 2011).

#### **3.4.3.6 Klamath Estuary**

The algal community in the Klamath Estuary is dominated by phytoplankton, but has more periphyton in the upstream areas where the estuary has more riverine characteristics. The presence of brackish water in the estuary influences the types of algae present in different areas of the estuary. Like the lower Klamath River, the Klamath Estuary has an algal community composed primarily of diatoms and blue-green algae (Fetcho 2007, Fetcho 2008). Phytoplankton densities are generally lower in this area than those measured concurrently in the lower Klamath River. On one occasion, in September 2007, estuary concentrations of *M. aeruginosa* twice exceeded the Yurok

Tribe posting action level (40,000 cells/mL). On a separate occasion, in September 2005, concentrations exceeded the WHO guidelines for low risk recreational use (20,000 cells/mL) (Fetcho 2006, Fetcho 2008). These instances of elevated levels of *M. aeruginosa* corresponded with elevated levels measured in the lower Klamath River, suggesting that *M. aeruginosa* is transported from the Klamath Hydroelectric Project reservoirs into the lower river and subsequently into the estuary.

Although periphyton data for the estuary is unavailable, in part due to the difficulty of sampling in deeper areas, abundant periphyton cover has been documented in the south slough (Hiner 2006).

#### **3.4.3.7 Marine Nearshore Environment**

The algal community of the near shore Pacific Ocean is dominated by marine algae, including attached red and brown seaweeds, as well as many marine planktonic species. The freshwater algae discussed above are not expected to grow in this turbulent, saline environment, but may be carried into the ocean with the current. Toxins can also be washed into the ocean, but are expected to be rapidly diluted, and there have been no reports of problems relating to freshwater algal toxins in the Pacific Ocean near the mouth of the Klamath River.

### **3.4.4 Environmental Consequences**

#### **3.4.4.1 Effects Determination Methodology**

Existing information regarding blue-green algal blooms in the Klamath Basin suggests that several critical factors determine the frequency and toxicity of such blooms in Upper Klamath Lake and the Klamath Hydroelectric Project reservoirs: water temperature, light levels (FERC 2007), flow rates (Kann 2006), nutrient availability/ratios (Chorus and Bartram 1999, Fetcho 2008) and wind-induced turbulence and mixing. In this nutrient-rich system, elevated temperatures and increased light levels that occur during the summer and early fall result in seasonal blue-green algal blooms in the Klamath River, and especially the reservoir reaches. Upstream areas in or in close proximity to the reservoirs generally have larger blooms relative to the downstream river reaches (Kann 2006, Kann and Corum 2009), and the highest *M. aeruginosa* cell density and microcystin toxin concentrations occur within and directly below the reservoirs (Kann and Corum 2009). This information indicates that the reservoirs provide ideal conditions (see Section 3.4.3.1) for proliferation of blue-green algal species, and serve as a source of algal cells and their toxins to downstream areas.

The Lead Agencies assessed the Proposed Action and alternatives' effects on toxic algal blooms based on the expected effects of the alternatives on water temperature, hydrodynamic conditions (water movement potential), and nutrient availability. The Lead Agencies used modeling data describing the expected effects of dam removal on water quality, as well as existing literature regarding the biology and ecology of blue-green algal species, to determine whether the alternatives would alter the spatial extent of the river that provides suitable growing conditions for blue-green algae.

The Lead Agencies evaluated specific metrics including the extent to which monthly mean and maximum water temperatures would be within the range from 18 to 25°C and exceed 28 °C, total suspended sediment and nutrient concentrations, and the presence or absence of lacustrine (i.e., lake-like) conditions. Nutrient and suspended sediment concentration data came from the TMDL and SRH-1D model output, respectively. The Lead Agencies obtained benthic chlorophyll-*a* data for evaluation of potential changes in periphyton biomass from the Nutrient Numeric Endpoint Analysis (NCRWQCB 2010a, Appendix 2). Mass balance nutrient budgets presented in Asarian et al. (2010) were also used to evaluate potential effects of the Proposed Project on periphyton. The Lead Agencies selected the temperature thresholds based on information regarding required temperatures for growth and toxicity of blue-green algae provided in the blue-green Algae Work Group assessment (2010) and Van Der Westhuizen and Eloff (1985). The Lead Agencies assessed changes in water quality (temperature, nutrient and suspended sediment concentrations) during the summer and early fall, at the Four Facilities and at various in-river locations throughout the project area. The Lead Agencies also used this information to evaluate Project-induced changes on other algal groups such as diatoms and periphyton.

#### **3.4.4.2 Significance Criteria**

For purposes of the EIS/EIR, impacts would be significant if they were to result in the following:

- An increase in the spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton blooms, including blue-green algae.
- An increase in the spatial extent, temporal duration, or biomass of nuisance periphyton (e.g., *Cladophora*) growth.

#### **3.4.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project Alternative**

##### **Phytoplankton**

*Continued impoundment of water in the reservoirs at the Four Facilities could support the growth of seasonal nuisance and/or noxious phytoplankton blooms in the reservoirs and subsequent transport to downstream reaches of the Klamath River.* Under the No Action/No Project Alternative, none of the actions under consideration would be implemented. The Klamath Hydroelectric Project would continue current operations under the terms of an annual license until a long term license is finalized. Annual licenses would not include the actions associated with the Klamath Hydroelectric Settlement Agreement (KHSAs) and Klamath Basin Restoration Agreement (KBRA). Some KBRA actions have already been initiated and would continue under the No Action/No Project Alternative. These include the Williamson River Delta Project, the Agency Lake and Barnes Ranch Project, fish habitat restoration work, and ongoing climate change assessments. Implementation of several Oregon and California TMDLs (Section 3.2.2.4) within the period of analysis is a reasonably foreseeable action associated with water quality under the No Action/No Project Alternative as the TMDLs are an unrelated regulatory action. Hydroelectric operations would continue as they have been, providing peaking power generation during the summer as demand requires and conditions allow.

However, increased water temperatures and nutrient loading associated with climate change could increase the spatial extent, temporal duration, toxicity, or concentration of blue-green algal blooms.

Continued impoundment of water at the Four Facilities could support long-term (>2 years following dam removal) growth of nuisance and/or noxious phytoplankton such as *M. aeruginosa* in the Hydroelectric Reach. Under existing conditions, nuisance phytoplankton blooms occur during summer and fall in Copco 1 and Iron Gate Reservoirs, with the most intense blooms generally occurring in the late summer (Section 3.4.3.4). High seasonal levels of algal toxins (microcystin) are linked to intense blue-green algae blooms (Section 3.2.3.7).

TMDLs for the Upper Klamath Lake drainage, the Upper Klamath River and Lost River in Oregon, the Lower Lost River in California, and the Klamath River in California include allocations and/or targets for nutrients and/or chlorophyll-*a* (Section 3.2.2.4); full and successful implementation of these TMDLs would result in a decreased spatial extent, duration, and concentration of phytoplankton blooms in the Upper and Lower Klamath Basin (see also analysis for chlorophyll-*a* under the No Action/No Project Alternative, Section 3.2.4.3.1.6). As discussed in Section 3.2, Water Quality, the timeframes for achieving water quality objectives with respect to the TMDLs will depend on the measures taken to improve water quality conditions. It is anticipated that full implementation would require decades to achieve.

Climate change is projected to result in increased water temperatures due to median annual increases in air temperatures of 3°C and decreases in snowpack (Snyder et al. 2004). The projected decreases in snowpack are associated with increased air temperatures and higher levels of rainfall relative to snowfall. Water temperature increases are generally expected to be more dramatic in the Lower Klamath Basin than in the Upper Basin over the next 50 years due to the cooling influence of ground water in the Upper Basin during the summer months (Hamilton et al. 2010). Between J.C. Boyle Reservoir and Iron Gate Dam, the benefits of substantial groundwater resources would not be realized because they are inundated by reservoirs or occur in bypass reaches (Hamilton et al. 2010). Higher intensity rainfall events are also expected to occur. Runoff from such events could increase the frequency with which the river exhibited high suspended sediment concentrations, which could increase the delivery of nutrients, such as phosphorous, to the system (Stillwater Sciences 2009). Increased summer temperatures and nutrient inputs would likely result in an increase in the magnitude, duration, and spatial extent of summer blooms of toxic blue-green algae.

Additionally, research conducted in the San Francisco Bay-Delta system indicates that increased temperatures could result in elevated toxicity of *M. aeruginosa* (i.e., increased microcystin concentrations produced by a bloom) (Mioni and Payton 2010). Under the No Action/No Project Alternative, an increase in the toxicity of seasonal phytoplankton blooms due to climate change would be a significant impact. The anticipated effects of climate change would also occur over a timescale of decades and may offset improvements expected from successful TMDL implementation throughout the Upper

and Lower Klamath Basin, particularly in the case of potential elevated toxicity of *M. aeruginosa*. However, overall, the benefits of nutrient reductions under the TMDLs are anticipated to be of greater relative importance with respect to phytoplankton blooms under the No Action/No Project Alternative.

**Existing seasonal nuisance and/or noxious phytoplankton blooms in the Upper and Lower Klamath Basin are adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly decrease these blooms. Continued impoundment of water at the Four Facilities would result in no change from existing conditions.**

### **Periphyton**

*Continued impoundment of water at the Four Facilities could support the growth of nuisance periphyton such as Cladophora spp. downstream of Iron Gate Dam.* Under existing conditions, periphyton coverage is relatively high immediately downstream of Iron Gate Dam, with coverage decreasing further downstream near the I-5 Bridge (RM 178), and increasing again to peak levels near the mouth of the Salmon River (RM 67) (Section 3.4.3.5). Because *Cladophora* provide suitable habitat for the polychaete worm that is the intermediate host for fish parasites, the presence of large seasonal periphyton mats immediately downstream of the Hydroelectric Reach have been linked to the potential for increased exposure to and incidence of fish disease.

As described above for phytoplankton (i.e., blue-green algae), full and successful implementation of Oregon and California TMDLs would decrease nutrients in the Klamath River and would result in decreased spatial extent, temporal duration, and/or biomass of phytoplankton mats. As discussed in Section 3.2, Water Quality, the timeframes for achieving water quality objectives with respect to the TMDLs will depend on the measures taken to improve water quality conditions. It is anticipated that full implementation would require decades to achieve.

Conversely, increases in water temperature with climate change are likely to result in increased growth of periphyton in the Klamath River. Increased temperature through climate change may exacerbate biostimulatory conditions through increased periphyton metabolic and growth rates. Increases in nutrient availability under climate change may also cause a shift in periphyton community composition from that dominated by nitrogen-fixing periphyton species to that dominated by non-nitrogen fixers. It remains uncertain whether this change in community composition would result in a change in periphyton biomass. As with phytoplankton, the benefits of nutrient reductions under the TMDLs are anticipated to be of greater relative importance with respect to periphyton spatial extent, bloom duration, and biomass under the No Action/No Project Alternative.

**Existing seasonal nuisance periphyton growth in the Upper and Lower Klamath Basin is potentially adverse. Full attainment of the Oregon and California TMDLs (implementation mechanism and timing unknown) would significantly decrease periphyton growth. Continued impoundment of water at the Four Facilities would result in no change from existing conditions.**

The implications of potential changes in periphyton biomass and community composition for DO and the spread of fish disease are described in Sections 3.2.4.3 and 3.3.3.3, respectively.

**Alternative 2: Proposed Action: Full Removal of Four Dams (Proposed Action)**

Under the Proposed Action, the four major dams in the Klamath Hydroelectric Project (J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams) would be removed along with the ancillary facilities of each installation. This includes the entire dam, the powerhouses, spillways, and other infrastructure associated with the power generating facilities, as well as the transfer of the Keno Dam facilities to the United States Department of the Interior (DOI) and the implementation of the KBRA.

**Upper Klamath Basin upstream of the influence of J.C. Boyle Reservoir**

**Phytoplankton**

*The Proposed Action could decrease the spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton in the area of analysis.* Dam removal activities would not affect the Klamath River upstream of J.C. Boyle Reservoir. Effects of KBRA in this reach are discussed in Section 3.4.4.3. Alternative 2: Full Removal of Four Dams – KBRA. **There would be no change from existing conditions from nuisance and/or noxious phytoplankton.**

**Periphyton**

*The Proposed Action could decrease the spatial extent, temporal duration, or biomass of nuisance periphyton in the area of analysis.* Dam removal activities would not affect the Klamath River upstream of J.C. Boyle Reservoir. Effects of KBRA in this reach are discussed in Section 3.4.4.3. Alternative 2: Full Removal of Four Dams – KBRA. **There would be no change from existing conditions from nuisance periphyton.**

**Hydroelectric Reach**

**Short-Term Effects**

**Phytoplankton** Under the Proposed Action, the short-term (<2 years following dam removal) increase in nutrients in the Hydroelectric Reach would be a less-than-significant impact (Section 3.2.4.3.2.3.). Additionally, by mid to late spring following reservoir drawdown (assuming drawdown Scenario 8), little to no reservoir habitat would be left, and blue-green algal blooms would be very limited if not eliminated from the Hydroelectric Reach. Thus, potential effects of increased nutrients on phytoplankton blooms in the Hydroelectric Reach are not considered further.

**Periphyton** While quiescent habitat for phytoplankton would be eliminated in the short-term by reservoir drawdown and dam removal (see above), periphyton growth in the riverine reaches of the Hydroelectric Reach could occur during the initial summer and fall months following drawdown. However, this is unlikely to occur due to increased short-term (<2 years following dam removal) nutrient availability under the Proposed Action since in the short-term, the increase in nutrients in the Hydroelectric Reach would be a less-than-significant impact (Section 3.2.4.3.2.3.). Additionally, higher flows during drawdown and late spring storm events would result in greater bed turnover (see Section

3.3.4.3, Bedload Sediment) and scouring, which would greatly limit, if not eliminate, short-term establishment of periphyton in the Hydroelectric Reach. Thus, potential effects of increased nutrients on short-term periphyton establishment in the Hydroelectric Reach is not considered further. The potential long-term effects of scour on periphyton biomass are discussed in greater detail below.

#### Long-Term Effects

**Phytoplankton** *Under the Proposed Action, removal of the reservoirs at the Four Facilities would eliminate lacustrine habitat behind the dams and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms.* This change, particularly within the larger Copco 1 and Iron Gate Reservoirs, would decrease or eliminate the system's support for excessive growth of blue-green algae over the long-term by eliminating quiescent habitat where these algal species can thrive. This change in suitable habitat would occur even if relatively high nutrient concentrations were to remain in the Klamath River system. This would substantially reduce the production of toxins from these reservoirs that are harmful to animals and humans. This would be a major benefit of the Proposed Action. Moreover, dam removal would allow the substantial groundwater resources within this area of analysis to cool water temperatures during the summer months (Hamilton et al. 2010). This would further reduce the suitability of conditions for blue-green algae growth and mitigate for the effects of climate change. The Proposed Action would provide a substantial long-term benefit with regard to phytoplankton in the Hydroelectric Reach. **Under the Proposed Action, long-term reductions in the growth of nuisance and/or noxious phytoplankton due to the elimination of the reservoirs in the Hydroelectric Reach would be beneficial.**

**Periphyton** *Under the Proposed Action, dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton in low-gradient channel margin areas downstream of J.C. Boyle Dam.* Periphyton growth in the Hydroelectric Reach downstream of J.C. Boyle Dam could be quite high on a seasonal basis following dam removal. This is because until full attainment of the Oregon and California TMDLs can be achieved, high nutrient inputs from the Upper Klamath Basin would continue to support periphyton growth and removal of the reservoirs and the hydropower peaking reaches would create suitable physical habitat suitable for periphyton. Thus, the overall effect of the Proposed Action could be to eliminate blooms of toxic blue-green algae in the reservoirs and replace them with colonies of periphyton in the newly created margins of low gradient river channels in the Klamath Hydroelectric Project Reach. However, the particular periphyton species that may become abundant in these areas is unknown (E. Asarian, pers. comm., 2011). Although there is potential for nutrient concentrations to increase in these areas, these increases are expected to be less than significant (see Section 3.2.4.3.2.3). Moreover, these nutrient inputs would be expected to decrease over time with implementation of the Oregon and California TMDLs and KBRA projects (see Section 3.4.4.3 Alternative 2: Full Removal of Four Dams – KBRA).

Potential increases in periphyton growth could also be disrupted by more frequent river bed turnover (see Section 3.3.4.3) and increased flow variability during storm flow, which may result in increased scouring of periphyton during late spring storm events, following dam removal (See NCRWQCB 2010a, Appendix 2). This potential outcome is supported by results from the Nutrient Numeric Endpoint Benthic Biomass Predictor for the “natural conditions” (i.e., point sources eliminated, large reductions in nutrient input from Upper Klamath Lake and Straits Drain, and dams out) scenario. The model predicts that periphyton growth in the Klamath River downstream of Iron Gate Dam can achieve the proposed 150 mg/m<sup>2</sup> maximum benthic chlorophyll-*a* target under the “natural conditions” scenario when more frequent scouring events are allowed to occur, a condition that would be supported if the dams were not in place (see NCRWQCB 2010a, Appendix 2). However, the benthic chlorophyll-*a* predictions are subject to uncertainty because of a lack of data regarding relationships between nutrient concentrations, flows, periphyton biomass and chlorophyll-*a* concentrations and between dam removal and the frequency of scouring events. In addition, these model results include the effect of large reductions in nutrient loading based on compliance with the Upper Klamath Lake TMDL, and do not provide information regarding the isolated effects of the Proposed Project on periphyton abundance. **Under the Proposed Action, long-term increases in nuisance periphyton growth due to increases in available habitat along channel margin areas of the Hydroelectric Reach downstream of J.C. Boyle Dam would be a significant impact.**

The above “significant impact” determination represents a conservative assessment of the effects of the Proposed Action on periphyton growth since there is inherent uncertainty in the Nutrient Numeric Endpoint predictions and it is possible that excessive periphyton growth would not be supported in the Hydroelectric Reach. Additional research prior to the time of dam removal would help resolve these uncertainties. Monitoring could also be conducted after dam removal which would help identify the actual changes in the periphyton community resulting from dam removal. The implications of potential changes in periphyton biomass and community composition for DO and the spread of fish disease are described in Sections 3.2.4.3 and 3.3.3.3, respectively. If projects were well-designed and implemented at a large enough scale, reductions in nutrient loading resulting from implementation of TMDL and KBRA projects (see Section 3.4.4.3 Alternative 2: Full Removal of Four Dams – KBRA) proposed to reduce nutrient loading from the Upper Klamath Basin could fully mitigate for potential increases periphyton biomass associated with changes in nutrient concentrations under the Proposed Action (E. Asarian, pers. comm., 2011).

#### **Yreka Pipeline Relocation and Recreational Facilities Removal**

*Under the Proposed Action, removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline.* The water supply pipeline for Yreka will have to be relocated from its present location under Iron Gate Reservoir. Once the reservoir is drawn down, the existing pipeline would be exposed to higher velocity water flow, debris during flood events, and other potentially damaging situations that it is currently not exposed to at the bottom of the reservoir. To address this, the pipeline will be suspended from a pipe bridge across the Klamath River. Potential impacts to algae from the installation of the

pipe bridge will be minimized or eliminated through the implementation of Best Management Practices (BMPs) for construction activities (Appendix B). Implementation of BMPs would ensure that impacts are constrained to the individual sites and their immediate area, and not transferred downstream in the Klamath River. **There will be no change from existing conditions from algae in the Hydroelectric Reach or the Klamath River downstream of Iron Gate Dam as a result of the Yreka water supply pipeline relocation.**

*Under the Proposed Action, construction/deconstruction activities would include the demolition of various recreation facilities.* The existing recreational facilities located along the banks of the reservoirs will be removed once the reservoirs are drawn down. Facilities such as campgrounds and boat ramps, currently located on the reservoir banks will need to be relocated down slope to be near the new river channel once the reservoir is removed. Impacts specific to the deconstruction of the Recreation Facilities are discussed in Section 3.20, Recreation. Once the reservoirs are drawn down, the existing recreational facilities would be well above the new river channel. The removal of the facilities is not expected to impact algae biomass or lifecycles. The potential for impacts during the facilities removal will be minimized or eliminated through the implementation of BMPs for construction activities (Appendix B). Implementation of BMPs would ensure that impacts are constrained to the individual sites and their immediate area, and not transferred downstream in the Klamath River. **There would be no change from existing conditions from algae in the Hydroelectric Reach or the Klamath River downstream of Iron Gate Dam as a result of the removal of the recreational facilities.**

## **Klamath River Downstream of Iron Gate Dam**

### Long-Term Effects

**Phytoplankton** *Under the Proposed Action, removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream of Iron Gate Dam.* Reduced inputs of *M. aeruginosa* and *Anabaena flos-aquae* to the mainstem river downstream of Iron Gate Dam would result in a substantial reduction in the presence of toxic algal cells.

Increases in nutrient availability associated with delivery and deposition of sediments from the upper watershed could occur over the long term as a result of dam removal (DOI 2011; Section 3.3.4.3). However, possible summer through fall increases in nutrient concentrations, particularly directly downstream of Iron Gate Dam, following dam removal (see Section 3.2.4.3.2.3 Nutrients – Lower Klamath Basin) would not contribute significantly to blue-green algal blooms downstream of Iron Gate Dam due to the lack of the suitable hydrodynamic conditions required for extensive planktonic algal growth following implementation of the Proposed Action. This analysis suggests that the Proposed Action would have a positive effect on aquatic resources in the Klamath River downstream of Iron Gate Dam in the long-term based on reductions in downstream transport and concentrations of phytoplankton and microcystin toxins to this area. **Under the Proposed Action, long-term reductions in the growth of nuisance and/or noxious phytoplankton in the reservoirs in the Hydroelectric Reach would reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and**

**concentrations of algal toxins into the Klamath River downstream of Iron Gate Dam and would be beneficial.**

**Periphyton** *Under the Proposed Action, dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.* Periphyton growth could continue to be relatively high downstream of Iron Gate Dam on a seasonal basis following dam removal because of continuing nutrient inputs from the Upper Klamath Basin, as described for the J.C. Boyle to Iron Gate Dam reach. Despite the overall increases in absolute nutrient concentrations anticipated under the Proposed Action (see Section 3.2.4.3.2.3 Nutrients – Lower Klamath Basin), the relatively greater increases in Total Nitrogen (TN) may not result in significant biostimulatory effects on periphyton growth. Existing data indicate that the Klamath River is generally N-limited (TN:Total Phosphorus (TP) <10), with some periods of co-limitation by N and P (see also Section 3.2.3.4 and Appendix C, Section C.3.2.1). However, concentrations of both nutrients are high enough in the river from Iron Gate Dam (RM 190.1) to approximately Seiad Valley (RM 129.4) (and potentially further downstream) that nutrients are not likely to be limiting primary productivity (i.e., periphyton growth) in this portion of the Klamath River (FERC 2007, Hoopa Valley Tribe Environmental Protection Agency [HVTEPA] 2008, Asarian et al. 2010). In addition, N-fixing species dominate the periphyton communities in the lower reaches of the Klamath River where inorganic nitrogen concentrations are low (Asarian et al. 2010). Since these species can fix their own nitrogen from the atmosphere, increases in TN due to dam removal may not significantly increase their biomass, particularly if overall TN increases are less than those predicted by existing models due to implementation of TMDLs and general nutrient reductions in the Klamath Basin.

In addition to the effects of changes in nutrient concentrations, periphyton community composition and biomass may be affected by light levels and substrate stability. Light penetration would decrease following dam removal below Iron Gate Dam due to removal of the reservoirs, which serve as sediment catchment areas. This would have a reducing effect on periphyton growth downstream of Iron Gate Dam. In addition, potential increases in periphyton growth could be counteracted by more frequent river bed turnover (see Section 3.3.4.3) and increased flow variability during storm flow, which could result in increased scouring of periphyton during late spring storm events, following dam removal (NCRWQCB 2010a, Appendix 2). The magnitude of the effect of bed turnover and scouring on periphyton would likely decrease with distance downstream. As described for the Hydroelectric Reach, model results suggest that increased scouring may somewhat limit periphyton biomass following dam removal (NCRWQCB 2010a, Appendix 2).

Because of these many competing factors, some that may favor enhanced periphyton growth downstream of Iron Gate Dam (i.e., increased nutrients transport), and some that counteract this response (increased uptake of nutrients by periphyton in the Hydroelectric Reach, increased frequency and intensity of scouring events, decreasing nutrient concentrations due to TMDL implementation and KBRA nutrient reduction programs [see KBRA discussion below]), it is likely that increases in periphyton growth below Iron

Gate Dam would be less than significant. Moreover, the biological significance of potential increases in periphyton biomass is unknown due to uncertainty regarding the magnitude of increase in biomass required to generate a significant reduction in habitat quality for aquatic resources (NCRWQCB 2010a, Appendix 2).

**Under the Proposed Action, long-term increases in nuisance periphyton in the Klamath River downstream of Iron Gate Dam would be a less than significant impact.**

## **Klamath Estuary**

### Long-term Effects

**Phytoplankton** *Under the Proposed Action, removal of the reservoirs would eliminate lacustrine habitat behind the dams and could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath Estuary.* Information regarding current conditions of algal biomass, population dynamics, and the likelihood of nutrient limitation on algal growth in the Klamath Estuary is limited. Consequently, it is difficult to determine the potential long-term effects that the Proposed Action would have on algae in the estuary. Existing information suggests that the removal of the Four Facilities would reduce or eliminate elevated *M. aeruginosa* levels within the estuary, because *M. aeruginosa* that is transported downstream originates in the reservoirs (Fetcho 2006, Fetcho 2008). **Under the Proposed Action, long-term reductions in the growth of nuisance and nuisance and/or noxious phytoplankton in the Hydroelectric Reach would reduce or eliminate the transport of algal cells and their associated toxins into the Klamath Estuary and would be beneficial.**

**Periphyton** *Under the Proposed Action, dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath Estuary.* As discussed for the lower Klamath River downstream of Iron Gate Dam, periphyton growth under the Proposed Action could be affected by increased nutrient availability following dam removal. However, since the long-term increase in nutrients in the Klamath Estuary would be a less-than-significant impact due to the implementation of TMDLs and KBRA (see Section 3.2.4.3.2.3 Nutrients – Lower Klamath Basin), it is likely that increases in periphyton growth would also be less than significant. Moreover, the biological significance of potential increases in periphyton biomass in the Klamath estuary is unknown due to uncertainty regarding the magnitude of increase in biomass required to generate a significant reduction in habitat quality for aquatic resources (NCRWQCB 2010a, Appendix 2). **Under the Proposed Action, long-term increases in the growth of nuisance periphyton in the Klamath Estuary would be a less than significant impact.**

### **Marine Nearshore Environment**

*Under the Proposed Action, dam removal and conversion of the reservoir areas could cause long-term increases in freshwater phytoplankton and periphyton species of concern.* The marine nearshore environment is not a suitable habitat for the freshwater phytoplankton species of concern (i.e., *Aphanizomenon flos-aquae*, *Anabaena flos-aquae*, *M. aeruginosa*) or the freshwater periphyton species of concern (i.e., *Cladophora*).

**While other marine algal species would occur in the marine near shore environment, because of short-term (< 2 years following dam removal) increases in both rates of sediment deposition (Section 3.2.4.3.2.2 Suspended Sediments – Lower Klamath Basin) and sediment-associated nutrient levels, (Section 3.2.4.3.2.3 Nutrients – Lower Klamath Basin) the marine nearshore environment would be a less-than-significant impact under the Proposed Action and are not expected to effect marine algal species.**

### **Keno Transfer**

*Implementation of the Keno Transfer could cause adverse effects to algae.* The Keno Transfer would be a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in new impacts on algae compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

### **East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause adverse effects to algae.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in algae conditions in the Klamath River. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

### **KBRA**

The KBRA, which is a component of the Proposed Action, encompasses several programs that could affect nuisance and/or noxious phytoplankton and periphyton blooms in the Klamath Basin through improvements to water quality, including:

- Phases I and II Fisheries Restoration Plans
- Wood River Wetland Restoration
- Water Use Retirement Program
- Interim Flow and Lake Level Program
- Upper Klamath Lake and Keno Nutrient Reduction

Beneficial effects of these projects on nutrients in the Klamath Basin would also be beneficial for nuisance and/or noxious phytoplankton and periphyton blooms.

*Implementation of restoration actions, programs, and/or plans presented in the KBRA would accelerate restoration actions currently underway throughout the Klamath Basin (with the exception of the Trinity Basin) including KHSA implementation (i.e., dam removal) and reduce nuisance and/or noxious phytoplankton blooms through their beneficial effects on flow and water quality. Specific projects are addressed below.*

#### Phase I Fisheries Restoration Plan

*Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms. Several ongoing resource management actions related to nutrient reductions may be amplified under the Phase I Plan (Section 3.2.4.3.2.10). Ongoing actions and types of new programs that could be implemented are described at a programmatic level for water quality. Anticipated benefits with respect to phytoplankton and periphyton are the same as those described for any Phase I project that would decrease nutrient levels in the Klamath Basin (Section 3.2.4.3.2.10).*

The improvements in nuisance and/or noxious phytoplankton and periphyton blooms generated by implementation of the Phase I Fisheries Restoration Plan would contribute to the long-term water quality improvements anticipated from hydroelectric facility removal. **Resource management actions implemented under the KBRA Phase I Fisheries Restoration Plan would accelerate long-term decreases in nutrients and would reduce the prevalence of nuisance and/or noxious phytoplankton and periphyton blooms in the Klamath Basin and would be beneficial.**

#### Phase II Fisheries Restoration Plan

*Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same impacts as Phase I. Anticipated benefits with respect to phytoplankton and periphyton are the same as those described for any Phase II project that would decrease nutrient levels in the Klamath Basin (Section 3.2.4.3.2.10). The improvements in nuisance and/or noxious phytoplankton and periphyton blooms generated by implementation of the Phase II Fisheries Restoration Plan would contribute to the long-term water quality improvements anticipated from hydroelectric facility removal. **Resource management actions implemented under the KBRA Phase II Fisheries Restoration Plan would accelerate long-term decreases in nutrients and would reduce the prevalence of nuisance and/or noxious phytoplankton and periphyton blooms in the Klamath Basin and would be beneficial.***

#### Wood River Wetland Restoration

*Implementation of Wood River Wetland Restoration could result in reduced nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. This project may decrease overall nutrient inputs to Upper Klamath Lake by inundating wetland (peat) soils and creating anaerobic conditions that support nutrient retention, particularly in the case of phosphorus (Snyder and Morace 1997). Specific options still need to be developed and studied as part of a separate*

project-level National Environmental Policy Act (NEPA) evaluation and Federal Endangered Species Act (ESA) consultation. The improvements in nuisance and/or noxious phytoplankton blooms generated by implementation of the Wood River Wetland Restoration Project would contribute to the long-term water quality improvements anticipated in the Klamath Basin from hydroelectric facility removal. **Under the KBRA, the Wood River Wetland Restoration Project would accelerate ongoing long-term improvements in nutrients and would reduce the prevalence of nuisance and/or noxious phytoplankton blooms in Agency Lake and would be beneficial.**

#### Water Use Retirement Program

*Implementation of the Water Use Retirement Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.* Anticipated benefits with respect to phytoplankton are the same as those described for this project under water quality, because it would decrease nutrient levels (i.e., decrease irrigation and fallowing of crop land and would decrease fertilizer [nutrient] inputs) in Upper Klamath Lake (see Section 3.2.4.3.2.10). The decreases in nutrient inputs to Upper Klamath Lake generated by implementation of the Water Use Retirement Program would contribute to the long-term water quality improvements anticipated from hydroelectric facility removal. **The KBRA Water Use Retirement Program would decrease long-term nutrients and would reduce the prevalence of nuisance and/or noxious phytoplankton blooms in Upper Klamath Lake and would be beneficial.**

#### Interim Flow and Lake Level Program

*Implementation of the Interim Flow and Lake Level Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.* Anticipated benefits with respect to phytoplankton are the same as those described for this project under water quality, because the project would decrease nutrient levels in the Upper Klamath Lake (see Section 3.2.4.3.2.10). The decreases in nutrient inputs to Upper Klamath Lake generated by implementation of the Interim Flow and Lake Level Program would contribute to the long-term water quality improvements anticipated from hydroelectric facility removal. **The KBRA Interim Flow and Lake Level Program would decrease long-term nutrients and would reduce the prevalence of nuisance and/or noxious phytoplankton blooms in Upper Klamath Lake and would be beneficial.**

#### Upper Klamath Lake and Keno Nutrient Reduction

*Implementation of the Upper Klamath Lake and Keno Nutrient Reduction Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.* KBRA (Appendix C-2, line 11) includes a program to study and reduce nutrient concentrations in the Keno Impoundment and Upper Klamath Lake in order to reduce dissolved oxygen and nuisance algal problems in both water bodies. Restoration actions to control nutrients have not been developed, and there are many possible actions that could require construction of treatment wetlands, construction of facilities, or chemical treatments of bottom sediment, among other possibilities. A nutrient reduction program in the Keno Impoundment and Upper

Klamath Lake would be designed to improve water quality (increasing seasonally low dissolved oxygen and reducing seasonal algal blooms) and fish passage through the Keno Impoundment in summer and fall months, however implementation of this nutrient reduction program will require future environmental compliance investigations and a determination on significance cannot be made at this time.

### **Alternative 3: Partial Facilities Removal of Four Dams**

This alternative proposes to remove enough of the material from each dam to allow the river to retain a free-flowing condition and volitional fish passage under all river stages and flow conditions. Some portion of each dam and much of the appurtenant infrastructure could remain, such as the dam foundations, power houses, buildings, tunnels, and pipes. All tunnel openings would be sealed with concrete, remaining buildings would be fenced, and all hazardous materials would be removed from the site. This alternative would include the transfer of the Keno Facility to the DOI and implementation of the KBRA. **The Partial Facilities Removal of Four Dams Alternative effects on algae would be the same as those described for the Proposed Action.**

### **Alternative 4: Fish Passage at Four Dams**

This alternative would provide upstream and downstream fish passage at the Four Facilities, but would not include implementation of the KBRA. The ongoing restoration actions, described in the No Action/No Project Alternative, would continue. The alternative would incorporate the prescriptions from the Departments of Interior and Commerce imposed during the FERC relicensing process, including fishway installation for both upstream and downstream migrations at all facilities and barriers to prevent juvenile salmonid entrainment into turbines. In addition to the fishways, there are a series of flow-related measures, including a condition that requires at least 40 percent of the inflow to the J.C. Boyle Reservoir to be released downstream. This alternative would limit generation of peaking power at J.C. Boyle Power Plant to one day per week as water supplies allow, and would include recreation flows one day a week. The flow requirements would reduce the overall power generation. **The Fish Passage at Four Dams Alternative effects on algae would be similar to those described for the No Action/No Project Alternative.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

#### **Phytoplankton**

*Removal of Copco 1 and Iron Gate Dams would eliminate lacustrine habitat in the two largest reservoirs in the Hydroelectric Reach and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms in the Hydroelectric Reach and subsequent transport to the Klamath River from downstream of Iron Gate Dam to the Klamath Estuary.* The removal of quiescent reservoir habitat in Copco 1 and Iron Gate Reservoirs would decrease or eliminate conditions in the Hydroelectric Reach that support excessive growth of blue-green algae. This change in suitable habitat would occur even if relatively high nutrient concentrations were to remain in the Klamath River system. The reduction in growth of nuisance and/or noxious phytoplankton in the Hydroelectric Reach would reduce the transport of algal

cells and their associated toxins to the Klamath River downstream of Iron Gate Dam and the Klamath Estuary. This would substantially reduce the production of toxins from these reservoirs that are harmful to animals and humans. **Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, long-term reductions in the growth of nuisance and/or noxious phytoplankton due to the elimination of the two largest reservoirs in the Hydroelectric Reach would decrease levels of nuisance and nuisance and/or noxious phytoplankton and concentrations of algal toxins from the Hydroelectric Reach to the Klamath Estuary, and would be beneficial.**

#### **Periphyton**

*Removal of Copco 1 and Iron Gate Dams and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Hydroelectric Reach, the Klamath River downstream of Iron Gate Dam, and the Klamath Estuary.* The effects of removing the two largest dams in the Hydroelectric Reach, Copco 1 and Iron Gate Dams, on nutrients under this alternative would be similar to removing all four dams under the Proposed Action (Section 3.2.4.3.5.3). Long-term increases in periphyton growth in the Klamath River downstream of Iron Gate Dam and in the Klamath Estuary could also occur and would be the same as those described under the Proposed Action. **Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, long-term increases in the growth of nuisance periphyton in the Hydroelectric Reach, the Klamath River downstream of Iron Gate Dam, and the Klamath Estuary would be a less than significant impact.**

#### **Yreka Pipeline Relocation and Recreational Facilities Removal**

*Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline.* Under Alternative 5, Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate, the water supply pipeline for Yreka will have to be relocated from its present location under Iron Gate Reservoir. Once the reservoir is drawn down, the existing pipeline would be exposed to higher velocity water flow, debris during flood events, and other potentially damaging situations that it is currently not exposed to at the bottom of the reservoir. To address this, the pipeline will be suspended from a pipe bridge across the Klamath River. **There will be no impact to algae in the Hydroelectric Reach or the Klamath River downstream of Iron Gate Dam as a result of the Yreka water supply pipeline relocation.**

#### **3.4.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequences Summary**

**No mitigation measures are proposed beyond those described for water quality protection in Section 3.2, Water Quality.**

#### **3.4.4.5 Summary of Impacts on Algae**

Table 3.4-1 summarizes the impacts of the Proposed Action and alternatives on algae.

**Table 3.4.1 Summary of Algae Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir</i></b>				
Dam removal activities could decrease the spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton in the area of analysis.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities could decrease the spatial extent, temporal duration, or biomass of nuisance periphyton in the area of analysis	2, 3, 5	NCFEC	None	NCFEC
<b><i>Hydroelectric Reach</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms in the Hydroelectric Reach.	2, 3, 5	B	None	B
Dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton in low-gradient channel margin areas within the Hydroelectric Reach.	2, 3	S	None	S
	5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could impact algae.	2, 3, 5	NCFEC	None	NCFEC
Construction and deconstruction activities would include the demolition of various recreation facilities that could affect algae.	2, 3, 5	NCFEC	None	NCFEC

**Table 3.4.1 Summary of Algae Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Klamath River Downstream of Iron Gate Dam</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach and subsequent transport into the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities could support long-term growth of nuisance periphyton such as <i>Cladophora spp.</i> downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream of Iron Gate Dam.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.	2, 3, 5	LTS	None	LST
<b><i>Klamath Estuary</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach and subsequent transport into the Klamath Estuary.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath Estuary.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath Estuary.	2, 3, 5	LTS	None	LTS

**Table 3.4.1 Summary of Algae Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Marine Nearshore Environment</i></b>				
Dam removal and conversion of the reservoir areas could cause long-term increases in freshwater phytoplankton and periphyton species of concern.	2, 3, 5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
<b><i>East and Westside Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of restoration actions, programs, and/or plans presented in the KBRA would accelerate restoration actions currently underway throughout the Klamath Basin and reduce nuisance and/or noxious phytoplankton blooms through their beneficial effects on flow and water quality.	2, 3	B	None	B
Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms.	2, 3	B	None	B
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same impacts as Phase I.	2, 3	B	None	B
Implementation of Wood River Wetland Restoration could result in reduced nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B

**Table 3.4.1 Summary of Algae Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Water Use Retirement Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B
Implementation of the Interim Flow and Lake Level Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms	2, 3	B	None	B

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## 3.5 Terrestrial Resources

### 3.5.1 Area of Analysis

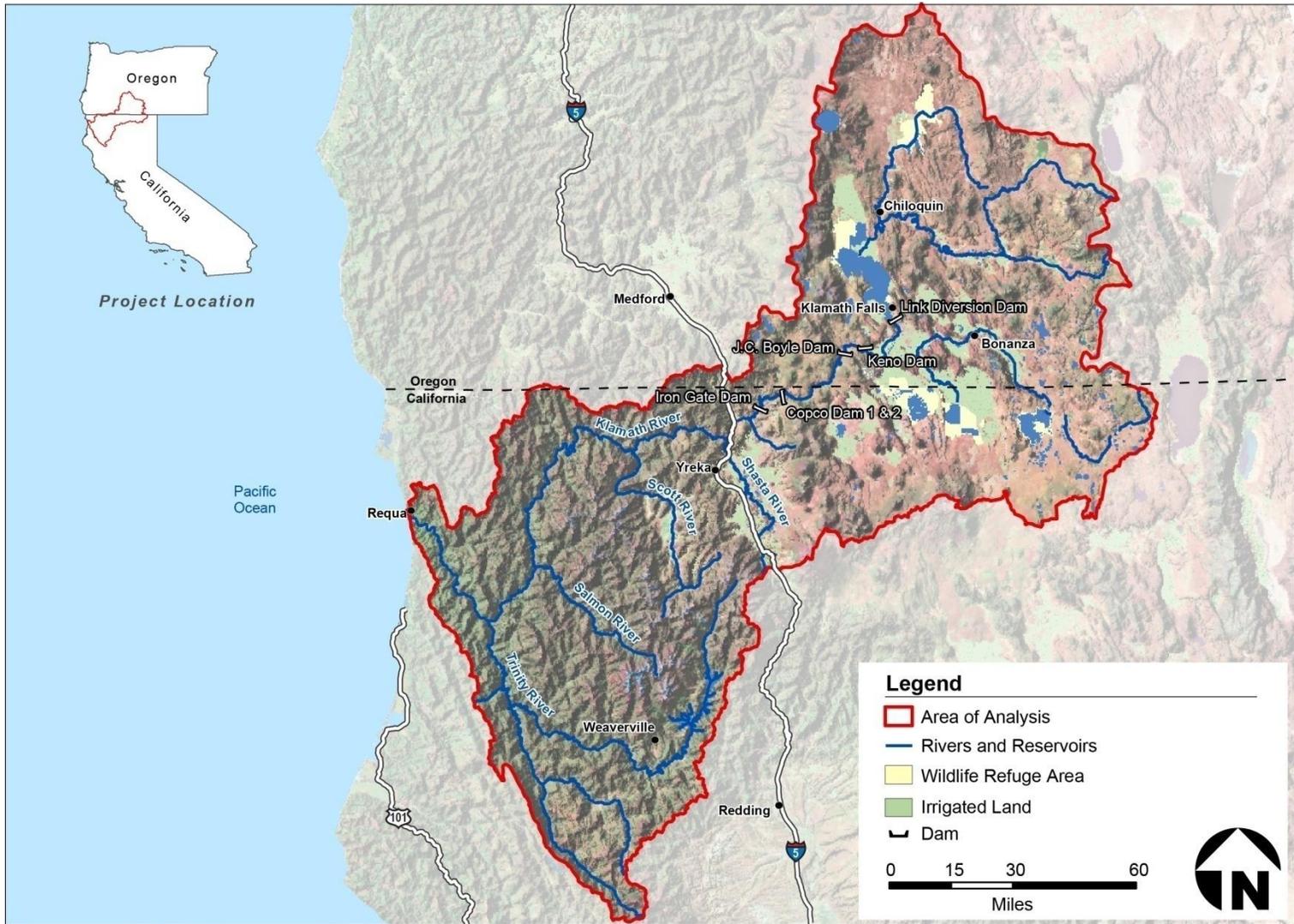
The Klamath Hydroelectric Settlement Agreement (KHSA) area of analysis or “project area” for terrestrial resources impacts includes vegetation communities and habitats of the Klamath River watershed currently influenced by the presence of the Four Facilities. Both the riparian vegetation communities downstream from these dams and the associated reservoirs upstream are influenced by the presence of the dams and have the potential to be affected by their removal. Thus, the project area extends along the Klamath River from Keno Dam to the Pacific Ocean and includes the river channel and riparian zone. Upland habitats occurring in construction areas are also included in the project area. This would include areas potentially affected by changes in land use and water supply patterns caused by the KHSA. In addition, the area of analysis includes areas where Klamath Basin Restoration Agreement (KBRA) actions would occur, particularly the Lower Klamath, Tule Lake, and Upper Klamath National Wildlife Refuges in the Klamath Basin National Wildlife Refuge System (Figure 3.5-1). Most KBRA actions would occur within the Upper Klamath Basin, but some would also occur in the Lower Klamath Basin (excluding the Trinity River watershed), and are included in the area of analysis.

### 3.5.2 Regulatory Framework

Terrestrial resources within the area of analysis are regulated by several federal, state, and local laws and policies, which are listed below.

#### 3.5.2.1 Federal Authorities and Regulations

- Endangered Species Act (7 USC § 136; 16 USC § 1531 et seq.)
- Fish and Wildlife Coordination Act (16 USC § 661 et seq.)
- Migratory Bird Treaty Act (16 USC § 703 et seq.)
- Clean Water Act (33 USC § 1251 et seq.)
- Executive Order 11990- Protection of Wetlands (42 FR 26961)
- Executive Order 11988- Floodplain Management (42 FR 26951)
- Bald and Golden Eagle Protection Act (16 CFR 668)
- National Wildlife Refuge Administration Act, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 USC § 668dd et seq.)
- United States Fish and Wildlife Service (USFWS) Biological Opinion
- Northwest Forest Plan
- Noxious Weed Act (7 USC § 2801 et seq.) and Executive Order 13112 Invasive Species (64 FR 6183)



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Figure 3.5-1. PacifiCorp Terrestrial Resources Study Area

### **3.5.2.2 State Authorities and Regulations**

- California Endangered Species Act (California Fish and Game Code [FGC] Section 2050 et seq.)
- Migratory Bird Protection (FGC Sections 3500 - 3705)
- Streambed Alterations (FGC Section 1600)
- Exotic Species Introductions (California Food and Agriculture Code Section 403)
- Oregon Endangered Species Act (Oregon Revised Statutes [ORS] 496 et seq.)
- Oregon Removal-Fill Law (ORS 196 et seq.)
- Oregon Noxious Weed Control Law (ORS 561)

### **3.5.2.3 Local Authorities and Regulations**

- Siskiyou County General Plan (1973)
- Humboldt County General Plan (1984)
- Del Norte County General Plan (2003)
- Klamath County Comprehensive Plan (2010)

### **3.5.3 Existing Conditions/Affected Environment**

The project area is within the Klamath Ecological Province and the Klamath Bioregion, characterized by forested mountains and a fairly wet climate that supports large river systems. Vegetation communities include wetter forests near the coast, including white fir and Douglas fir, transitioning to drier mixed conifer-pine and mixed conifer-fir in the mountain ranges of Siskiyou County. Sagebrush and interior valley vegetation communities also exist within lower elevation areas. In Oregon, the project area is within the East Slope Cascades and the West Slope Cascades eco-regions. In California, the project area is within the Southern Cascades and the Modoc Plateau physiographic provinces and is also within the Cascade-North Sierra floristic region of the California floristic province (Federal Energy Regulatory Commission [FERC] 2007).

The Klamath-Siskiyou mountain ranges are recognized for their biological diversity, with more than 3,000 known plant species, including 30 temperate conifer tree species, more than any other ecosystem in the world (California Department of Fish and Game [CDFG] 2006). The Klamath River Canyon is a mosaic of pine, oak, juniper, and mixed conifer forest communities, with ponderosa pine and Oregon white oak being the dominant tree species. Riparian habitats are dominated by oak, birch, and white alder (FERC 2007).

#### **3.5.3.1 Vegetation Communities and Habitat Types**

The majority of the information in this section was obtained from the PacifiCorp Final Technical Report (FTR) on terrestrial resources prepared for the Klamath Hydroelectric Project (PacifiCorp 2004a). The “primary study area” for the terrestrial resources technical report included the Klamath River from the Link River Dam to the Shasta River and the area within 0.25 mile of all PacifiCorp facilities, reservoirs, and river reaches. PacifiCorp also identified a “secondary study area” that included the area between the canyon rims from J.C. Boyle Dam to the eastern end of Copco Reservoir and all PacifiCorp-owned lands near the PacifiCorp facilities (Figure 3.5-2).

“Study area” in this section refers to the area covered by the terrestrial resources FTR, whereas “project area” refers to the area of analysis defined in Section 3.5.1. The terrestrial resources FTR study area does not include the Klamath River downstream of Shasta River, and information on vegetation communities is not available to the level of detail presented in the terrestrial FTR for the downstream reaches of the Klamath River.

Unless specified, information on terrestrial resources in the lower Klamath River was obtained from the following sources:

- Draft Hydrology, Hydraulics, and Sediment Transport Studies for the Secretary’s Determination on Klamath River Dam Removal and Basin Restoration (Greimann et al 2010), which discusses the general physical characteristics of the Klamath River reaches;
- *Green Diamond Resource Company Aquatic Habitat Conservation Plan and Candidate Conservation Agreement with Assurances* (Green Diamond Resource Company 2006), which provides information on habitat and occurrence of southern torrent salamander and tailed frog in the lower Klamath River reaches;
- *Mid-Klamath Subbasin Fisheries Resource Recovery Plan* (Karuk Tribe of California 2003), which covers the Klamath River between Iron Gate Dam and the Trinity River;
- *The Lower Klamath River Sub-Basin Watershed Restoration Plan* (Yurok Tribal Watershed Restoration Program 2000), which covers the Klamath River between the Trinity River and the Pacific Ocean; and
- *Klamath River Estuary Wetlands Restoration Prioritization Plan* (Yurok Tribe Environmental Program 2009), which covers the Klamath River Estuary.

The study area for the PacifiCorp FTR includes 11 river reaches of the Klamath River upstream from the Shasta River, as listed in Table 3.5-1.

**Table 3.5-1. River Reaches in the PacifiCorp Study (2004a)**

River Reach	River Mile
Link River	253.3 to 254.8
Keno Impoundment	233.3 to 253.3
Keno Canyon	228.2 to 233.3
J.C. Boyle Reservoir	224.6 to 228.2
J.C. Boyle Bypass	220.2 to 224.6
J.C. Boyle Peaking Reach	203.9 to 220.2
Copco 1 Reservoir	198.7 to 203.9
Fall Creek	0 to 1.5*
Copco 2 Bypass	196.8 to 198.7
Iron Gate Reservoir	188.9 to 196.8
Iron Gate-Shasta	176.8 to 188.9

Source: PacifiCorp 2004a

Notes:

\*River Mile of Fall Creek

Eight vegetation cover types were mapped by PacifiCorp (2004a), with each cover type further sub-classified. Appendix G includes a series of 18 vegetation maps covering the PacifiCorp study reaches. These figures and a description of each cover type are included in Appendix G. Table 3.5-2 lists the major cover types and their relative distribution and acreage among the river reaches and Table 3.5-3 lists the sub-classifications of each cover type. PacifiCorp considered Copco 1 and Copco 2 as one reservoir during their study, and collectively referred to them as Copco reservoir (PacifiCorp 2004a). The methods used by PacifiCorp to map vegetation communities in the study area are summarized in Appendix H.

As shown in Table 3.5-2, upland tree habitat occupies 54 percent of the study area and is the most abundant cover type in all locations except at Keno Impoundment and along the Klamath River, from the Iron Gate development to the Shasta River, where aquatic and wetland cover types dominate at Keno Impoundment and upland herbaceous cover types dominate at Klamath River from Iron Gate Dam to Shasta River. Upland shrub habitat occupies 9.5 percent of the study area and is particularly abundant near the Copco 2 bypass reach. Upland herbaceous habitat occupies 9.2 percent of the study area and is common along the Klamath River between the Iron Gate development and the Shasta River (25.5 percent) and at the Iron Gate (21 percent) and Copco Reservoirs (16 percent).

Barren habitat, consisting of rock talus (rubble at the bottom of a slope or cliff) or exposed rock, occupies 1.7 percent of the study area. Agricultural and developed habitat (excluding general grazing allotment areas) occupies 11 percent of the study area, primarily along Link River, at Keno Impoundment, and along the Klamath River from Iron Gate development to the Shasta River. Developed and agricultural lands dominate the area near Keno Impoundment (48 percent), and consist primarily of pasture or irrigated hayfields.

Wetland and riparian vegetation in the project area is influenced by water flow and level in the river and reservoirs and sediment flow and deposition through the system. Wetland habitat consists of emergent marsh, shrub-scrub wetlands, and forested wetlands and occupies only 4.2 percent of the study area. Wetland habitat occurs primarily at the Keno Impoundment (19.5 percent of wetland habitat in the study area), the J.C. Boyle Reservoir (5.5 percent of wetland habitat), and Copco Reservoir (1.3 percent of wetland habitat). Iron Gate Reservoir contains 60 acres of wetland habitat, or only 0.9 percent of total wetland habitat. Aquatic habitat (open water habitat largely devoid of vegetation) occupies 9.6 percent of the study area, with the highest percentage (22.4 percent or 2,136.6 acres) occurring at the Keno Impoundment.

Riparian habitat occurs along the river and reservoir shorelines in some areas and consists of deciduous, shrub, and grassland vegetation. Riparian habitat occupies only 1.1 percent of the study area. Along the river reaches, reed canarygrass is a common riparian plant species in high flow areas. Reed canarygrass may outcompete other riparian species due to its ability to better use abundant nutrients and withstand frequently fluctuating peaking flows. Along the banks above high flow areas, most river reaches have even distribution

of coyote willow/reed canarygrass/colonial bentgrass, perennial ryegrass, and Oregon ash/colonial bentgrass/woolly sedge (PacifiCorp 2004a).

Wetland and riparian vegetation occurs to varying degrees along the project reservoirs. The majority of this habitat is limited to small patches in protected locations and near inlets/tributaries. However, several large wetland and riparian habitats are associated with the Keno Impoundment and J.C. Boyle Reservoir. Both the Copco Reservoir and Iron Gate Reservoir have steep slopes that generally lack extensive, near-shore riparian and wetland habitat. Emergent vegetation within the wetland and riparian communities of the reservoirs includes sedge, rush, bentgrass, bulrush, and cattail. Coyote willow is the dominant shrub layer of the wetlands at reservoirs in the project area (PacifiCorp 2004a).

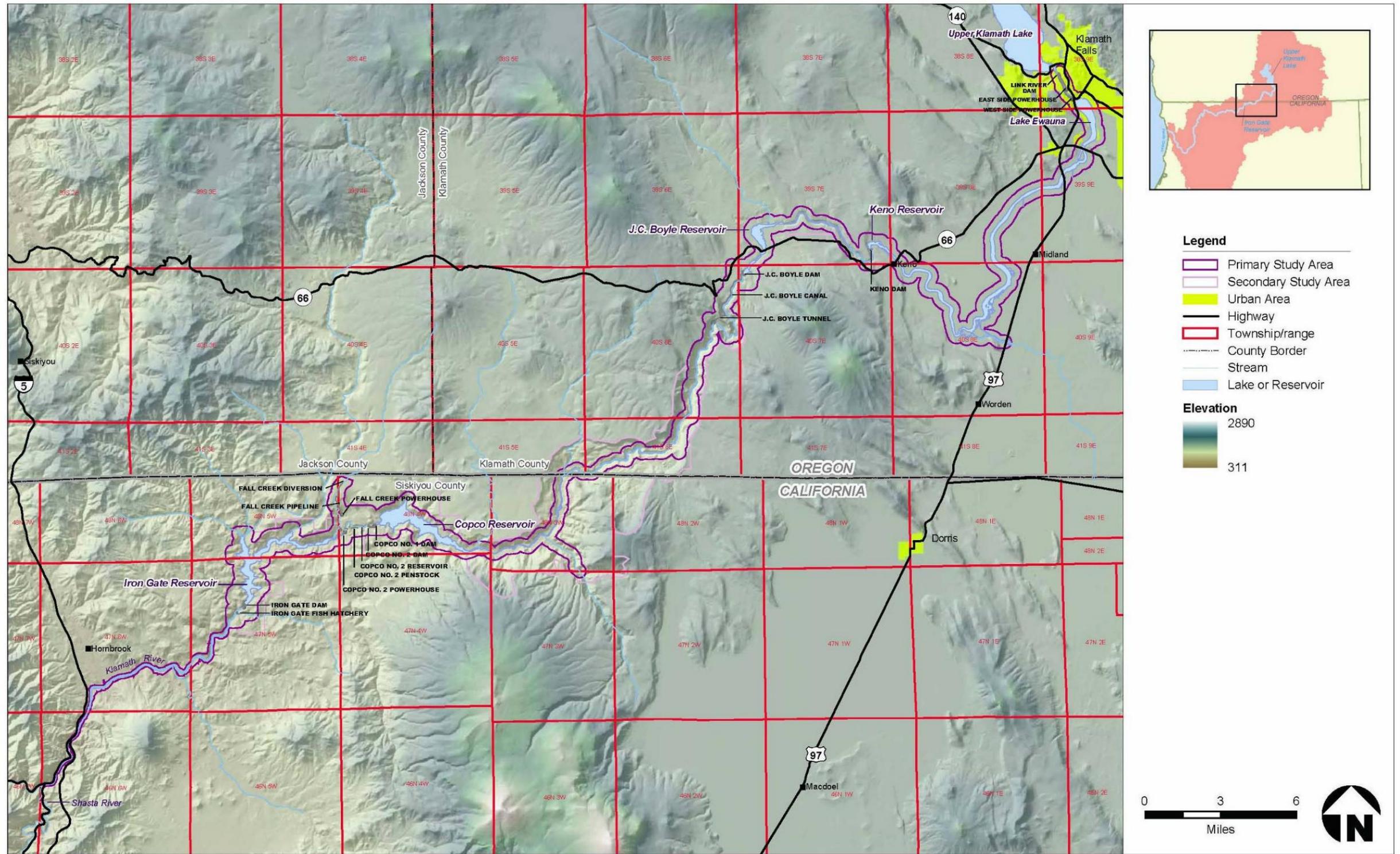
### **Noxious Weeds and Invasive Plant Species**

During biological surveys conducted in 2002, 2003, and 2004, 17 species of noxious weeds were identified within the study area. The noxious weed inventory fieldwork emphasized areas around PacifiCorp facilities, roads, transmission lines, and at reservoirs, riverine shorelines, and riparian areas from the Link River to the mouth of the Shasta River. In addition, data from resource agencies on noxious weeds was obtained to supplement surveys for a 0.25-mile wide (0.4-km-wide) buffer around PacifiCorp structures, reservoirs, and river reaches (PacifiCorp 2004a).

During the surveys, the following 17 noxious weed species were found in the study area:

- Bull thistle (*Cirsium vulgare*)
- Canada thistle (*Cirsium arvense*)
- Cheatgrass (*Bromus tectorum*)
- Diffuse knapweed (*Centaurea diffusa*)
- Dalmatian toadflax (*Linaria dalmatica*)
- Dyer's woad (*Isatis tinctoria*)
- Hoary Cress (*Cardaria draba*)
- Mediterranean sage (*Salvia aethiopsis*)
- Medusahead (*Taeniatherum caput-medusae*)
- Perennial pepperweed (*Lepidium latifolium*)
- Puncture vine (*Tribulus terrestris*)
- Russian knapweed (*Acroptilon repens*)
- Scotch thistle (*Onopordum acanthium*)
- Scotch broom (*Cytisus scoparius*)
- Spiny cocklebur (*Xanthium spinosum*)
- St. John's wort (*Hypericum perforatum*)
- Yellow starthistle (*Centaurea solstitialis*)

In addition to the species listed above, reed canarygrass is an invasive plant species found throughout the project area.



W:\REPORTS\SIUS Dept of Interior\_Klamath\Figures\Figure 3.5-1 PacifiCorp Terrestrial Resources Study Area TC 11/24/10

Figure 3.5-2. PacifiCorp Terrestrial Resources Study Area (PacifiCorp 2004a)

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**Table 3.5-2. Distribution of Vegetation Cover Types Mapped in 2002 in the PacifiCorp Study Area (2004a)**

Vegetation Cover Type	Iron Gate-Shasta	Iron Gate Reservoir	Copco 2 Bypass	Fall Creek	Copco Reservoir	J.C. Boyle Peaking Reach	J.C. Boyle Bypass	J.C. Boyle Reservoir	Keno Canyon	Keno Impoundment	Link River	Grand Total
<b>Upland Tree</b>												
Subtotal	135.1	3,472.5	714.4	692.1	3,159.0	15,400.9	1,465.2	1,136.8	1,599.4	304.6	237.3	28,316.9
Percent of Reach	9.7%	52.7%	59.4%	74.6%	51.2%	75.3%	70.6%	59.1%	78.0%	3.2%	42.2%	53.6%
<b>Upland Shrub</b>												
Subtotal	205.8	478.4	251.7	102.6	791.2	1,851.2	285.9	120.0	259.3	607.5	88.7	5,042.2
Percent of Reach	14.8%	7.3%	20.9%	11.1%	12.8%	9.1%	13.8%	6.2%	12.6%	6.4%	15.8%	9.5%
<b>Upland Herbaceous</b>												
Subtotal	353.5	1,383.8	80.4	28.7	962.5	1,675.8	109.6	171.6	24.7	46.8	3.4	4,840.6
Percent of Reach	25.5%	21.0%	6.7%	3.1%	15.6%	8.2%	5.3%	8.9%	1.2%	0.5%	0.6%	9.2%
<b>Wetland</b>												
Subtotal	0.6	60.1	4.5	13.5	79.2	89.9	14.1	105.1	5.1	1,860.8	5.6	2,238.5
Percent of Reach	0.0%	0.9%	0.4%	1.5%	1.3%	0.4%	0.7%	5.5%	0.2%	19.5%	1.0%	4.2%
<b>Aquatic</b>												
Subtotal	218.5	964.9	10.0	0.9	999.6	277.1	45.5	299.4	92.3	2,136.6	32.3	5077.1
Percent of Reach	15.8%	14.7%	0.8%	0.1%	16.2%	1.4%	2.2%	15.6%	4.5%	22.4%	5.7%	9.6%
<b>Riparian</b>												
Subtotal	151.1	41.8	23.1	39.9	25.6	228.3	32.1	0.8	20.3	0.8	33.9	597.5
Percent of Reach	10.9%	0.6%	1.9%	4.3%	0.4%	1.2%	1.6%	0.0%	1.0%	0.0%	6.0%	1.1%
<b>Barren</b>												
Subtotal	17.4	63.1	82.6	38.3	61.4	545.0	96.0	10.2	12.3	0.0	0.0	926.2
Percent of Reach	1.3%	1.0%	6.9%	4.1%	1.0%	2.7%	4.6%	0.5%	0.6%	0.0%	0.0%	1.7%
<b>Agricultural/ Developed</b>												
Subtotal	304.4	120.3	35.5	11.7	96.3	379.6	28.0	80.7	37.2	4,575.8	161.0	5,830.5
Percent of Reach	22.0%	1.8%	3.0%	1.3%	1.6%	1.8%	1.3%	4.2%	1.8%	48.0%	28.6%	11.0%
<b>Total Acres</b>	<b>1,386.4</b>	<b>6,585.1</b>	<b>1,202.2</b>	<b>927.7</b>	<b>6,174.7</b>	<b>20,447.8</b>	<b>2,076.1</b>	<b>1,924.5</b>	<b>2,050.6</b>	<b>9,532.9</b>	<b>562.1</b>	<b>52,869.5</b>
<b>Percent of Total</b>	<b>2.6%</b>	<b>12.5%</b>	<b>2.3%</b>	<b>1.8%</b>	<b>11.7%</b>	<b>38.7%</b>	<b>3.9%</b>	<b>3.6%</b>	<b>3.9%</b>	<b>18.0%</b>	<b>1.1%</b>	<b>100.0%</b>

**Table 3.5-3. Sub-Classification of Vegetation Cover Types Mapped in 2002 in the PacifiCorp Study Area (2004a)**

<p><b>Upland Tree Habitats</b> Montane Hardwood Oak Montane Hardwood Oak-Conifer Montane Hardwood Oak-Juniper Juniper Mixed Conifer Lodgepole Pine Ponderosa Pine</p>	<p><b>Wetland Habitats</b> Palustrine Emergent Palustrine Scrub-Shrub Palustrine Forested Palustrine Aquatic Bed</p>	<p><b>Barren Habitat</b> Rock Talus Exposed Rock</p>
<p><b>Upland Shrub Habitats</b> Mixed Chaparral Rabbitbrush Sagebrush</p>	<p><b>Riparian Habitats</b> Riparian Grassland Riparian Shrub Riparian Deciduous Riparian Mixed Deciduous-Coniferous</p>	<p><b>Agricultural/Developed</b></p>
<p><b>Upland Herbaceous Habitats</b> Annual Grassland Perennial Grassland</p>	<p><b>Aquatic Habitat</b> Riverine and Lacustrine Unconsolidated Bottom Riverine and Lacustrine Unconsolidated Shore</p>	

In addition to these species, other invasive species occur throughout the project area, including the middle and lower Klamath River reaches. These species include reed canarygrass, Japanese and Himalayan knotweed, and Himalayan blackberry (personal communication with J. Hamilton, USFWS, January 7, 2011). In addition, poison hemlock (*Conium maculatum*) is a common noxious weed present along the shores of Keno Impoundment (personal communication with R. Larson, USFWS, March 13, 2011).

During the PacifiCorp vegetation surveys, cheatgrass, yellow starthistle, and medusahead were the most widespread noxious weed species across all 11 of the study area sections. Bull thistle and Canada thistle were also pervasive in the study area (PacifiCorp 2004a). Noxious weeds occurred in 62 percent of the sampled riparian/wetland sites. Many of the weed species occur in uplands or near the riparian/upland interface. In general, noxious weeds were found to be abundant where ground disturbance had occurred. The spread of these weeds likely occurs as a result of vehicles or machinery spreading weed seeds and propagules in areas where bare soil is exposed. Ground disturbance has resulted from various land uses and maintenance activities in the study area, including maintenance of power plants, transmission lines, flowlines, recreation sites, and roads. The abundance of weeds at Keno Impoundment may be the result of agricultural development and livestock grazing. In addition, residential and commercial developments contribute to the spread of these invasive plants (PacifiCorp 2004a).

In addition to the surveys conducted by PacifiCorp (2004a), vegetation surveys were conducted around the perimeter of J.C. Boyle, Copco, and Iron Gate Reservoirs in November 2009 and July 2010 (United States Department of the Interior [DOI] 2011). These surveys confirmed the presence of yellow starthistle and medusahead at Copco and Iron Gate Reservoirs, but did not find these species at J.C. Boyle Reservoir. However, large stands of reed canarygrass were documented along the eastern shoreline of the northern section of the J.C. Boyle Reservoir.

### **Upper Klamath River**

The Upper Klamath River includes the areas upstream of J.C. Boyle Reservoir. Findings of vegetation and wildlife surveys conducted for the PacifiCorp study (2004a) in the Link River Reach, Keno Impoundment, and Keno Canyon Reach are summarized below. As described in Section 3.5.1, the area of analysis for this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) also includes areas of the Upper Klamath Basin where KBRA actions would occur, particularly those areas associated with the National Wildlife Refuges (NWRs). Lower Klamath, Tule Lake, and Upper Klamath NWRs would be most directly affected by the KBRA (USFWS 2010). These NWRs are managed to provide habitat and food for waterfowl. As such, they consist largely of seasonal and permanently flooded marshes with emergent and submergent wetland vegetation. In addition, a large amount of croplands surrounding these wetlands provide food for wintering waterfowl.

### **Link River Reach**

The Link River is the headwaters reach of the Klamath River just above Lake Ewauna near the city of Klamath Falls. The Link River Dam and its reservoir (Upper Klamath Lake) are not part of the project area for the Klamath Hydroelectric Settlement Agreement, but are part of the area that would be affected by the KBRA.

In addition to being affected by river hydrology and seepage from canals and penstocks, user-created trails and encampments and maintenance activities have adversely affected riparian vegetation along the Link River reach through ground disturbance that precludes vegetation growth. The riparian vegetation along the right bank is structurally diverse and relatively continuous, while the vegetation on the left bank is more disturbed and patchy. Vegetation in the reach has an abundance of introduced woody species, including apple, plum, and elm (PacifiCorp 2004a).

### **Keno Impoundment**

Keno Impoundment is not part of the project area for the Klamath Hydroelectric Settlement Agreement, but is part of the area that would be affected by the KBRA. Keno Impoundment has a surface area of 2,475 acres. As with the other project reservoirs, wetlands at the Keno Impoundment are influenced by the hydrology of the reservoir. However, the water level at the Keno Impoundment fluctuates less than at the other reservoirs, and the wetlands occur in naturally low-lying areas that probably supported significant wetlands before formation of the Keno Impoundment (PacifiCorp 2004a).

The wetland vegetation at Keno Impoundment is more diverse than at any other project reservoir, with the most abundant wetland vegetation types dominated by hardstem bulrush and broadfruted bur-reed. Applegate's milk-vetch (*Astragalus applegatei*), a federally endangered and Oregon endangered species, was documented during surveys at Keno Impoundment (PacifiCorp 2004a). See Table 3.5-4 in Section 3.5.3.4 for a discussion of special-status species that occur in the project area. The coyote willow vegetation type, which is dominated by coyote willow in the shrub layer, is not common at the Keno Impoundment, but occurs in dense, small stands in low-lying pastures protected by levees. The tops of the levees are dominated by noxious weed species, such as poison hemlock and Canada thistle (PacifiCorp 2004a). The noxious weed, perennial pepperweed (*Lepidium latifolium*), also occurs in wetlands along the Keno Impoundment and is likely to be present on private lands (personal communication with R. Larson, [USFWS], March 13, 2011).

### **Keno Canyon Reach**

The Keno Canyon reach has steep slopes with a narrow shoreline. The reach experiences low flows in the growing season, resulting in the growth of intact, undisturbed riparian grass vegetation dominated by reed canarygrass. Willow reproduction in the Keno Canyon reach is lacking, and existing willow trees are in a state of decay with large horizontal branches broken because of rot or chewing by beavers (PacifiCorp 2004a). There is a mostly intact transition from the riparian zone to the upland zone that consists primarily of shrub vegetation on the canyon slopes. Some riparian areas are disturbed from recreational use by fishermen.

### **J.C. Boyle Reservoir**

The water level in J.C. Boyle Reservoir is controlled at the J.C. Boyle powerhouse and by inflows from upstream irrigation. As a result, there are wide mudflats exposed on a daily basis in some portions of the reservoir, and there is no woody riparian/wetland vegetation immediately along the shoreline. In spite of water fluctuations, the wetland vegetation at the reservoir is diverse and largely undisturbed, with patches of dense emergent marsh in low-gradient areas. Areas that are fenced and protected, such as at the mouth of Spencer Creek, support high quality woody and herbaceous riparian and wetland vegetation. In contrast, wetlands along the northwest shoreline are highly disturbed by cattle grazing (PacifiCorp 2004a).

### **J.C. Boyle Bypass and Peaking Reaches**

The J.C. Boyle bypass reach generally has a stable water level with low flows, supporting reed canarygrass as well as sedges and willows. A canal with long steep slopes covered by boulders runs along the bypass reach. At the end of the canal is a spillway below which vegetation is lacking due to scour from periodic high flows (PacifiCorp 2004a). In both the J.C. Boyle bypass and peaking reaches, Oregon oak and Oregon ash are dominant tree species, with arroyo willow and coyote willow also common (PacifiCorp 2004a).

Approximately two-thirds of the riparian habitat in the J.C. Boyle bypass reach is riparian grassland, which is predominately reed canarygrass (Administrative Law Judge 2006). The high prevalence of reed canarygrass in this area is a result of current low flows. Project operations have adversely affected riparian resources in both the J.C. Boyle bypass and peaking reaches by supporting the perpetuation of reed canarygrass and by affecting the structure, size, and nature of depositional features (Administrative Law Judge 2006).

The J.C. Boyle peaking reach has a generally lower gradient and supports large stands of shrub and tree-dominated riparian vegetation. Wetland habitat occurs on wide benches above the banks that are used for hay production and pasture. Some parts of this reach are accessible to cattle grazing. Many of these wide terraces along this reach are used as large irrigated pastures. Irrigation has created vertical and horizontal discontinuity in the riparian vegetation along the river and reduced cover of native herbaceous and woody riparian vegetation. As a result, exotic and non-native invasive species such as Himalayan blackberry, whitetop, and non-native pasture grasses, have become established (PacifiCorp 2004a).

### **Copco 1 and Copco 2 Reservoirs**

PacifiCorp considered Copco 1 and Copco 2 as one reservoir during their study, and collectively referred to them as Copco Reservoir (PacifiCorp 2004a). Along the shorelines of Copco Reservoir, wetlands are highly disturbed in many areas by a variety of land uses, including livestock grazing and recreational fishing. At the shoreline, the low herbaceous vegetation is heavily grazed and has an abundant “weedy” component of yellow starthistle and medusahead in many locations. Willow habitat is limited to areas

where the steep banks of the reservoir shorelines are eroding to form benches upon which coyote willow has become established (FERC 2007).

During invasive plants surveys conducted in November 2009 and July 2010, yellow starthistle was only observed growing on the northern side of the reservoir, where it occurs in dense stands in some areas (DOI 2011a).

### **Copco 2 Bypass Reach**

In the Copco 2 Bypass Reach, a dense riparian community of white alder dominates, likely prohibiting shade-intolerant coyote willow and reed canarygrass in this reach. Low river flows and water levels in this reach have provided substrate for the establishment of riparian and wetland vegetation consisting of native and non-native hydrophilic herbaceous species that form a relatively sparse herb layer under the dense white alder canopy (PacifiCorp 2004a).

### **Iron Gate Reservoir**

Wetland and riparian areas along the shorelines of Iron Gate Reservoir are highly disturbed by livestock grazing. The reservoir has moderately steep slopes. Along the larger tributaries of Jenny, Scotch, Dutch, and Beaver Creeks, some tree-dominated riparian habitat occurs, and consists of Oregon ash, Oregon oak, and white alder. Shining willow also occurs at Iron Gate Reservoir.

During invasive plant surveys conducted in November 2009 and July 2010, yellow starthistle was documented as prolific in the dry upland slopes and near roadsides around Iron Gate Reservoir (DOI 2011a).

### **Fall Creek Reach**

Fall Creek is a tributary to the Klamath River just upstream from Iron Gate Reservoir. In the Fall Creek Reach, there is a unique abundance of conifers in the riparian zone, and coyote willow is absent. Four riparian/wetland vegetation types occurring along Fall Creek include Oregon ash/western birch, Oregon ash/Douglas' spiraea, white alder, and ponderosa pine/Douglas fir/western serviceberry, which typically occurs in drier and more upland areas (PacifiCorp 2004a).

### **Middle Klamath River**

The Mid-Klamath subbasin includes the lower Mid-Klamath and the upper Mid-Klamath. The upper Mid-Klamath includes all watersheds from Iron Gate Reservoir downstream to Seiad Creek, excluding the Scott and Shasta Rivers, while the lower Mid-Klamath includes the mainstem of the Klamath River and all watersheds from Grinder Creek downstream to Weitchpec, excluding the Salmon River (Karuk Tribe of California 2003).

The upper Mid-Klamath subbasin has an interior montane climate. Vegetation within the Klamath Range is primarily mixed conifer/hardwood forests while vegetation in the Great Basin consists of chaparral, sagebrush, and juniper woodland. Riparian habitat in the upper Mid-Klamath is affected by a variety of land management practices, including grazing and irrigated agricultural lands, dams and diversions, gravel mining, and roads (Karuk Tribe of California 2003).

The Klamath River from Iron Gate Dam to Shasta River contains the highest percentage (10.9 percent; Table 3.5-2) of riparian habitat in the PacifiCorp (2004a) study area. In most of the reach, the floodplain is mostly restricted to narrow terraces between the in-channel alluvium and steeper slopes or higher elevation surfaces. The narrow terraces typically support coyote willow, shining willow, Oregon ash, and Oregon oak. Cattle grazing in many areas have degraded these stands, as well as some of the coyote willow stands growing on in-channel bars. Even so, woody riparian vegetation is more abundant in this reach than in any other reach of the study area, although tree-dominated stands are typically much smaller in area than in other reaches, due to recreation development on the larger floodplain surfaces between Iron Gate Dam and Cottonwood Creek. Reed canarygrass is not common along the river downstream of Iron Gate Dam for unknown reasons (PacifiCorp 2004a).

Langley Falls is along the middle Klamath River at Gottsville, where several tributaries enter from the north and form a large alluvial fan complex that constricts the river. At the lower end of the Middle Klamath River, Seiad Valley lies where large alluvial fans from Seiad Creek, Little Grider Creek and Grider Creek form a wider alluvial valley with large unvegetated gravel bars (Griemann et al 2010).

The lower Mid-Klamath subbasin has a coastal-influenced, Pacific-maritime climate, grading to interior climates of the Klamath Range. The Klamath River and tributaries in this portion of the project area generally have steep slopes and are vegetated with mixed hardwood/conifer forests with mixed conifer evergreen and true fir forests upslope. Riparian habitat in the lower Mid-Klamath has been altered primarily by timber harvest, gravel mining, roads, and fire suppression (Karuk Tribe of California 2003). Several reaches of the middle Klamath River in this area have been extensively mined. Unvegetated gravel bars are common. Major tributaries include the Salmon River, Trinity River, Bluff Creek, Camp Creek and Ukonom Creek (Griemann et al 2010). The middle Klamath River runs through both the Klamath National Forest and the Six Rivers National Forest.

#### **Lower Klamath River and Klamath River Estuary**

The Lower Klamath subbasin extends from the confluence of the Klamath and Trinity Rivers to the Pacific Ocean. The coast redwood groves are unique to this part of the project area. Vegetation types are similar to that of the lower Mid-Klamath subbasin, with mixed hardwood/conifer forests dominant. However, based on habitat surveys conducted in 1996 and 1997, conifers comprise less than one third of the riparian canopy in lower Klamath tributaries. Riparian areas are dominated by deciduous trees including red alder, which are less able to stabilize streambanks than coniferous trees. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid to upper slope hardwood, with Pacific madrone occurring as a minor stand component on drier sites (Green Diamond Resource Company 2006). Grazing, timber harvest, and roads have degraded riparian habitat in the Lower Klamath (Yurok Tribal Watershed Restoration Program 2000).

The Klamath River estuary lies where the Klamath River enters the Pacific Ocean. A mile-long spit extends from the south shore of the estuary. The estuary is shallow and is about 2,500 feet long and up to 1,000 feet wide. The river channel in the estuary changes positions often as a result of large flood events, during which most of fine-grained sediments are flushed to the ocean (DOI 2010).

The estuary consists of several wetland complexes, which have been altered to varying degrees from their historical condition. Large wetlands have been converted into grass pastures for cattle or sown for hay, and hydrology has been altered for the construction of roads including U.S. Highway 101. In addition, many tributaries to the estuary have been straightened and lack connection to the floodplain (Yurok Tribe Environmental Program 2009). The lower channel of the estuary was extensively cleared of snags and large woody debris at the turn of the century for commercial gillnetting and navigational purposes (Green Diamond Resource Company 2006).

Freshwater emergent wetland vegetation dominates the estuary. The estuary also supports a number of salt-tolerant species. Invasive species, including reed canarygrass (*Phalaris urundinacea*), Himalayan blackberry (*Rubus procerns*), and common reed (*Phragmites australis*) also occur, particularly in areas of disturbed soil. Beaver activity in the estuary helps to create and maintain wetland conditions through the building and maintenance of beaver dams (Yurok Tribe Environmental Program 2009).

#### **3.5.3.2 Culturally Significant Species**

Many plants, especially wetland plants, in the project area are culturally important to Indian Tribes in the Klamath River region for food and basketry (Larson and Brush 2010). Among these plants are ipos (roots of *Carum oregonum*), desert parsley (*Lomatium canbyi*), camas bulbs, cattail roots, and wocas (yellow pond lily seeds). Wild celery, wild parsley, and wild rhubarb were gathered along with hazelnuts, acorns, and pine nuts and the fruits of chokecherries, serviceberries, Klamath plums, elderberries, blackberries, gooseberries, wild grapes, and huckleberries (FERC 2007).

All of the tribes in the Klamath basin collect materials from along the Klamath River for making baskets that are used in various ceremonies. Willows (*Salix spp.*) and ferns (*Pteridophyta*) are both common species used in making basketry and regalia, and are important medicinal plants used in healing and ceremony (Yurok Tribe Environmental Program 2009). Tribes commonly collect young willow shoots from gravel bars within riparian areas. Other plant materials used in basket-making include pine, redwood and spruce roots, and grapevine (FERC 2007).

#### **3.5.3.3 Wildlife**

The project area supports a large number and diversity of wildlife species. During PacifiCorp surveys conducted in 2002 and 2003, 225 vertebrate wildlife species were detected or confirmed from other sources as occurring in the study area, including five amphibians, 16 reptiles, 174 birds, and 30 mammal species (PacifiCorp 2004a).

### **Amphibians**

Amphibians and some reptiles are reliant on aquatic, wetland, and riparian habitat. PacifiCorp conducted an inventory of amphibians and reptiles in 2002 and 2003 to document species occurrence and identify important habitats and sites for amphibians and reptiles within the same study area that was used for the community mapping (PacifiCorp 2004a). The focus of the study included aquatic, wetland, and riparian habitats at the reservoirs and within a 0.25 mile buffer around river reaches from Link River to Shasta River. During the surveys, biologists searched suitable aquatic and riparian habitat for adults, larvae, and egg masses, turning rocks, litter, and other cover objects and using nets to catch individuals (PacifiCorp 2004a). Amphibian and reptile surveys were also conducted in suitable upland areas and complemented surveys conducted during previous investigations. Riverine surveys for amphibians found only two amphibian species, Pacific giant salamander and Pacific chorus frog. No amphibians were found during upland surveys. Based on the 2002 and 2003 surveys as well as previous investigations, five amphibian species are known to occur in the Klamath River study area: long-toed salamander, bullfrog, Pacific chorus frog, western toad, and Pacific giant salamander. All of these species are generally restricted to ponds or other still-water habitat, except for the Pacific giant salamander, which is a stream-dwelling species. Results of the PacifiCorp study indicate that reservoirs in the study area appear to provide only marginal breeding habitat for native pond-breeding amphibians. Fluctuating water levels and predation by yellow perch and bullfrog may limit the suitability of these habitats for amphibian breeding. Existing land uses, including roads, cattle grazing, and recreational activities also affect habitat quality in the study area (PacifiCorp 2004a).

Green Diamond Resource Company conducted presence/absence surveys for tailed frogs and southern torrent salamanders (both California species of concern) in the lower Klamath River and tributary streams and found these two amphibian species to be widespread (Green Diamond Resource Company 2006). In addition, western toad and yellow-legged frog were reported in some of the tributaries of the lower Klamath subbasin during trapping studies conducted in 1991 (USFWS 1992).

### **Reptiles**

Based on surveys conducted in 2002 and 2003 as well as previous surveys in the study area, reptile species diversity and relative abundance is considered high in the study area, particularly in the Klamath River Canyon, along the J.C. Boyle canal, and near Keno Impoundment. In total, 16 reptile species were documented in the study area. Of these, the western fence lizard was the most abundant reptile species and was found in a variety of habitats. Other reptile species found during the surveys included gopher snake, northern sagebrush lizard, western rattlesnake, southern alligator lizard, yellow-bellied racer, common garter snake, western terrestrial garter snake, and western pond turtle. The remaining seven (7) species documented in the study area were recorded as incidental observations or from other investigators and include common kingsnake, striped whipsnake, sharptail snake, ringneck snake, western skink, rubber boa, and California mountain kingsnake (PacifiCorp 2004a).

Surveys for snake hibernacula, or over-wintering locations, were conducted at six specific areas. Although no snake hibernacula locations were confirmed through 2003 surveys, several locations with suitable habitat were identified (PacifiCorp 2004a).

### **Birds**

A portion of the project area is in the Upper Klamath Basin along the Pacific Flyway, a major north-south route of travel for migratory birds in the Americas. The Upper Klamath Basin supports the largest concentration of migratory waterfowl in North America, with up to 2 million migratory birds during peak fall migration and about half that number in peak spring migration (Jarvis 2002). Migratory birds travel along the Pacific Flyway in spring and in fall, following food sources, heading to breeding grounds, or travelling to overwintering sites. Fall migration peaks in September and October and spring migration peaks in March and April in the Upper Klamath Basin (Jarvis 2002). During these months, the wetlands of the Basin support nearly 80 percent of the Pacific Flyway's migratory waterfowl along with thousands of shorebirds and other waterbirds (Point Reyes Bird Observatory 2010).

Large numbers of water-related birds also use the Upper Klamath Basin for breeding. Several bird species have basin-wide populations of greater than 5,000 individuals during the summer months, and 11 other species exceed 1,000 individuals (Shuford et al 2004). The wetlands support large breeding colonies of American white pelicans, double-crested cormorants, eared, Western, and Clark's grebes, great egret, white-faced ibis, ring-billed gull, California gull, and Caspian, Forster's, and black terns. A large number of these species also use the Upper Klamath Basin for staging prior to breeding in California's Central Valley. The Upper Klamath Basin also supports a high number of nesting bald eagles.

Overwintering birds that occur in the Upper Klamath Basin include tundra swans, snow geese, sandhill cranes, and a large number of waterfowl, other water birds, and raptors. In addition, the Upper Klamath Basin supports the largest wintering population of bald eagles in the coterminous United States (Shuford et al 2004). Waterfowl are important prey for bald eagles in the Upper Klamath Basin (Manning and Edge 2002).

PacifiCorp conducted avian surveys in 2002 and 2003, consisting of avian point counts and area searches, protocol surveys for northern spotted owl and northern goshawk, and reservoir surveys. In addition, five Rapid Ornithological Inventories were conducted in 2002 by ornithologists from the Klamath Bird Observatory to document avian use and occurrence in riparian habitat during the fall migration. The Rapid Ornithological Inventories included mist-netting and banding along with area searches and nocturnal call-and-response owl surveys conducted during an intensive 3-day survey period in several river reaches. During these surveys, 174 bird species were detected with a total of more than 20,000 individual detections. Over 11,000 of these detections were recorded as occurring on reservoirs, with the highest number of birds found at Keno and Iron Gate Reservoirs. The importance of reservoir habitat was evidenced by the fact that approximately 67 percent of all birds documented by PacifiCorp during its field surveys were waterfowl and other water-related birds. The field surveys documented 47 species

of water birds, including 20 species of waterfowl and 19 species of open-water, marsh, and wading birds other than waterfowl (PacifiCorp 2004a).

Seven common bird species were found in all 11 PacifiCorp study area sections. These include the western wood pewee, song sparrow, Brewer's blackbird, yellow warbler (a California species of special concern), brown-headed cowbird, black-headed grosbeak, and mourning dove. Each of these species is associated with riparian and/or wetland habitat (PacifiCorp 2004a). In addition, PacifiCorp documented 19 species of birds of prey, including six species of hawk, two eagle species, three falcon species, seven owl species, and one species of vulture; eight species of woodpeckers, including acorn woodpecker, white-headed woodpecker, Lewis' woodpecker, red-shafted flicker, red-breasted sapsucker, downy woodpecker, hairy woodpecker, and pileated woodpecker; and five game bird species, including wild turkey, blue grouse, California quail, mountain quail, and mourning dove (PacifiCorp 2004a).

#### **National Wildlife Refuges (NWRs)**

Key wetland sites that support large numbers of birds in the Upper Klamath Basin include Clear Lake NWR, Klamath Marsh NWR, Lower Klamath NWR, Sycan Marsh, Tule Lake NWR, and Upper Klamath Lake (Shuford et al 2004). These large wetland complexes support the vast majority of birds in the Basin (Jarvis 2002). Of the six refuges within the Upper Klamath Basin NWR System, Lower Klamath, Tule Lake, and Upper Klamath NWRs would be most directly affected by the KBRA (USFWS 2010). For this reason, the affected environment/existing conditions of three NWRs are described in the following paragraphs. Lower Klamath NWR and Tule Lake NWR are shown in Figure 2-13; Upper Klamath NWR is shown in Figure 2-15.

#### **Lower Klamath NWR**

Lower Klamath NWR represents the remnants of historic 80,000 acre Lower Klamath Lake and is divided into a number of management units ranging from 63 acres to over 4,000 acres. Basic wetland habitat types consist of seasonal and permanently flooded marshes and winter irrigated grain fields. Seasonally flooded wetlands are critical to meeting the migratory waterfowl goals of the refuge and for providing brood areas for early nesting waterfowl species. Permanent wetlands are flooded year-round and are crucial to meeting the refuge goals of waterfowl production and habitat for fall and spring migrant waterfowl. In addition, permanently flooded wetlands provide key breeding habitat for colonial nesting waterbirds such as several heron and egret species. The emergent vegetation provides nesting substrate for many species of waterfowl, wading birds, and passerine birds and acts as cover for resting waterfowl during periods of inclement weather. The submergent plant community supports a diverse and productive invertebrate community. An additional use of permanently flooded wetlands is by molting waterfowl in July-September (USFWS 2010, Yarris et al 1994).

In addition to wetland habitats, Lower Klamath NWR also contains approximately 9,000 acres of agricultural lands including grain fields that are extremely attractive to fall migrant and wintering waterfowl and large numbers of wintering raptors, with bald

eagles being the most conspicuous. Hayfields attract large populations of spring migrant geese which helps alleviate potential damage to private farmlands off the refuge.

Lower Klamath NWR receives most of its water from two sources: 1) D Plant, which pumps water from Tule Lake through the Sheepy Ridge tunnel and 2) the Ady Canal, which supplies water directly diverted from the Klamath River. Deliveries to the refuge in recent years (since about 2004) have been limited (USFWS 2010).

### **Tule Lake NWR**

Tule Lake NWR is comprised of approximately 17,000 acres of croplands and 13,000 acres of wetlands contained within Sumps 1(A) and 1(B). Most of the area is comprised of open water dominated by submergent plant communities with extensive periodic blooms of filamentous green algae. High fish densities in Sumps 1(A) and 1(B) make them extremely important foraging areas for fish-eating birds such as white pelicans, western and Clark's grebes, and double crested cormorants. Large areas of submerged aquatic vegetation are very important to migrating diving ducks, especially canvasback, ruddy ducks and lesser scaup (USFWS 2010).

In addition, Tule Lake NWR agricultural programs require growers to leave a proportion of small grain crops (typically 25-33 percent) standing for wildlife consumption. The high energy content of agricultural crops provides an important energy source for migrating waterfowl as they travel northward and southward in the Pacific Flyway (USFWS 2010).

Tule Lake NWR Sumps 1(A) and 1(B) primarily receive agricultural return flows during the spring/summer irrigation season and runoff during winter and spring precipitation events. Excess water in Sumps 1(A) and 1(B) is removed via a tunnel (D-Plant) through Sheepy Ridge to Lower Klamath NWR.

### **Upper Klamath NWR**

Upper Klamath NWR is in Klamath County, Oregon, approximately 35 miles north of the California border and consists of 14,966 acres divided into two units; Hank's Marsh (approximately 1,191 acres) at the south end of Upper Klamath Lake, and Upper Klamath Marsh at the north end. Both Upper Klamath Marsh and Hank's Marsh represent relatively undisturbed remnant wetlands. Additional acreage of water storage within the Upper Klamath NWR include Agency Lake (approximately 9,000 acres) connected to the northern part of Upper Klamath Lake, and Barnes Ranch (approximately 2,000 acres) located northwest of Agency Lake. Because emergent wetlands of Upper Klamath NWR are not separated from the open waters of the lake by perimeter levees, water elevations in the lake have a direct effect on wetland water levels (USFWS 2010).

### **Mammals**

During the PacifiCorp study, surveys for mammals included small mammal trapping, canal wildlife surveys, winter bait station and track surveys, and bat roost surveys. Common mammals that were found throughout the study area include black-tailed jackrabbit, mule deer, and California ground squirrel. Small mammals commonly found during trapping included deer mouse, bushy-tailed woodrat, least chipmunk, and montane

vole. Medium-sized mammals detected in the study area included bobcat, striped skunk, gray fox, yellow-bellied marmot, and coyote. Large mammals included deer, elk, mountain lion, and black bear. Five aquatic and/or riparian-associated fur-bearing mammals were detected: raccoon, beaver, muskrat, mink, and river otter (PacifiCorp 2004a).

#### **3.5.3.4 Special-Status Species**

During the PacifiCorp (2004a) study, focused surveys for special-status species were conducted. Appendix G includes a series of 5 maps that show the occurrences of special-status plant species and three maps that show the occurrence of special-status wildlife species observed during the PacifiCorp study (PacifiCorp 2004a). These maps are assumed to reflect current conditions, as recent comprehensive wildlife surveys have not been conducted. The methods used during these surveys are also summarized in Appendix H.

Fourteen special-status plants and 47 special-status wildlife species were detected in the PacifiCorp study area. Plant species include one federally endangered and Oregon endangered plant, Applegate's milk-vetch, and five federal plant species of concern. Wildlife species include one federal threatened species, the northern spotted owl, 15 federal species of concern, two Oregon threatened species and one California threatened species, three California endangered wildlife species, and four fully protected bird species, golden eagle, bald eagle, peregrine falcon, and greater sandhill crane; Table 3.5-4 lists these species.

In addition to those species identified by PacifiCorp as having the potential to occur, new species lists were obtained for this Klamath Facilities Removal EIS/EIR from USFWS, Oregon Department of Fish and Wildlife (ODFW), Oregon Biodiversity Information Center (ORBIC), and CDFG's California Natural Diversity Database (CNDDDB). The USFWS list included species listed by the National Marine Fisheries Service. The ORBIC database search included a 0.25 mile buffer around the Klamath River and the Keno Impoundment and J.C. Boyle Reservoir within Oregon. The CNDDDB search included a total of 27 United States Geological Survey 7.5-minute topographic quadrangles within which the project area is within California. A list of these quadrangles is provided in Appendix I.

Any new species that appeared on lists provided by the resource agencies (in addition to those found during the PacifiCorp study) were compiled into a comprehensive list of special-status species with some potential to occur in the project area (Appendix I). This list includes 242 special-status species: 2 invertebrates, 14 amphibians, 5 reptiles, 70 birds, 24 mammals, 115 plants, 3 bryophytes, and 9 lichens. Non-terrestrial species (fish, sea turtles, sea birds [albatross], marine invertebrates [abalone], and marine mammals) were not included here but are addressed in the Biological Assessment prepared for the project under Section 7 of the federal Endangered Species Act.

No additional plant or wildlife surveys beyond those conducted by PacifiCorp (2004b) were conducted for this EIS/EIR.

Table 3.5-4 identifies all the special-status plant species with documented occurrences in the project area based on the results of the PacifiCorp study and the ORBIC, and CNDDDB searches. A total of 77 special-status species have been documented as occurring in the project area, including: 3 amphibians, 5 reptiles, 47 birds, 5 mammals, and 17 plants, based on information from PacifiCorp surveys plus occurrences documented on ORBIC and CNDDDB and information provided by the USFWS.

Special-status wildlife species were found to occur in each of the 11 PacifiCorp study area sections and in every delineated habitat type except rock talus. The largest number of special-status plants and wildlife species was found in the J.C. Boyle peaking reach. Keno Impoundment, which has the highest amount of wetland and riparian habitat of the study area sections as well as limited water level fluctuations, was found to support a relatively high abundance of special-status wildlife across species groups, including the largest number of western pond turtles. Keno Impoundment also supports special-status plants including Applegate's milk-vetch (PacifiCorp 2004a; USFWS 2009).

### **Amphibians**

Western toad was the only special-status amphibian species detected in the study area during PacifiCorp surveys; tailed frog and southern torrent salamander have also been documented in the study area during other investigations (Table 3.5-4). During PacifiCorp surveys, western toad breeding sites were confirmed in 2002 along the north shore of Iron Gate Reservoir and in the J.C. Boyle peaking reach along Way Creek. Adult toads were also reported from near the Copco 1 village. There are likely other breeding sites either along the reservoir shorelines or in small, isolated ponds throughout the study area (PacifiCorp 2004a). Tailed frog and southern torrent salamander were found to be widespread in the lower Klamath River and tributaries (Green Diamond Resources Company 2006).

No Oregon spotted frogs were detected during 2003 surveys, or during surveys conducted in 1994 at locations of historic occurrence based on the Oregon Natural Heritage Program database. The presence of non-native bullfrog throughout the study area may indicate that predation has led to the extirpation of Oregon spotted frogs from the study area. Habitat degradation and poor water quality are other likely reasons why the Oregon spotted frog does not occur in the study area (PacifiCorp 2004a).

There is one historical record of foothill yellow-legged frog near the site of the J.C. Boyle Dam. There were no foothill yellow-legged frog detections during focused surveys in 2003, and it is likely that this species has been extirpated from the study area. This species is affected by loss of river habitat, predation by bullfrog and other aquatic predators, and desiccation or scour of egg masses resulting from flow alterations (PacifiCorp 2004a).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
<b>Amphibians</b>				
Tailed frog	<i>Ascaphus truei</i>	CSSC	Perennial, cold, fast-flowing mountain streams with dense vegetation cover, or streams in steep-walled valleys in non-forested areas.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).
Western toad	<i>Bufo boreas</i>	BLM, SV, ONHP List 4	Breeds from February to early May in ponds, the edges of shallow lakes, and in slow-moving streams. Adults are common near marshes and small lakes but may also be found in dry forests, shrubby areas, and meadows.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach, along the north shore of Iron Gate Reservoir, and along Klamath River near river mile 185 (between the confluence of Bogus and Cottonwood Creeks). One occurrence near Frain Ranch, Klamath River Canyon (ORBIC 2010).
Southern torrent salamander	<i>Rhyacotriton variegatus</i>	FSC, CSSC	Uppermost portions of cold, well shaded permanent streams with a loose gravel substrate, springs, headwater seeps, waterfalls, and moss covered rock rubble with flowing water.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).
<b>Reptiles</b>				
Western pond turtle	<i>Actinemys marmorata</i>	FSC, BLM, SC, ONHP List 2, CSSC	Prefers quiet water in small lakes, marshes, and sluggish streams and rivers; requires basking sites.	Documented during PacifiCorp surveys at Keno, J.C. Boyle, Copco, and Iron Gate Reservoirs, along J.C. Boyle bypass reach, along J.C. Boyle peaking reach in California, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir and along Klamath River (ORBIC, CNDDB 2010).
Northern sagebrush lizard	<i>Sceloporus graciosus graciosus</i>	FSC, BLM, SV, ONHP List 4	Inhabits sagebrush, chaparral, juniper woodlands, and dry conifer forests.	Documented during PacifiCorp surveys in the rocky riparian shrub habitat of Keno reach, along J.C. Boyle peaking reach, near J.C. Boyle powerhouse intake canal, and near the edge of a forested wetland along Iron Gate Reservoir.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Status</b>	<b>Habitat</b>	<b>Occurrence in Project Area*</b>
Sharptail snake	<i>Contia tenuis</i>	BLM	Inhabits moist sites in chaparral, conifer forests, and deciduous forests, but primarily occurs in oaks and other deciduous tree woodlands, particularly in the forest edges.	Known to occur along upper J.C. Boyle peaking reach west of Frain Ranch in Douglas-fir habitat but not detected by PacifiCorp during its surveys.
California mountain kingsnake	<i>Lampropeltis zonata</i>	FSC, BLM, SV, ONHP List 4	Inhabits thick vegetation along watercourses, farmland, chaparral, deciduous, and mixed-coniferous forests; specifically associated with moist river valleys and dense riparian vegetation.	Documented during PacifiCorp surveys along Copco Road and in close proximity to J.C. Boyle powerhouse intake canal. Also known to occur along J.C. Boyle peaking reach. Documented in Klamath River Canyon and at J.C. Boyle Dam (ORBIC 2010).
Common kingsnake	<i>Lampropeltis getula</i>	FSC, BLM, SV, ONHP List 4	Occurs in pine forests, oak woodlands, and chaparral in, under, or near rotting logs and usually near streams; associated with well-illuminated rocky riparian habitat with mixed deciduous and coniferous trees.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach in oak/woodland and mixed conifer woodland and along Copco Road.
<b>Birds</b>				
Common loon	<i>Gavia immer</i>	FSC, CSSC	May over-winter on project reservoirs or occur in aquatic habitat associated with large bodies of water like the project reservoirs while migrating from sub-arctic freshwater breeding grounds to coastal and near-shore pelagic marine habitat along the Pacific coast.	Documented during PacifiCorp surveys at Iron Gate Reservoir.
American white pelican	<i>Pelecanus erythrorhynchos</i>	BLM, SV, ONHP List 2, CSSC	Nests at lakes and marshes and uses almost any lake outside of the breeding season; have a restricted range in southern Oregon and along the California border, where they are found to be associated with only a few large bodies of inland water.	Documented during PacifiCorp surveys on all project reservoirs, with the highest number occurring on Keno Impoundment, and along Link River, Keno reach, J.C. Boyle bypass reach, and on Klamath River between Iron Gate Dam and Shasta River.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Double-crested cormorant	<i>Phalacrocorax auritus</i>	Nesting colonies are afforded special protection by CDFG.	Colonial nester on coastal cliffs, rocks, offshore islands, and along lake margins.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Dams. Documented nesting colonies near mouth of Klamath River (CNDDDB 2010).
Black-crowned night heron	<i>Nycticorax nycticorax</i>	FSC	Found in riparian habitats and in wetland sites.	Documented during PacifiCorp surveys primarily along Keno reach, but also along Link River, at Keno Impoundment, and along Klamath River from Iron Gate Dam to Shasta River. Communal roost used by night herons and other heron species in a group of willow trees near the East Side powerhouse adjacent to Link River.
Snowy egret	<i>Egretta thula</i>	BLM, SV, ONHP List 2	Inhabits emergent wetlands associated with freshwater marshes and along the periphery of large water bodies. The northern limit of the species range includes southern Oregon.	Documented during PacifiCorp surveys near Link River Dam, at Keno Dam, and along Keno reach.
Great egret	<i>Casmerodius albius</i>	BLM	Nests in willows and other trees; forages in shallow water, wetlands, and fields. Range includes Klamath basin and eastern Siskiyou County. Known to occur in the study area.	Documented during PacifiCorps surveys at J.C. Boyle and Keno Impoundments, Keno Canyon reach, J.C. Boyle bypass and peaking reaches, and Link River.
Great blue heron	<i>Ardea herodias</i>	Breeding colonies are afforded special-status protection by CDFG	Forages mostly in slow-moving or calm salt, fresh, or brackish water in a variety of habitats, including rocky shores, coastal lagoons, saltwater and freshwater marshes, mudflats, bays, estuaries, along the margins of rivers, lakes, and irrigation canals, and in flooded fields. Nesting colonies are typically found in groves of large trees, often in mixed colonies with other herons, egrets, and cormorants.	Documented during PacifiCorps surveys at all reservoirs and most study area reaches; colony documented at Copco Reservoir. Several rookeries documented along the Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
White-faced ibis	<i>Plegadis chihi</i>	FSC, BLM, ONHP List 4, CSSC	Breeds in freshwater marshes and lakes, and estuaries, and nests near the water on mats of vegetation and twigs; usually occurs in isolated con-specific flocks. Does not typically overwinter in Oregon but is a fairly common visitor in the Klamath Wildlife Area during the spring and summer.	Documented during PacifiCorp surveys along Link River and at Keno Impoundment and J.C. Boyle Reservoir.
Bufflehead	<i>Bucephala albeola</i>	BLM, SU, ONHP List 4	Typically breeds around isolated mountain lakes; nesting habitat includes mixed conifer forest and ponderosa pine forests with sparse to moderate tree canopy closure close to lakes and ponds. Nests in cavities, including artificial nest boxes. May be found in open water and riverine habitat throughout southern Oregon after the breeding season.	Documented during PacifiCorp surveys primarily from January until April along the Link River, at Keno Impoundment and Copco and Iron Gate Reservoirs.
Barrow's goldeneye	<i>Bucephala islandica</i>	SU, ONHP List 4, CSSC	Tends to breed along high-elevation mountain lakes and winter in coastal areas. Potential nesting habitat includes forests with sparse to moderate tree canopy closure next to rivers and reservoirs.	Documented during PacifiCorp surveys along Keno Impoundment, in an inundated drainage ditch off of Copco Reservoir, and on Iron Gate Reservoir. Common winter migrant on the Link River and Keno Impoundment (R. Larson, USFWS).
Osprey	<i>Pandion haliaetus</i>	CSSC	Nests in all forested vegetation types with large trees near water, as well as on platforms erected in less optimal habitat.	A minimum of 16 active osprey nests, both artificial nesting platforms and natural sites, are found along the shores of the project reservoirs and river reaches. Documented during PacifiCorp surveys along the Keno reach, along the J.C. Boyle bypass reach, along the J.C. Boyle peaking reach, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Several occurrences along lower Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Northern harrier	<i>Circus cyaneus</i>	CSSC	Nests and forages in grasslands and emergent wetlands. Permanent residents in the project vicinity and common at the Klamath Wildlife Area.	Documented during PacifiCorp surveys in the low-lying marshland and agricultural fields east of Keno Impoundment and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Golden eagle	<i>Aquila chrysaetos</i>	CSSC, BCC, FP	Breeds in open mountain and hill habitats, nests in coniferous and deciduous trees and on cliff ledges, forages in grasslands and open conifer forests and woodlands with sparse to open tree canopy closure. Eagles typically use two to three nests during a lifetime.	Historical records exist of several golden eagle nests on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. Documented during PacifiCorp surveys at J.C. Boyle powerhouse, along the lower section of J.C. Boyle peaking reach, along Copco and Iron Gate Reservoirs, and Copco bypass reach.
Bald eagle	<i>Haliaeetus leucocephalus</i>	FD, BCC, OT, ONHP List 4, CE, FP	Nests in large conifers within several miles of water; forages in rivers and lakes for fish and waterfowl; requires large snags for perching and conifers for night roosts.	Documented during PacifiCorp surveys at all project reservoirs and in all project reaches throughout the project vicinity. Also documented on Upper Klamath River, on the Klamath River near OR-CA border (ORBIC 2010), and along lower Klamath River (CNDDDB 2010).
Cooper's hawk	<i>Accipiter cooperii</i>	CSSC	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak-juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches, and along Klamath River from the Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Northern goshawk	<i>Accipiter gentilis</i>	FSC, BLM, BCC, SC, ONHP List 4, CSSC	Inhabits forested communities with at least 60 percent canopy cover and trees greater than 6 inches in diameter, except oak woodland, oak-conifer woodland, and oak-juniper woodland; forages over large home ranges.	Documented during PacifiCorp surveys flying over J.C. Boyle peaking reach. Documented near tributaries of lower Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Sharp-shinned hawk	<i>Accipiter striatus</i>	CSSC	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure and tree diameters ranging from 6 to 24 inches.	Documented during PacifiCorp surveys in oak habitat along J.C. Boyle bypass and peaking reaches, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Swainson's hawk	<i>Buteo swainsoni</i>	FSC, BLM, SV, ONHP List 4, , CT	Dwells in open country and typically inhabits sagebrush, annual grassland, juniper woodland, montane hardwood oak-juniper, and riparian deciduous forest with sparse to open tree canopy closure. The species' range generally lies east of the project vicinity and includes the plains of the Great Basin in southeast Oregon and eastern northern California.	Documented during PacifiCorp surveys flying over agricultural fields southeast of Keno Impoundment. Not listed on CNDDDB for project area (CNDDDB 2010).
Merlin	<i>Falco columbarius</i>	BLM, ONHP List 2, CSSC	Uses a variety of forested and open habitats. Ranges throughout North America and travels great distances during migration from breeding grounds in northern Canada and Alaska to wintering habitat through the contiguous United States south to Central America.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Not listed on CNDDDB for project area (CNDDDB 2010).
Prairie falcon	<i>Falco mexicanus</i>	CSSC	Uses cliffs for nesting and plateau grasslands for foraging.	Documented during PacifiCorp surveys near Keno campground and boat ramp, above J.C. Boyle bypass reach, near Copco Reservoir, and flying over Klamath Wildlife Refuge. Several occurrences listed as sensitive (CNDDDB 2010).
American peregrine falcon	<i>Falco peregrinus anatum</i>	FD, BLM, BCC, OE, ONHP List 2, FP	Breeds at suitable nest sites on cliffs and rocky outcroppings. Uses a variety of habitats, including open grassland areas, forest stands, and reservoirs throughout the project vicinity.	The project vicinity is in a management area designated for peregrine falcon recovery. Known to occur along Keno Impoundment and the J.C. Boyle bypass reach but not documented during PacifiCorp surveys. Several occurrences listed as sensitive (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Mountain quail	<i>Oreortyx pictus</i>	FSC, BLM, SU, ONHP List 4	Inhabits open forests, chaparral, and juniper woodlands with dense undergrowth offering suitable refuge; breeds in higher elevation areas; migrates on foot up to 40 miles to lower elevation winter grounds.	Documented during PacifiCorp surveys at J.C. Boyle reservoir, along the J.C. Boyle bypass reach and peaking reaches, along Fall Creek, and along Klamath River from the Iron Gate Dam to Shasta River.
Greater sandhill crane	<i>Grus canadensis tabida</i>	FSC, BLM, SV, ONHP List 4, CT, FP	Nests in marshes and wet meadows, and occasionally in pastures and irrigated hayfields. A primary requirement for suitable nesting habitat is the presence of surrounding water or undisturbed habitat.	Documented during PacifiCorp surveys east of Keno Impoundment and along J.C. Boyle reservoir. PacifiCorp located an active nest with two eggs in it in the emergent wetland bordering J.C. Boyle Reservoir. Several occurrences in the Lower Klamath Lake NWR (CNDDDB 2010).
Caspian tern	<i>Sterna caspia</i>	BCC	Nests in tightly packed colonies on undisturbed islands, levees, and shores along inland water bodies during the summer breeding season. Forages over water.	Documented during PacifiCorp surveys on all project reservoirs as well as along Link River, Keno and J.C. Boyle bypass reaches, and along the Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Forster's tern	<i>Sterna forsteri</i>	BLM, ONHP List 4	Breeds at lakes and marshes and on mud or sand flats near water; forages over water.	Documented during PacifiCorp surveys along Link River, along Keno and J.C. Boyle bypass and peaking reaches, and at all project reservoirs. Not listed on CNDDDB for project area (CNDDDB 2010).
Black tern	<i>Chlidonias niger</i>	FSC, BLM, ONHP List 4, CSSC	Nests in emergent vegetation along the shoreline periphery of freshwater lakes, wetlands, and marshes along rivers and ponds; forages in wet meadows, pastures, agricultural fields, and water.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Reservoirs. Not listed on CNDDDB for project area (CNDDDB 2010).
Marbled murrelet	<i>Brachyramphus marmoratus</i>	FT, OT, ONHP List 2, CE	Spends most of the time in the marine environment foraging in nearshore areas. Uses old-growth forests (coast Redwood forests in California) for nesting.	Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the mouth of the Klamath River.
Flammulated owl	<i>Otus flammeolus</i>	BLM, BCC, SC, ONHP List 4	Nests in abandoned woodpecker nest cavities in open forests with a ponderosa pine component.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
<b>Amphibians</b>				
Tailed frog	<i>Ascaphus truei</i>	CSSC	Perennial, cold, fast-flowing mountain streams with dense vegetation cover, or streams in steep-walled valleys in non-forested areas.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).
Western toad	<i>Bufo boreas</i>	BLM, SV, ONHP List 4	Breeds from February to early May in ponds, the edges of shallow lakes, and in slow-moving streams. Adults are common near marshes and small lakes but may also be found in dry forests, shrubby areas, and meadows.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach, along the north shore of Iron Gate Reservoir, and along Klamath River near river mile 185 (between the confluence of Bogus and Cottonwood Creeks). One occurrence near Frain Ranch, Klamath River Canyon (ORBIC 2010).
Southern torrent salamander	<i>Rhyacotriton variegatus</i>	FSC, CSSC	Uppermost portions of cold, well shaded permanent streams with a loose gravel substrate, springs, headwater seeps, waterfalls, and moss covered rock rubble with flowing water.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).
<b>Reptiles</b>				
Western pond turtle	<i>Actinemys marmorata</i>	FSC, BLM, SC, ONHP List 2, CSSC	Prefers quiet water in small lakes, marshes, and sluggish streams and rivers; requires basking sites.	Documented during PacifiCorp surveys at Keno, J.C. Boyle, Copco, and Iron Gate Reservoirs, along J.C. Boyle bypass reach, along J.C. Boyle peaking reach in California, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir and along Klamath River (ORBIC, CNDDB 2010).
Northern sagebrush lizard	<i>Sceloporus graciosus graciosus</i>	FSC, BLM, SV, ONHP List 4	Inhabits sagebrush, chaparral, juniper woodlands, and dry conifer forests.	Documented during PacifiCorp surveys in the rocky riparian shrub habitat of Keno reach, along J.C. Boyle peaking reach, near J.C. Boyle powerhouse intake canal, and near the edge of a forested wetland along Iron Gate Reservoir.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Sharptail snake	<i>Contia tenuis</i>	BLM	Inhabits moist sites in chaparral, conifer forests, and deciduous forests, but primarily occurs in oaks and other deciduous tree woodlands, particularly in the forest edges.	Known to occur along upper J.C. Boyle peaking reach west of Frain Ranch in Douglas-fir habitat but not detected by PacifiCorp during its surveys.
California mountain kingsnake	<i>Lampropeltis zonata</i>	FSC, BLM, SV, ONHP List 4	Inhabits thick vegetation along watercourses, farmland, chaparral, deciduous, and mixed-coniferous forests; specifically associated with moist river valleys and dense riparian vegetation.	Documented during PacifiCorp surveys along Copco Road and in close proximity to J.C. Boyle powerhouse intake canal. Also known to occur along J.C. Boyle peaking reach. Documented in Klamath River Canyon and at J.C. Boyle Dam (ORBIC 2010).
Common kingsnake	<i>Lampropeltis getula</i>	FSC, BLM, SV, ONHP List 4	Occurs in pine forests, oak woodlands, and chaparral in, under, or near rotting logs and usually near streams; associated with well-illuminated rocky riparian habitat with mixed deciduous and coniferous trees.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach in oak/woodland and mixed conifer woodland and along Copco Road.
<b>Birds</b>				
Common loon	<i>Gavia immer</i>	FSC, CSSC	May over-winter on project reservoirs or occur in aquatic habitat associated with large bodies of water like the project reservoirs while migrating from sub-arctic freshwater breeding grounds to coastal and near-shore pelagic marine habitat along the Pacific coast.	Documented during PacifiCorp surveys at Iron Gate Reservoir.
American white pelican	<i>Pelecanus erythrorhynchos</i>	BLM, SV, ONHP List 2, CSSC	Nests at lakes and marshes and uses almost any lake outside of the breeding season; have a restricted range in southern Oregon and along the California border, where they are found to be associated with only a few large bodies of inland water.	Documented during PacifiCorp surveys on all project reservoirs, with the highest number occurring on Keno Impoundment, and along Link River, Keno reach, J.C. Boyle bypass reach, and on Klamath River between Iron Gate Dam and Shasta River.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Double-crested cormorant	<i>Phalacrocorax auritus</i>	Nesting colonies are afforded special protection by CDFG.	Colonial nester on coastal cliffs, rocks, offshore islands, and along lake margins.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Dams. Documented nesting colonies near mouth of Klamath River (CNDDDB 2010).
Black-crowned night heron	<i>Nycticorax nycticorax</i>	FSC	Found in riparian habitats and in wetland sites.	Documented during PacifiCorp surveys primarily along Keno reach, but also along Link River, at Keno Impoundment, and along Klamath River from Iron Gate Dam to Shasta River. Communal roost used by night herons and other heron species in a group of willow trees near the East Side powerhouse adjacent to Link River.
Snowy egret	<i>Egretta thula</i>	BLM, SV, ONHP List 2	Inhabits emergent wetlands associated with freshwater marshes and along the periphery of large water bodies. The northern limit of the species range includes southern Oregon.	Documented during PacifiCorp surveys near Link River Dam, at Keno Dam, and along Keno reach.
Great egret	<i>Casmerodius albius</i>	BLM	Nests in willows and other trees; forages in shallow water, wetlands, and fields. Range includes Klamath basin and eastern Siskiyou County. Known to occur in the study area.	Documented during PacifiCorps surveys at J.C. Boyle and Keno Impoundments, Keno Canyon reach, J.C. Boyle bypass and peaking reaches, and Link River.
Great blue heron	<i>Ardea herodias</i>	Breeding colonies are afforded special-status protection by CDFG	Forages mostly in slow-moving or calm salt, fresh, or brackish water in a variety of habitats, including rocky shores, coastal lagoons, saltwater and freshwater marshes, mudflats, bays, estuaries, along the margins of rivers, lakes, and irrigation canals, and in flooded fields. Nesting colonies are typically found in groves of large trees, often in mixed colonies with other herons, egrets, and cormorants.	Documented during PacifiCorps surveys at all reservoirs and most study area reaches; colony documented at Copco Reservoir. Several rookeries documented along the Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
White-faced ibis	<i>Plegadis chihi</i>	FSC, BLM, ONHP List 4, CSSC	Breeds in freshwater marshes and lakes, and estuaries, and nests near the water on mats of vegetation and twigs; usually occurs in isolated con-specific flocks. Does not typically overwinter in Oregon but is a fairly common visitor in the Klamath Wildlife Area during the spring and summer.	Documented during PacifiCorp surveys along Link River and at Keno Impoundment and J.C. Boyle Reservoir.
Bufflehead	<i>Bucephala albeola</i>	BLM, SU, ONHP List 4	Typically breeds around isolated mountain lakes; nesting habitat includes mixed conifer forest and ponderosa pine forests with sparse to moderate tree canopy closure close to lakes and ponds. Nests in cavities, including artificial nest boxes. May be found in open water and riverine habitat throughout southern Oregon after the breeding season.	Documented during PacifiCorp surveys primarily from January until April along the Link River, at Keno Impoundment and Copco and Iron Gate Reservoirs.
Barrow's goldeneye	<i>Bucephala islandica</i>	SU, ONHP List 4, CSSC	Tends to breed along high-elevation mountain lakes and winter in coastal areas. Potential nesting habitat includes forests with sparse to moderate tree canopy closure next to rivers and reservoirs.	Documented during PacifiCorp surveys along Keno Impoundment, in an inundated drainage ditch off of Copco Reservoir, and on Iron Gate Reservoir. Common winter migrant on the Link River and Keno Impoundment (R. Larson, USFWS).
Osprey	<i>Pandion haliaetus</i>	CSSC	Nests in all forested vegetation types with large trees near water, as well as on platforms erected in less optimal habitat.	A minimum of 16 active osprey nests, both artificial nesting platforms and natural sites, are found along the shores of the project reservoirs and river reaches. Documented during PacifiCorp surveys along the Keno reach, along the J.C. Boyle bypass reach, along the J.C. Boyle peaking reach, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Several occurrences along lower Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Northern harrier	<i>Circus cyaneus</i>	CSSC	Nests and forages in grasslands and emergent wetlands. Permanent residents in the project vicinity and common at the Klamath Wildlife Area.	Documented during PacifiCorp surveys in the low-lying marshland and agricultural fields east of Keno Impoundment and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Golden eagle	<i>Aquila chrysaetos</i>	CSSC, BCC, FP	Breeds in open mountain and hill habitats, nests in coniferous and deciduous trees and on cliff ledges, forages in grasslands and open conifer forests and woodlands with sparse to open tree canopy closure. Eagles typically use two to three nests during a lifetime.	Historical records exist of several golden eagle nests on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. Documented during PacifiCorp surveys at J.C. Boyle powerhouse, along the lower section of J.C. Boyle peaking reach, along Copco and Iron Gate Reservoirs, and Copco bypass reach.
Bald eagle	<i>Haliaeetus leucocephalus</i>	FD, BCC, OT, ONHP List 4, CE, FP	Nests in large conifers within several miles of water; forages in rivers and lakes for fish and waterfowl; requires large snags for perching and conifers for night roosts.	Documented during PacifiCorp surveys at all project reservoirs and in all project reaches throughout the project vicinity. Also documented on Upper Klamath River, on the Klamath River near OR-CA border (ORBIC 2010), and along lower Klamath River (CNDDDB 2010).
Cooper's hawk	<i>Accipiter cooperii</i>	CSSC	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak-juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches, and along Klamath River from the Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Northern goshawk	<i>Accipiter gentilis</i>	FSC, BLM, BCC, SC, ONHP List 4, CSSC	Inhabits forested communities with at least 60 percent canopy cover and trees greater than 6 inches in diameter, except oak woodland, oak-conifer woodland, and oak-juniper woodland; forages over large home ranges.	Documented during PacifiCorp surveys flying over J.C. Boyle peaking reach. Documented near tributaries of lower Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Sharp-shinned hawk	<i>Accipiter striatus</i>	CSSC	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure and tree diameters ranging from 6 to 24 inches.	Documented during PacifiCorp surveys in oak habitat along J.C. Boyle bypass and peaking reaches, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Swainson's hawk	<i>Buteo swainsoni</i>	FSC, BLM, SV, ONHP List 4, , CT	Dwells in open country and typically inhabits sagebrush, annual grassland, juniper woodland, montane hardwood oak-juniper, and riparian deciduous forest with sparse to open tree canopy closure. The species' range generally lies east of the project vicinity and includes the plains of the Great Basin in southeast Oregon and eastern northern California.	Documented during PacifiCorp surveys flying over agricultural fields southeast of Keno Impoundment. Not listed on CNDDDB for project area (CNDDDB 2010).
Merlin	<i>Falco columbarius</i>	BLM, ONHP List 2, CSSC	Uses a variety of forested and open habitats. Ranges throughout North America and travels great distances during migration from breeding grounds in northern Canada and Alaska to wintering habitat through the contiguous United States south to Central America.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Not listed on CNDDDB for project area (CNDDDB 2010).
Prairie falcon	<i>Falco mexicanus</i>	CSSC	Uses cliffs for nesting and plateau grasslands for foraging.	Documented during PacifiCorp surveys near Keno campground and boat ramp, above J.C. Boyle bypass reach, near Copco Reservoir, and flying over Klamath Wildlife Refuge. Several occurrences listed as sensitive (CNDDDB 2010).
American peregrine falcon	<i>Falco peregrinus anatum</i>	FD, BLM, BCC, OE, ONHP List 2, FP	Breeds at suitable nest sites on cliffs and rocky outcroppings. Uses a variety of habitats, including open grassland areas, forest stands, and reservoirs throughout the project vicinity.	The project vicinity is in a management area designated for peregrine falcon recovery. Known to occur along Keno Impoundment and the J.C. Boyle bypass reach but not documented during PacifiCorp surveys. Several occurrences listed as sensitive (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Mountain quail	<i>Oreortyx pictus</i>	FSC, BLM, SU, ONHP List 4	Inhabits open forests, chaparral, and juniper woodlands with dense undergrowth offering suitable refuge; breeds in higher elevation areas; migrates on foot up to 40 miles to lower elevation winter grounds.	Documented during PacifiCorp surveys at J.C. Boyle reservoir, along the J.C. Boyle bypass reach and peaking reaches, along Fall Creek, and along Klamath River from the Iron Gate Dam to Shasta River.
Greater sandhill crane	<i>Grus canadensis tabida</i>	FSC, BLM, SV, ONHP List 4, CT, FP	Nests in marshes and wet meadows, and occasionally in pastures and irrigated hayfields. A primary requirement for suitable nesting habitat is the presence of surrounding water or undisturbed habitat.	Documented during PacifiCorp surveys east of Keno Impoundment and along J.C. Boyle reservoir. PacifiCorp located an active nest with two eggs in it in the emergent wetland bordering J.C. Boyle Reservoir. Several occurrences in the Lower Klamath Lake NWR (CNDDDB 2010).
Caspian tern	<i>Sterna caspia</i>	BCC	Nests in tightly packed colonies on undisturbed islands, levees, and shores along inland water bodies during the summer breeding season. Forages over water.	Documented during PacifiCorp surveys on all project reservoirs as well as along Link River, Keno and J.C. Boyle bypass reaches, and along the Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Forster's tern	<i>Sterna forsteri</i>	BLM, ONHP List 4	Breeds at lakes and marshes and on mud or sand flats near water; forages over water.	Documented during PacifiCorp surveys along Link River, along Keno and J.C. Boyle bypass and peaking reaches, and at all project reservoirs. Not listed on CNDDDB for project area (CNDDDB 2010).
Black tern	<i>Chlidonias niger</i>	FSC, BLM, ONHP List 4, CSSC	Nests in emergent vegetation along the shoreline periphery of freshwater lakes, wetlands, and marshes along rivers and ponds; forages in wet meadows, pastures, agricultural fields, and water.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Reservoirs. Not listed on CNDDDB for project area (CNDDDB 2010).
Marbled murrelet	<i>Brachyramphus marmoratus</i>	FT, OT, ONHP List 2, CE	Spends most of the time in the marine environment foraging in nearshore areas. Uses old-growth forests (coast Redwood forests in California) for nesting.	Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the mouth of the Klamath River.
Flammulated owl	<i>Otus flammeolus</i>	BLM, BCC, SC, ONHP List 4	Nests in abandoned woodpecker nest cavities in open forests with a ponderosa pine component.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Great gray owl	<i>Strix nebulosa</i>	BLM, S/M-C, SV, ONHP List 4, CE	Inhabits mixed conifer, ponderosa pine, and riparian mixed forest stands with trees greater than 11 inches in diameter providing at least 60 percent canopy cover within at least 984 feet of a natural or manmade opening greater than 10 acres. Breeds in tree cavities, typically near suitable open grassland foraging habitat.	Documented during PacifiCorp surveys east of Fall Creek near Jenny Creek. Not listed on CNDDDB for project area (CNDDDB 2010).
Northern Spotted Owl	<i>Strix occidentalis caurina</i>	FT, OT, ONHP List 1	Inhabits ponderosa pine forest, mixed conifer forest, and conifer forest with trees greater than 11 inches in diameter. Prefers old-growth forests with multi-layered tree canopies. Critical habitat occurs within the project area upstream of Copco Reservoir and south of the Klamath River and along portions of the lower Klamath River.	Documented during PacifiCorp surveys near J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Several occurrences within the project area (CNDDDB 2010). Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the mouth of the Klamath River.
Vaux's swift	<i>Chaetura vauxi</i>	CSSC	Found in mixed conifer, ponderosa pine, lodgepole pine, riparian deciduous, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle bypass and peaking reaches, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Black swift	<i>Cypseloides niger</i>	SP, ONHP List 2, CSSC	Suitable nesting habitat is limited to cliffs near water courses. Breeding sites are widely distributed in Oregon and California; none known in Klamath or northern Siskiyou Counties.	Not documented during PacifiCorp surveys. Documented along Klamath River near Orleans (CNDDDB 2010).
Pileated woodpecker	<i>Drycopus pileatus</i>	BLM, SV ONHP List 4	Occurs in all forest and woodland cover types with moderate to dense tree canopy closure. Requires large snags 25 inches or more in diameter for excavating suitable nest cavities.	Documented during PacifiCorp surveys along Keno reach, at J.C. Boyle Reservoir, along J.C. Boyle bypass and peaking reaches, and along Fall Creek.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Great gray owl	<i>Strix nebulosa</i>	BLM, S/M-C, SV, ONHP List 4, CE	Inhabits mixed conifer, ponderosa pine, and riparian mixed forest stands with trees greater than 11 inches in diameter providing at least 60 percent canopy cover within at least 984 feet of a natural or manmade opening greater than 10 acres. Breeds in tree cavities, typically near suitable open grassland foraging habitat.	Documented during PacifiCorp surveys east of Fall Creek near Jenny Creek. Not listed on CNDDDB for project area (CNDDDB 2010).
Northern Spotted Owl	<i>Strix occidentalis caurina</i>	FT, OT, ONHP List 1	Inhabits ponderosa pine forest, mixed conifer forest, and conifer forest with trees greater than 11 inches in diameter. Prefers old-growth forests with multi-layered tree canopies. Critical habitat occurs within the project area upstream of Copco Reservoir and south of the Klamath River and along portions of the lower Klamath River.	Documented during PacifiCorp surveys near J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Several occurrences within the project area (CNDDDB 2010). Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the mouth of the Klamath River.
Vaux's swift	<i>Chaetura vauxi</i>	CSSC	Found in mixed conifer, ponderosa pine, lodgepole pine, riparian deciduous, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle bypass and peaking reaches, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Black swift	<i>Cypseloides niger</i>	SP, ONHP List 2, CSSC	Suitable nesting habitat is limited to cliffs near water courses. Breeding sites are widely distributed in Oregon and California; none known in Klamath or northern Siskiyou Counties.	Not documented during PacifiCorp surveys. Documented along Klamath River near Orleans (CNDDDB 2010).
Pileated woodpecker	<i>Drycopus pileatus</i>	BLM, SV ONHP List 4	Occurs in all forest and woodland cover types with moderate to dense tree canopy closure. Requires large snags 25 inches or more in diameter for excavating suitable nest cavities.	Documented during PacifiCorp surveys along Keno reach, at J.C. Boyle Reservoir, along J.C. Boyle bypass and peaking reaches, and along Fall Creek.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Acorn woodpecker	<i>Melanerpes formicivorus</i>	FSC, BLM, ONHP List 4	Nests in cavities in snags of deciduous tree species, particularly oak snags at least 17 inches in diameter.	Several nesting colonies documented during PacifiCorp surveys in oak, oak-juniper, and oak/conifer habitats, primarily at Copco Reservoir. Also documented during PacifiCorp surveys at J.C. Boyle and Iron Gate Reservoirs, along J.C. Boyle peaking reach, along Copco bypass reach, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River.
Lewis' woodpecker	<i>Melanerpes lewis</i>	FSC, BLM, BCC, SC, ONHP List 2	Associated with oak woodlands and mixed oak conifer habitat, but also can be found in a variety of open forest stands including ponderosa pine and cottonwood-dominated riparian areas.	Documented during PacifiCorp surveys in upland habitats along J.C. Boyle peaking reach, in riparian habitats at Iron Gate Reservoir, and along Klamath River from Iron Gate Dam to Shasta River. Documented in Klamath River Canyon (ORBIC 2010).
White-headed woodpecker	<i>Picoides albolarvatus</i>	FSC, BLM, BCC, SC, ONHP List 2	Nests in cavities typically in ponderosa pine at least 18 inches in diameter. Occurs in lodgepole pine, ponderosa pine, and Klamath mixed conifer forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys along J.C. Boyle bypass reach. Not listed on CNDDDB for project area (CNDDDB 2010).
Williamson's sapsucker	<i>Sphyrapicus thyroideus</i>	BLM, SU	Associated with higher-elevation coniferous forest types including ponderosa pine, lodgepole pine, and Douglas-fir.	Known to occur in the general project vicinity but not documented during PacifiCorp surveys.
Olive-sided flycatcher	<i>Contopus cooperi</i>	FSC, BLM, BCC, SV, ONHP List 4	Typically found in coniferous forests with tall trees providing suitable perch sites.	Documented during PacifiCorp surveys along Link River, at Keno, J.C. Boyle and Iron Gate Reservoirs, and along Keno and J.C. Boyle peaking reaches. Not listed on CNDDDB for project area (CNDDDB 2010).
Willow flycatcher	<i>Empidonax traillii</i>	FSC, BLM, BCC, SV, ONHP List 4, CE	Associated with dense riparian willow thickets.	Documented during PacifiCorp surveys in some of the more dense willow patches along Link River, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle peaking reach, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir at Jenny Creek (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Status</b>	<b>Habitat</b>	<b>Occurrence in Project Area*</b>
Black phoebe	<i>Sayornis nigricans</i>	BLM	Nests on cliffs or rock outcrops near water. Forage in riparian areas with thick vegetation and some nearby vertical surface. The Klamath study area exists along the northern limit of the species range.	Documented during PacifiCorp surveys along the Iron Gate-Shasta reach. Also regularly seen along the Miller Island section of the Keno Impoundment (R. Larson, USFWS).
Purple martin	<i>Progne subis</i>	FSC, BLM, SC, ONHP List 2, CSSC	Riparian and wetland forests, as well as Klamath mixed conifer forest, ponderosa pine forest, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper with sparse to moderate tree canopy closure (<60 percent). Range is patchy and may include portions of the study area.	Documented during PacifiCorp surveys above the upper falls at Fall Creek.
Black-capped chickadee	<i>Parus atricapillus</i>	CSSC	Nests in a variety of woodland habitats wherever suitable, small nest cavities can be found.	Documented during PacifiCorp surveys along Link River and at Copco and Iron Gate Reservoirs.
Pygmy nuthatch	<i>Sitta pygmea</i>	BLM, SV	Typically found in ponderosa pine forests with less than 70 percent canopy closure.	Documented during PacifiCorp surveys at Keno Impoundment and J.C. Boyle Reservoir.
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>	BLM	Mixed chaparral, montane hardwood oak woodland, montane hardwood oak-juniper. Range overlaps the study area. The species is specifically known to breed in the chaparral of the Klamath basin.	Documented during PacifiCorp surveys at Iron Gate reservoir.
Western bluebird	<i>Sialia mexicana</i>	BLM, SV, ONHP List 4	Found in a variety of open habitats; may be limited by the availability of suitable nesting cavities. Nests in open clearings adjacent to woodlands or in human-made structures providing suitable nest sites.	Documented during PacifiCorp surveys along Copco bypass reach, along Fall Creek, and at Iron Gate Reservoir.

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Yellow warbler	<i>Dendroica petechia</i>	CSSC	Found in riparian deciduous forest, riparian shrub, scrub-shrub wetland, and forested wetland. Breeds in riparian habitat throughout North America and winters south from Mexico through South America.	Documented during PacifiCorp surveys throughout the project vicinity at all project reservoirs and in all project reaches. Not listed on CNDDDB for project area (CNDDDB 2010).
Yellow-breasted chat	<i>Icteria virens</i>	FSC, BLM, ONHP List 4, CSSC	Found in the brushy understory of deciduous and mixed woodlands; breeds in brushy vegetation, typically willow thickets, along rivers and streams.	Documented during PacifiCorp surveys primarily in wetland and riparian habitats along J.C. Boyle peaking reach, at Copco Reservoir, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
<b>Mammals</b>				
Townsend's western big-eared bat	<i>Corynorhinus townsendii townsendii</i>	FSC, BLM, SC, ONHP List 2, CSSC	Generally found in open forests and a variety of habitats; the availability of suitable roost sites (rock crevices, cliff ledges, and human-made structures) limits distribution and occurrence.	Known from J.C. Boyle peaking reach but not documented during PacifiCorp surveys. One occurrence in project area listed as sensitive by ORBIC (2010). Not listed on CNDDDB for project area (CNDDDB 2010).
Yuma myotis bat	<i>Myotis yumanensis</i>	FSC, BLM, ONHP List 4	Generally found in open forests and a variety of habitats; the availability of suitable roost sites (rock crevices, cliff ledges, and human-made structures) limits distribution and occurrence.	Documented during PacifiCorp surveys roosting in J.C. Boyle forebay spillway house, in transformer bays at Copco No. 1 powerhouse, and in rafters at Iron Gate south gatehouse. Also known from J.C. Boyle peaking reach. One occurrence outside project area (CNDDDB 2010).
Western gray squirrel	<i>Sciurus griseus</i>	BLM, SU, ONHP List 4	Found in a variety of forested habitat types including mixed conifer forest, ponderosa pine forest, lodgepole pine, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak juniper with trees greater than 6 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle and Copco Reservoirs, along J.C. Boyle peaking reach, and along Copco bypass reach.
Ringtail	<i>Bassariscus astutus</i>	BLM, SU, ONHP List 4	Uses a mixture of forest and shrublands or other habitats that provide vertical structure near rocky or riparian areas. Range overlaps the study area. The species is known to occur in the study area.	Not documented during PacifiCorp surveys. Documented in Klamath River Canyon (ORBIC 2010). Not listed on CNDDDB for project area (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Fisher	<i>Martes pennanti</i>	FC, BLM, SC, ONHP List 2, CSSC	Mature, closed canopy forests with some deciduous trees; intermediate to large tree stages of conifer forests and riparian deciduous forests both with high tree canopy closure. Habitats in the study area include lodgepole pine, Klamath mixed conifer forest, ponderosa pine forest, riparian deciduous forest, montane hardwood oak-conifer with trees >11 inches dbh. Range overlaps the study area.	Not documented during PacifiCorp surveys. Documented along lower Klamath River (CNDDDB 2010). Has been documented in the Upper Klamath Basin within the last two years (T. Collom, ODFW, personal communication, April 29, 2011).
<b>Plants</b>				
Applegate's milk-vetch	<i>Astragalus applegatei</i>	FE, OE, ONHP List 1	Occurs in flat-lying, seasonally moist, strongly alkaline soils.	Documented during PacifiCorp surveys at Keno Impoundment. 450 plants were found in 2009 on the west side of the Keno Impoundment near the PacifiCorp wareyard and 10,000 plants occur in a number of sites near the west side of Keno Impoundment on Collins Products property (R. Larson, USFWS).
Greene's mariposa-lily	<i>Calochortus greenei</i>	FSC, BLM, OC, ONHP List 1, CNPS List 1B	Occurs primarily in annual grassland, wedgeleaf ceanothus chaparral, and oak and oak-juniper woodlands.	Documented during PacifiCorp surveys at Iron Gate Reservoir. Yellow starthistle, medusahead, and annual bromes form the dominant herb layer cover at nearly all of the sites where Greene's mariposa lily was observed. Also known to occur at Copco Reservoir and along J.C. Boyle peaking reach. Several occurrences on CNDDDB along Klamath River (2010).
Bristly sedge	<i>Carex comosa</i>	ONHP List 2	Marshes, lake shores, and wet meadows.	Not documented during PacifiCorp surveys. Documented along east shore of J.C. Boyle Reservoir (ORBIC 2010).
Brown fox sedge	<i>Carex vulpinoidea</i>	CNPS List 2	Near water on moist open ground in swamps, prairie swales, lowland forests, wet ditches, ravines, and along the edges of marshes, springs, lakes, and ponds.	Not documented during PacifiCorp surveys. Documented on north shore of Iron Gate Reservoir, 0.1 mile downstream from mouth of Fall Creek (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Mountain lady's slipper	<i>Cypripedium montanum</i>	BLM, S/M-D, ONHP List 4, CNPS List 4	Occurs in dry, open conifer forests, but more often in moist riparian habitats.	Documented during PacifiCorp surveys on a shaded and mesic, forested slope above Frain Creek, a small tributary to the Klamath River at Frain Ranch along J.C. Boyle peaking reach. Not listed on CNDDDB for project area (CNDDDB 2010).
Del Norte buckwheat	<i>Eriogonum nudum</i> var. <i>paralinum</i>	CNPS List 2	Coastal bluff scrub, coastal prairie.	Not documented during PacifiCorp surveys. Documented on sand bar at mouth of Klamath River (CNDDDB 2010).
Bolander's sunflower	<i>Helianthus bolanderi</i>	BLM, ONHP List 3	Occurs in yellow pine forest, foothill oak woodland, chaparral, and occasionally in serpentine substrates or wet habitats.	Documented during PacifiCorp surveys in highly disturbed and degraded sites filled with annual bromes and starthistle along the lower reach of Hayden Creek, a tributary to the Klamath River along J.C. Boyle peaking reach, and south of Iron Gate Reservoir.
Salt heliotrope	<i>Heliotropium curvasassavicum</i>	BLM, ONHP List 2	Occurs in seasonally flooded, low-lying, non-porous areas on the east side of the Cascades.	Documented during PacifiCorp surveys at the upper end of Keno Impoundment.
Bellinger's meadow-foam	<i>Limnanthes floccosa</i> ssp. <i>bellingerana</i>	FSC, BLM, OC, ONHP List 1, CNPS List 1B	Occurs in rocky, seasonally wet meadows, or along the margins of damp rocky meadows often partially shaded by adjacent trees and shrubs.	Not documented during PacifiCorp surveys. Known to occur along J.C. Boyle peaking reach. Not listed on CNDDDB for project area (CNDDDB 2010).
Detling's silverpuffs	<i>Microseris laciniata</i> ssp. <i>detlingii</i>	CNPS List 2	Chaparral and grassy openings among Oregon white oak trees.	Not documented during PacifiCorp surveys. Documented west of Iron Gate Reservoir, 1.2 miles north of Klamath River bridge at Iron Gate Dam (CNDDDB 2010).
Egg Lake monkeyflower	<i>Mimulus pygmaeus</i>	FSC, CNPS List 4	Occurs in damp areas or vernal moist conditions in meadows and open woods.	Documented during PacifiCorp surveys on the southwest end of J.C. Boyle Reservoir in damp mudflats adjacent to shallow and narrow tributaries to the Reservoir and under the transmission line just southwest of J.C. Boyle Dam. Not listed on CNDDDB for project area (CNDDDB 2010).
Wolf's evening-primrose	<i>Oenothera wolfii</i>	CNPS List 1B	Coastal bluff scrub, coastal dunes, coastal prairie, lower montane coniferous forest.	Not documented during PacifiCorp surveys. Documented along lower Klamath River (CNDDDB 2010).

**Table 3.5-4. Special-Status Species Known to Occur in the Project Area**

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*
Red-root yampah	<i>Perideridia erythrorhiza</i>	FSC, BLM, OC, ONHP List 1	Occurs in moist prairies, pastureland, seasonally wet meadows, and oak or pine woodlands, often in dark wetland soils and clay depressions.	Not documented during PacifiCorp surveys. Known to occur along Keno reach, at J.C. Boyle Reservoir, and along J.C. Boyle peaking reach.
Columbia yellow cress	<i>Rorippa columbiae</i>	FSC, BLM, OC, ONHP List 1, CNPS List 1B	Occurs in cobbly, gravelly silt associated with seasonal creek drainages in ponderosa pine/juniper woodland, on the shores of alkaline lakes, along roadside ditches, in meadows, and seeps.	Documented during PacifiCorp surveys at Keno Impoundment. One occurrence at Klamath River near Orleans (CNDDDB 2010).
Fleshy sage	<i>Salvia dorrii</i> var. <i>incana</i>	CNPS List 3	Occurs in silty to rocky soils in great basin scrub, pinyon, and juniper woodland.	Documented during PacifiCorp surveys on weathered bedrock outcrops overlain with thin, loose, and rocky substrate at Iron Gate Reservoir and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDDB for project area (CNDDDB 2010).
Pendulous bulrush	<i>Scirpus pendulus</i>	BLM, ONHP List 2, CNPS List 2	Occurs along streambanks and in wet meadows.	Documented during PacifiCorp surveys along Fall Creek and J.C. Boyle peaking reach. Documented outside project area (CNDDDB 2010).
Short-podded thelypody	<i>Thelypodium brachycarpum</i>	FSC, BLM, ONHP List 2, CNPS List 4	Occurs in meadows and open flats.	Documented during PacifiCorp's field surveys in low-lying saltgrass grassland at Keno Impoundment. Large populations occur along both sides of the Keno Impoundment at Miller Island and on Collins Products property on the west side of Keno Impoundment (R. Larson, USFWS). Not listed on CNDDDB for project area (CNDDDB 2010).

Notes:

\*Information on occurrence in the project area is based on PacifiCorp surveys (PacifiCorp 2004a) and information obtained from Oregon Biodiversity Information Center (ORBIC) and California Natural Diversity Database (CNDDDB) databases (2010).

Key:

BCC: Birds of Conservation Concern (USFWS Division of Migratory Bird Management 2008a)

BLM: Bureau of Land Management sensitive species - species that could easily become endangered or extinct.

CDFG: California Department of Fish and Game

CE: California Endangered

CNPS List 1A: California Native Plant Society (CNPS)- Presumed extinct in California.

CNPS List 1B: rare, threatened, or endangered in California and elsewhere.

CNPS List 2: rare, threatened, or endangered in California, but more common elsewhere.

CNPS List 3: on the review list - more information needed

CNPS List 4: on the watch list - limited distribution

CSSC: California Department of Fish and Game Species of Special Concern - not listed under the federal or California Endangered Species Act but are believed to: 1) be declining at a rate that could result in listing, or 2) historically occurring in low numbers and having current known threats to their persistence

CT: California Threatened

FC: Federal Candidate Species

FD: Federal Delisted

FE: Federal Endangered

FP: Fully protected under the California Fish and Game Code

FSC: Federal Species of Concern

FT: Federal Threatened

OC: Candidate listing by Oregon Department of Agriculture (ODA) or Oregon Department of Fish and Wildlife (ODFW)

OE: Listed as endangered by ODA or ODFW

ONHP List 1: Oregon Natural Heritage Program (ONHP) threatened with extinction or presumed to be extinct throughout their entire range

ONHP List 2: threatened with extirpation or presumed to be extirpated from the state of Oregon

ONHP List 3: more information is needed before status can be determined, but may be threatened or endangered in Oregon or throughout their range

ONHP List 4: of conservation concern but not currently threatened or endangered

OT: Listed as threatened by ODA or ODFW

SC: Sensitive Critical - listed by ODFW as threatened or endangered is pending, or listing as threatened or endangered may be appropriate if immediate conservation actions are not taken.

SP: Sensitive Peripheral or Naturally Rare - listed by ODFW with populations on the edge of the range or historically low because of naturally occurring limiting factors

SU: Sensitive Undetermined Status - listed by ODFW for which status is unclear

SV: Sensitive Vulnerable - listed by ODFW as threatened or endangered is not imminent and can be avoided through continued or expanded use of adequate protective measures and monitoring. In some cases the populations are sustainable and protective measures

S/M-C: Survey and Manage Species, as designated in the Northwest Forest Plan; category C - Uncommon, pre-disturbance surveys practical

S/M-D: Survey and Manage Species, as designated in the Northwest Forest Plan; category D - Uncommon, pre-disturbance surveys not practical or necessary

USFWS: United States Fish and Wildlife Service

### **Reptiles**

Four special-status reptile species were documented during PacifiCorp surveys: western pond turtle, northern sagebrush lizard, California mountain kingsnake, and common kingsnake. One additional species, sharptail snake, is known to occur based on previous studies (Table 3.5-4). Focused surveys for western pond turtle in 2002 resulted in 501 western pond turtle detections recorded during turtle surveys and 47 incidental observations in the study area, including 18 turtles in the beaver dam pond/wetland between Fall Creek and Iron Gate Reservoir, and 24 turtle observations along the Keno Impoundment shoreline during other wildlife surveys. A total of 276 turtles were documented in Keno Impoundment, 23 in J.C. Boyle Reservoir, 12 in Copco Reservoir, and 17 in Iron Gate Reservoir.

Several river reaches were also found to support pond turtles, including Fall Creek, the J.C. Boyle Peaking reach, and the Iron Gate-Shasta River reach. The turtle nesting habitat suitability mapping conducted in 2002 indicates that out of the 198 miles (319 km) of river and reservoir shoreline in the study area, approximately 42 miles (68 km) (21 percent) were characterized as having suitable nesting and basking habitat. An additional 60 miles (97 km) (30 percent) have suitable basking habitat structure (logs, large rocks, or patches of persistent emergent vegetation), but do not have the high quality potential nesting habitat either because of steep slopes, developed shorelines, or shorelines with dense understory vegetation (PacifiCorp 2004a).

Habitat for western pond turtle is affected by fluctuating water levels at reservoirs and along river reaches, particularly Iron Gate Reservoir and the J.C. Boyle peaking reach. Lower water levels can reduce the amount of aquatic habitat and make bordering emergent wetlands less accessible due to increased distance from water for hatchling turtles (PacifiCorp 2004a).

In addition, dense emergent vegetation may reduce turtle access to upland habitat, although typically small breaks are present. Developed areas and recreation sites may restrict shoreline habitat for turtles and affect their movement into nesting and overwintering sites. Turtles are known to be sensitive to human activity at distances of 328 feet; thus, human disturbance along roads, vegetation management, recreational activities, and other human activities are likely to affect turtles in the study area (PacifiCorp 2004a).

Northern sagebrush lizard was found during PacifiCorp surveys in or near forest habitat at locations including Iron Gate Reservoir, Keno Canyon reach, and J.C. Boyle peaking reach. California mountain kingsnake was recorded along Copco Road and along the J.C. Boyle canal near riparian woodlands. Common kingsnake was found on Copco Road, at the Iron Gate Reservoir, on a road in the Iron Gate-Shasta River reach, and near the Fall Creek reach within oak/woodland or chaparral habitat. No sharptail snakes were detected in the study area during 2002 surveys; however, the species was detected in the upper J.C. Boyle peaking reach during Bureau of Land Management (BLM) surveys in the spring of 2001 (PacifiCorp 2004a).

### **Birds**

Birds represent the largest group of special-status species detected in the study area with 46 of the 69 species with potential to occur detected during PacifiCorp surveys or listed by ORBIC or CNDDDB as occurring in the project area (Table 3.5-4). Among these, there are 14 water birds, 1 quail, 11 raptors, 3 owls, 2 swifts, and 15 passerines.

Most detections of special-status birds during PacifiCorp surveys were recorded in wetland, riparian, or aquatic habitat. During reservoir surveys, large numbers of American white pelicans were found on all reservoirs: 191 birds on Keno Impoundment, 71 birds on J.C. Boyle Reservoir, 55 birds on Copco Reservoir, and 107 birds on Iron Gate Reservoir. In addition, a great blue heron colony, which is afforded special protection by CDFG, was documented at Copco Reservoir during supplemental surveys in that area (PacifiCorp 2004b).

Bald eagles were also found at all reservoirs, with the highest number (12) found at Copco Reservoir (PacifiCorp 2004a). A known bald eagle nesting site is south of Copco Dam (USFWS 2007). Bald eagles also utilize the middle and lower Klamath River for foraging and nesting.

Golden eagles have historically nested on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. During PacifiCorp surveys, golden eagles were found in several locations, including Copco and Iron Gate Reservoirs and J.C. Boyle powerhouse (PacifiCorp 2004a).

The only federally-listed bird species detected during PacifiCorp surveys was the northern spotted owl, a federal threatened species found near J.C. Boyle Reservoir and along J.C. Boyle peaking reach. A nest site is also known to occur near the Copco Reservoir. All known nest sites and suitable nesting or roosting habitat is more than one mile away from the dams and associated facilities (personal communication with L. Roberts, USFWS, June 27, 2011).

Critical habitat for northern spotted owl is located north of the Klamath Hydroelectric Project boundary in the Jenny Creek watershed, upstream of the Copco Reservoir, and along portions of the lower Klamath River. Northern spotted owls are also documented to occur on National Forest lands and along the Lower Klamath River on lands managed by Green Diamond Resources Company, and a Habitat Conservation Plan for the northern spotted owl is currently in development. Potentially suitable spotted owl habitat in the project area includes all forested communities and oak woodlands adjacent to mixed conifer stands with high canopy cover and large diameter trees (USFWS 2008b).

The marbled murrelet, a federal threatened bird species, is known to occur on National Forest lands along the coast as well as on lands managed by Green Diamond Resources Company. This species does not occur inland near the PacifiCorp dams and associated facilities.

Four fully protected bird species, bald eagle, golden eagle, American peregrine falcon, and greater sandhill crane, are known to occur in the project area. Bald and golden eagles

are discussed above. American peregrine falcons are known to occur along the river including the J.C. Boyle bypass reach. Greater sandhill cranes have been documented nesting at J.C. Boyle Reservoir.

### **Mammals**

Two special-status mammals, western gray squirrel and Yuma myotis bat, were detected during PacifiCorp surveys (Table 3.5-4). Three other species, Townsend's western big-eared bat, ringtail, and Pacific fisher, have documented occurrences on ORBIC or CNDDDB within the project area.

Yuma myotis was detected at the J.C. Boyle forebay spillway house, the Copco 1 powerhouse, and the Iron Gate south gatehouse (PacifiCorp 2004a). Although the presence of the seven other special-status bat species with potential to occur in the project area was not detected during bat roost surveys at PacifiCorp facilities, it is likely that one or more of these other special-status bat species occur in the roosting colonies (personal communication with G. Leppig, CDFG, October 27, 2010).

### **Terrestrial Invertebrates**

PacifiCorp did not conduct surveys for terrestrial invertebrates; however, special-status invertebrate species may occur within the project area (personal communication with R. Larson, USFWS, March 13, 2011). One species that may occur based on known occurrences near the project area is the Siskiyou sideband (*Monadenia chaceana*). A petition for federal listing of this species is currently under review (USFWS 2011).

### **Plants**

Ten special-status plant species were documented during PacifiCorp surveys. Of these, seven species are associated with wetland and/or riparian habitats. Seven additional species are known to occur in the project area based on previous investigations or occurrences listed on ORBIC or CNDDDB (Table 3.5-4). Four of these additional species are associated with wetland and/or riparian habitats.

One federally-listed species, Applegate's milk-vetch, was detected at the Keno Impoundment during PacifiCorp surveys. Applegate's milk-vetch, a federal and Oregon endangered species, was found growing in an area of dense, undisturbed salt grass within 45 to 100 feet (17 to 30 m) of Keno Impoundment. The plant was observed along the reservoir in an area of approximately 250 feet (76 m) in length at a height or elevation above the reservoir water surface of less than 2 feet (0.6 m) (PacifiCorp 2004a). Additional surveys have identified Applegate's milk-vetch at several sites along the Keno Impoundment totaling over 10,000 plants. Three sites occur in areas within 100 meters of the Keno Impoundment in areas dominated by rabbitbrush (USFWS 2009).

Two other federal endangered plants potentially occur in the project area. These are Yreka phlox (*Phlox hirsuta*) and Gentner's fritillary (*Fritillaria gentneri*). Ultramafic soils upon which the phlox is found occur within two miles of Copco Reservoir. The habitat for the fritillary that consists of mixed hardwood-conifer vegetation dominated by Oregon oak is present in the reach along Copco and Iron Gate Reservoirs (personal communication with R. Larson, USFWS, March 13, 2011).

No rare or threatened natural communities were identified during the PacifiCorp study or documented on database searches by ORBIC or CNDDDB.

#### **3.5.3.5 Wildlife Corridors and Habitat Connectivity**

Riparian corridors enable movement of both aquatic and terrestrial wildlife. Project reservoirs and waterways create substantial breaks in the connectivity of riparian habitat. Large mammals such as elk and deer are likely able to traverse these waterways, while they may create a barrier to movement by small mammals, reptiles, and amphibians. In addition, canals, roads, powerhouses, and other facilities often block movement of amphibians and reptiles (PacifiCorp 2004a).

Birds are highly mobile; however, the presence of transmission power lines has the potential to cause bird mortality from collisions, particularly when transmission lines cross flight paths that birds use during seasonal migration or daily movements between foraging and roosting areas. PacifiCorp determined that there are four segments of project transmission lines near areas of high waterfowl and wading bird use: one at Link River, one near the upstream end of Iron Gate Reservoir, and two segments of line that cross Iron Gate Reservoir. However, because these lines do not pass between the reservoirs/rivers and major wetlands or cropland that would attract foraging birds, the probability of collision is reduced, and there has been no evidence of avian collisions occurring on PacifiCorp lines (PacifiCorp 2004a).

### **3.5.4 Environmental Consequences**

#### **3.5.4.1 Effects Determination Methods**

Evaluating potential impacts on terrestrial resources first entailed identification of the affected terrestrial resources within the analysis area. These include existing terrestrial vegetation communities and their value as habitat for wildlife; terrestrial special-status wildlife and plant species; use and dependence of terrestrial species on riparian, wetland, and aquatic reservoir habitat; and terrestrial wildlife corridors.

Habitats that are most likely to be most affected by the project alternatives are the riparian zones, wetlands, and aquatic habitats. Upland habitats would also be affected by KBRA actions. These habitats are important to many terrestrial wildlife species by providing food, water, cover, and breeding sites. Riparian and wetland communities have been greatly reduced in size within the Klamath Basin, with a wetland loses up to 90 percent by some estimations (Larson and Brush 2010). Thus, such habitats within the project area very important to the many species they support. Special-status species are vulnerable to any habitat loss or degradation. The ability to move to other habitat through wildlife corridors is vital to many terrestrial species. Modification of existing terrestrial habitat in the project area, especially limited riparian and wetland habitat, would have the potential to cause adverse effects.

The evaluation of the project alternatives considered short-term construction effects as well as permanent effects on terrestrial resources. Outputs of sediment transport and

hydrologic models were used to identify predicted modifications of terrestrial vegetation communities and how that would affect wildlife habitat, including riparian areas, wetlands, and at reservoirs.

#### **3.5.4.2 Significance Criteria**

For the purposes of this EIS/EIR, impacts would be significant if they would result in the following:

- A substantial adverse effect, either directly or through habitat modifications, on any special-status terrestrial species identified in local or regional plans, policies, or regulations, or by the CDFG, USFWS, BLM, or USFWS;
- A substantial adverse effect on any riparian habitat;
- A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption, or other means;
- A substantial adverse effect on species considered significant to Indian Tribes;
- A substantial interference with the movement of any native resident or migratory wildlife species or with established native resident or migratory wildlife corridors; or
- A substantial adverse effect on natural communities through the introduction or spread of invasive plants.

#### **3.5.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

Under the No Action/No Project Alternative, the Four Facilities would remain in place. There would be no change to current sedimentation or scour rates in downstream river reaches.

As no construction would occur, there would be no impacts related to temporary loss of riparian habitat or direct mortality or disturbance of wildlife. No long-term habitat loss or gain would occur under the No Action/No Project Alternative. Existing habitat provided by the reservoirs would remain, which would benefit many species of birds, including waterfowl and bald eagles, bats, and other wildlife and plants that are supported by the aquatic habitat the reservoirs provide.

Populations of special-status plant and animal species, locally rare populations, and rare or threatened natural communities would continue to be influenced by various stressors in the Klamath Basin, including habitat degradation from surrounding land uses and invasive species. There would be no substantial changes to these stressors under the No Action/No Project Alternative. Under the No Action/No Project Alternative, existing wildlife corridors would remain. The reservoirs and other facilities would continue to present a barrier to movement of some terrestrial wildlife species.

The KBRA would not be implemented under the No Action/No Project Alternative; however, some Ongoing Restoration Actions would occur, including the Agency Lake and Barnes Ranches project which would breach existing dikes to convert the current

63,770 acre feet of pumped storage to passive storage in Upper Klamath Lake. This would provide benefits to waterfowl and their habitat in Upper Klamath Lake NWR through the re-establishment of a natural system of passive water storage. However, since the KBRA would not be fully implemented under the No Action/No Project Alternative, there would continue to be uncertainty regarding water deliveries to the NWRs, and subsequent impacts on terrestrial resources within the Lower Klamath NWR, Tule Lake NWR, and Upper Klamath NWR. Specifically, there would be continued impacts on wetland habitat, waterfowl, and nongame waterbirds that utilize the NWRs based on predicted water deliveries without implementation of the KBRA.

Adverse impacts on terrestrial resources under the No Action/No Project Alternative would be associated with the continuance of various stressors within the area of analysis, including habitat degradation, invasive species, barriers to movement of some terrestrial wildlife species, and uncertainties in water deliveries to the NWRs. **There would be no change from existing conditions for these threats under the No Action/No Project Alternative.**

**Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

The Proposed Action would include the complete removal of power generation facilities, bypass canals, pipelines, unnecessary transmission lines, dams, and dam foundations associated with the Four Facilities. The Proposed Action also includes implementation of the KBRA.

To facilitate dam removal, PacifiCorp reservoirs would be drawn down. Accumulated sediment behind the dams would be flushed downstream with river flows, particularly natural seasonal high flows, during dam removal. The drawdown of the reservoirs and dam demolition would begin in November 2019. It is assumed that blasting would be required to remove each of the dams. Blasting would occur between January and July 2020 and would be conducted twice a day (early morning and late afternoon) for up to six days per week during the dam removal period. As described in Section 3.23, Noise and Vibration, blasting would introduce noise levels up to a maximum of 94 A-weighted decibels (dBA) at a distance of 50 feet, while maximum levels for typical construction equipment would range from 75 dBA (pickup truck) to 90 dBA (mounted impact hammer/hoe ram) at 50 feet.

Drawdown of all reservoirs would occur at a rate that would minimize riverbank erosion, while maintaining regulatory discharge rates from the reservoirs (Greimann et al 2010). This rate would be adjusted depending on the water year, such that flow rates downstream of the dams would not increase significantly above regulatory rates.

Following drawdown of the reservoirs, existing upland vegetation is expected to remain unchanged and contribute to successional processes on newly exposed areas. Wetland-dependent vegetation currently along the margins of the reservoirs is expected to die out and transition to upland communities. Wetland species that occur near confluences may remain unchanged if the hydrology is unaltered, and could expand down to the river channel at reconnected tributaries. Passive restoration of wetland vegetation in areas

along the restored river channel is considered feasible, since relatively high densities of viable wetland vegetation seed are present in reservoir sediments based on seedbank analysis (DOI 2011a).

In contrast, active restoration would be needed for upland and riparian areas. In accordance with the Reservoir Area Management Plan (DOI 2011), the reservoir areas will be re-seeded with various herbaceous species (primarily grasses) following drawdown in the spring. Seeding is expected to occur via aerial application of hydromulch, as access to newly drawn down reservoir areas would be limited. Hydroseeding would occur prior to full drawdown, likely in stages as areas are exposed, and ultimately covering the entire area of exposed sediment following drawdown. It would be necessary to hydroseed before the reservoir sediment desiccates so that there is residual soil moisture for seed germination. Following hydroseeding, grasses would quickly germinate and grow on the exposed reservoir surfaces to stabilize the surface of the sediment, minimizing erosion. Invasive plant species would be controlled with the use of herbicides such as glyphosate that have low soil mobility and low toxicity to fish and aquatic organisms (DOI 2011a).

Riparian restoration activities would include planting of various woody species along the channel margins to stabilize the river banks and provide habitat for fish and other species. Pole plantings would be installed in the riparian/wetland zone once the reservoirs have been completely drawn down, the new river channel is established, and banks are stabilized so that labor crews can access riparian zones. Pole planting would occur in the spring the year after drawdown, ideal timing for establishment of woody species in riparian zones (DOI 2011a).

Following reservoir drawdown and prior to restoration activities, additional fencing may be necessary at the reservoir sites to keep livestock out and protect restoration areas, including Parcel B lands. If needed, any new fencing would be “wildlife-friendly” to enable elk and deer to jump over without getting entangled in barbed wire. The amount and location of additional fencing would be determined once the Definite Plan is available.

In addition to restoration of reservoir areas, many of the developed recreation sites around the reservoirs would be removed and restored following dam removal. This would include regrading, seeding, and planting of parking lots (DOI 2011a).

Due to the likelihood for invasive or weedy species to colonize newly exposed areas, and the known presence and proximity of large stands of upland invasive species near the reservoir shorelines, active control measures would be required to ensure native species are established. A Habitat Restoration Plan and construction specifications would be developed once the Definite Plan is available and would be submitted to the resource agencies for review and approval as part of required permit application packages prior to construction.

The Habitat Restoration Plan would include details for the installation of native plants and hydroseeding in appropriate areas to re-vegetate all areas disturbed during construction, including reservoir areas, demolition and disposal sites, staging, access and haul roads, and turn-arounds. Long-term maintenance and monitoring to control invasive species would be included. Performance standards to be met to ensure successful re-vegetation of disturbed areas will be developed as described in **Mitigation Measure TER-1** in Section 3.5.4.4.

In addition, to minimize the introduction of invasive plant species into construction areas, construction vehicles and equipment would be cleaned with compressed water or air within a designated containment area to remove pathogens, invasive plant seeds, or plant parts and dispose of them in an appropriate disposal facility.

#### **Construction Impacts on Wetland and Riparian Vegetation Communities**

*Construction of the Proposed Action could result in the loss of wetland and riparian vegetation communities.* Disturbances associated with construction areas and haul roads where clearing, grading, and staging of equipment would occur would have impacts on sensitive habitats, including wetlands and riparian habitats along reservoirs and river reaches. Culturally important species such as willows occur in these riparian areas. Heavy machinery traversing wetland and riparian areas could change local topography and destroy wetland and riparian vegetation, and could introduce hazardous materials that would adversely affect water quality in wetland and riparian areas.

Once the Definite Plan is prepared and construction areas are delineated, measures would be implemented prior and during construction to avoid and mitigate impacts to sensitive vegetation communities such as wetlands. During construction for the Proposed Action, wetlands within 50 feet of any ground disturbance and construction-related activities (including staging and access roads) would be clearly marked and/or fenced to avoid impacts from construction equipment and vehicles. If new temporary access roads are required, grading would be conducted such that existing hydrology would be maintained. In addition, best management practices (BMPs) would be implemented to address potential water quality impacts on wetlands. These construction BMPs are discussed further in Section 3.2, Water Quality. The following pollution and erosion control measures would be incorporated into the Proposed Action to prevent pollution caused by construction operations and to reduce contaminated stormwater runoff:

- Oil-absorbing floating booms would be kept onsite and the contractor would respond immediately to aquatic spills during construction.
- Vehicles and equipment would be kept in good repair, without leaks of hydraulic or lubricating fluids. If such leaks or drips do occur, they would be cleaned up immediately. Equipment maintenance and/or repair would be confined to one location at each project construction site. Runoff in this area would be controlled to prevent contamination of soils and water.
- Dust control measures would be implemented, including wetting disturbed soils.
- A stormwater pollution prevention plan would be implemented to control the release of stormwater from construction areas. The plan would also prevent construction

materials (fuels, oils, and lubricants) from spilling or otherwise entering waterways or water bodies.

**Incorporation of these elements into the Proposed Action would avoid or reduce temporary impacts on wetland and riparian vegetation communities including culturally important species that occur there to less than significant.**

#### **Construction Impacts on Wildlife**

*Construction activities could result in direct mortality or harm to special-status amphibian and reptile species during construction.* Construction would require heavy machinery to move through construction areas, staging areas, and haul roads where special-status amphibian and reptile species could occur. Contact with construction vehicles could result in direct mortality or injury to special-status amphibian and reptile species including western toad, western pond turtle, California mountain kingsnake, and common kingsnake.

To avoid or reduce the potential for mortality and disturbance of special-status species within construction areas for the Proposed Action, the following elements would be incorporated:

- **Biological Resources Awareness Training.** Before any ground-disturbing work (including vegetation clearing and grading) occurs in the construction area, a qualified biologist would conduct a mandatory biological resources awareness training for all construction personnel and the construction foreman. This training would inform the crews about special-status species that could occur on site. The training would consist of a brief discussion of the biology and life history of the special-status species; how to identify each species, including all life stages; the habitat requirements of these species; their status; measures being taken for the protection of these species and their habitats; and actions to be taken if a species is found within the project area during construction activities. Identification cards would be issued to shift supervisors; these cards would have photos, descriptions, and actions to be taken upon sighting of special-status species during construction. Upon completion of the training, all employees would sign an acknowledgment form stating that they attended the training and understand all protection measures. An updated training would be given to new personnel and in the event that a change in special-status species occurs.
- **Protocol-level Wildlife Surveys.** Prior to construction, a biologist approved by the resource agencies (USFWS, ODFW, and/or CDFG) would conduct protocol surveys to ensure no special-status animals are present within the area in which any construction activity would occur. If special-status species are present (except for birds), they would be captured and relocated to a suitable area in consultation with the resource agencies.
- **Exclusion Measures for Special-Status Wildlife.** Construction areas, including staging areas and access routes, would be fenced with orange plastic snow fencing to demarcate work areas. The approved biologist would confirm the location of the

fenced area prior to habitat clearing, and the fencing would be maintained throughout the construction period. Additional exclusion fencing or other appropriate measures would be implemented in consultation with the resource agencies to prevent use of construction areas by special-status species during construction.

- To prevent entrapment of wildlife that do enter construction areas during activities, all excavated, steep-walled holes or trenches in excess of 2 feet deep would be inspected by a biologist or construction personnel approved by the resource agencies at the start and end of each working day. If no animals are present during the evening inspection, plywood or similar materials would be used to immediately cover the trench, or it would be provided with one or more escape ramps set at no greater than 1,000 foot intervals and constructed of earth fill or wooden planks. Trenches and pipes would be inspected for entrapped wildlife each morning prior to onset of activity. Before such holes or trenches are filled, they would be thoroughly inspected for entrapped animals. Any animals so discovered would be allowed to escape voluntarily, without harassment, before activities resume, or removed from the trench or hole by a qualified biologist approved by the resource agencies and the animals would be allowed to escape unimpeded. A biologist approved by the resource agencies would be responsible for overseeing compliance with protective measures during clearing and construction activities within designated areas throughout the construction activities.
- General Requirements for Construction Personnel include the following:
  - The contractor would clearly delineate the construction limits and prohibit any construction-related traffic outside these boundaries.
  - Construction crews would be required to maintain a 20 miles per hour (mph) speed limit on all unpaved roads to reduce the chance of wildlife being harmed if struck by construction equipment.
  - All food-related trash items such as wrappers, cans, bottles, and food scraps generated during construction, subsequent facility operation, or permitted operations and maintenance activities of existing facilities would be disposed of in closed containers only and removed at least once a week from the site. The identified sites for trash collection would be fenced to minimize access from wildlife.
  - No deliberate feeding of wildlife would be allowed.
  - No pets would be allowed on the project site.
  - No firearms would be allowed on the project site.
  - If vehicle or equipment maintenance is necessary, it would be performed in the designated staging areas.
  - Any worker who inadvertently injures or kills a federally or state listed species, bald eagle, or golden eagle, or finds one dead, injured, or entrapped would immediately report the incident to the construction foreman or biological monitor. The construction foreman or monitor would notify the resource agencies within 24 hours of the incident.

These elements of the Proposed Action would avoid or reduce mortality and harm to special-status amphibian and reptile species during construction.

In addition to direct mortality and harm, the initial release of sediment from behind the dams could result in impacts on western pond turtle if it causes turtles to move away from underwater refugia and thus become more vulnerable to predators. Increased sediment following dam removal is anticipated to be a short-term effect immediately following dam removal. Western pond turtles utilize deep pools and low velocity areas with underwater refugia to hide from predators. Increased sediment may actually benefit turtles by providing substrate turtles burrow into for cover (Reese and Welsh 1998). Other important habitat features, such as availability of basking sites, are not anticipated to be adversely affected by the release of sediment. In the long term, sediment released during dam removal would be flushed out of downstream reached during subsequent high flow events. Dam removal is anticipated to result in benefits to western pond turtle by restoring a more natural flow regimes that increases slow-flowing pool habitat near the river banks and habitat heterogeneity overall (Reese and Welsh 1998). Therefore, there would be no adverse effects on western pond turtle from short-term sedimentation following dam removal. **Therefore, impacts on special-status amphibian and reptile species during construction would be less than significant.**

*Construction activities could result in adverse impacts on birds, including special-status bird species, during construction.* Potential impacts on migratory birds, including several special-status species, could occur through nest abandonment due to noise and human activity during construction periods.

It is anticipated that dam demolition activities (including blasting) would begin in January 2020 and mobilization of construction equipment would begin in the late fall of 2019. Construction activities that could result in noise and disturbance impacts on birds would include dam demolition, clearing of access and haul roads, upload staging and disposal sites, and restoration activities. While it would not be possible to exclude all birds from these construction areas throughout the construction period, the Proposed Action incorporates specific construction measures to avoid or reduce impacts on birds, as described below.

It is important to note that analysis of effects to northern spotted owl and other federally-listed species that could be affected by the Proposed Action will be evaluated in a Biological Assessment (BA) under Section 7 of the federal Endangered Species Act. Avoidance measures and project design standards will be detailed in the description of the Proposed Action in the BA.

#### Northern Spotted Owl

The Proposed Action incorporates specific elements that would avoid or reduce impacts on northern spotted owls. The northern spotted owl typically nests from February through September in the project area. Suitable northern spotted owl nesting and roosting habitat does not occur within one mile of the dams, and none is expected to grow by 2019 (personal communication with L. Roberts, USFWS, June 27, 2011). In addition, since

mobilization of construction equipment would begin in November 2019, noise and human presence would likely discourage northern spotted owls from initiating nesting near construction areas. Therefore, impacts on this species from the Proposed Action would be limited to disturbance during aerial hydroseeding that would occur during restoration activities. All landings, staging areas and flight paths would avoid suitable northern spotted owl nesting or roosting habitat by 0.25 mile.

In addition, prior to construction, a biologist approved by the resource agencies (USFWS, ODFW, and/or CDFG) would conduct protocol surveys endorsed by USFWS for northern spotted owls in all areas supporting suitable habitat that may be affected by construction, including along access roads and haul routes. If, during preconstruction surveys, an active nest of northern spotted owl is identified, a restriction buffer would be established in consultation with the resource agencies to ensure nests are not disturbed from construction. This would include evaluation of noise levels at the nesting site.

#### Bald Eagle

Bald eagles are protected under the Bald and Golden Eagle Protection Act and are fully protected under California law. The Proposed Action incorporates specific elements that would avoid or reduce impacts on bald eagles<sup>1</sup>. Bald eagle nesting trees are known to exist within or near to construction areas for the Proposed Action, and bald eagles often use the same nests in multiple years. Prior to construction, all necessary permits in compliance with the Bald and Golden Eagle Protection Act would be obtained. Measures incorporated into the Proposed Action to reduce impacts on bald eagles (and golden eagles) from loss of nesting habitat will include the following:

- Complete a two-year survey for eagle use patterns prior to construction activities. Surveys will be conducted by a qualified avian biologist and will include any facilities to be removed or modified to determine bird use patterns. Surveys will be conducted during the time of year most likely to detect eagle usage.
- Prior to construction, conduct at least one focused survey for bald eagle nests within 2 miles of construction areas, including along access roads and haul routes, during the early bald eagle breeding season (January 15 through February 28). Three additional surveys would be conducted; two between March 1 and April 1, and one after April 1. Additional survey visits would be conducted to determine if eagles are nesting within 2 miles of the construction area. Before commencing construction activities during the early breeding season, at least one survey would be conducted within two weeks prior to beginning operations.
- Wherever possible, clearing, cutting, and grubbing activities shall be conducted outside the eagle breeding period (January 15 through August 15);

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<sup>1</sup> The discussion presented in this section includes both BMPs that would be incorporated during construction as well as mitigation measures in order to facilitate the development of compliance documentation for the Bald and Golden Eagle Protection Act. These BMPs are also described in Appendix B.

- If active nests are present within 2 miles of construction areas, a 0.5-mile restriction buffer would be established in consultation with the resource agencies to ensure nests are not disturbed. If active bald eagle nests are present within 0.5 miles of construction areas, construction activities would be halted until approval is obtained from the resource agencies to resume. If a nest is not within line of site of the project, meaning that trees or topographic features physically block the eagle's view of construction activities, the buffer could be reduced to 0.25 miles

### Golden Eagle

Golden eagles are protected under the Bald and Golden Eagle Protection Act and are fully protected under California law. The Proposed Action incorporates specific elements that would avoid impacts on golden eagles<sup>2</sup>. Golden eagles are known to have historically nested in cliffs within the project area. Golden eagles are also known to nest within pine, juniper and oak trees.

Measures incorporated into the Proposed Action to reduce impacts on golden eagles from loss of nesting habitat will include the following:

- Complete a two-year survey for eagle use patterns prior to construction activities. Surveys will be conducted by a qualified avian biologist and will include any facilities to be removed or modified to determine bird use patterns. Surveys will be conducted during the time of year most likely to detect eagle usage.
- Prior to construction, at least one protocol survey for golden eagle nests would be conducted within 5 miles of construction areas, including along access roads and haul routes, during the breeding season (January through July). Before commencing construction activities during the early breeding season, at least one focused survey would be conducted within two weeks prior to beginning operations. Additional survey visits would be conducted to determine if eagles are nesting within 2 miles of the construction area.
- Wherever possible, clearing, cutting, and grubbing activities shall be conducted outside the eagle breeding period (January through July).
- If active nests are present within 2 miles of construction areas, a 1-mile restriction buffer would be established in consultation with the resource agencies to ensure nests are not disturbed. If active golden eagle nests are present within 1 mile of construction areas, construction activities would be halted until approval is obtained from the resource agencies to resume. If an active nest is not within line of site of the project, meaning that trees or topographic features physically block the eagle's view of construction activities, the buffer could be reduced to 0.5 miles.

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<sup>2</sup> Please note that the discussion presented in this section includes both BMPs that would be incorporated during construction as well as mitigation measures in order to facilitate compliance with the Bald and Golden Eagle Protection Act. These BMPs are repeated in Appendix B.

It is noted that USFWS is not currently issuing permits authorizing take for golden eagles under the Bald and Golden Eagle Protection Act.

#### Osprey

The Proposed Action incorporates specific elements that would avoid or reduce impacts on ospreys. Known osprey nests are located within or near to construction areas for the Proposed Action. Some osprey nests are located on transmission line poles or other man-made platforms that would be removed during construction for the Proposed Action, or are located within areas where construction noise or human presence would cause disturbance to the birds. To avoid nesting disturbance, the nests located within or near to construction areas would be removed prior to the breeding season and replaced with nesting platforms following construction on a 1:1 basis. In addition, a search for osprey nests within 0.25 mile of construction areas, including along access roads and haul routes, would be conducted prior to beginning operations and during the breeding season, which begins in February. If active nests are present, a 0.75-mile restriction buffer would be established and delineated on maps and resource agencies would be consulted to obtain concurrence prior to conducting construction activities.

#### Willow Flycatcher

The Proposed Action incorporates specific elements that would avoid or reduce impacts on willow flycatcher. Prior to construction during the nesting season of June 1-August 31, a focused survey for willow flycatcher would be conducted within construction areas, including along access roads and haul routes. The survey would follow the established protocol described in Bombay et al (2003). If active willow flycatcher nests are detected, a 0.5-mile restriction buffer would be established and delineated on maps and resource agencies would be consulted to obtain concurrence prior to conducting construction activities.

#### Peregrine Falcon

Peregrine falcons, a fully protected species, are known to occur along the J.C. Boyle bypass reach, and have the potential to occur elsewhere in the project area. Specific elements described below (see Other Migratory Birds) would be incorporated during construction, including nesting surveys, to avoid or reduce impacts on peregrine falcons. If nesting peregrine falcons are detected, a restriction buffer would be established prior to conducting construction activities.

#### Greater Sandhill Crane

Greater sandhill cranes, a fully protected species, are known to occur in the project area, and have been documented nesting along the J.C. Boyle Reservoir. Specific elements described below (see Other Migratory Birds) would be incorporated during construction, including nesting surveys, to avoid or reduce impacts on greater sandhill cranes. If nesting sandhill cranes are detected, a restriction buffer would be established prior to conducting construction activities.

### Other Migratory Birds

The Proposed Action incorporates the following specific elements that would avoid or reduce impacts on migratory birds from removal, destruction, or disturbance of active nests during construction:

- Removal or trimming of any trees or other vegetation for construction would be conducted outside of the nesting season (March 20 through August 20). This would include removal or trimming of trees along access roads and haul routes and within disposal sites.
- Where clearing, trimming, and grubbing work cannot occur outside the migratory bird nesting season, a qualified avian biologist will survey construction areas to determine if any migratory birds are present and nesting in those areas.
- For all raptors (other than eagles), inactive nests will be removed before nesting seasons begin, to the greatest extent practicable. For those nests where access is difficult, traffic cones or other deterrents will be placed in the nest platform to prevent nesting in the year of construction. All deterrents will be removed as soon as possible after construction crews have passed to a point beyond the disturbance buffer for that species. See **Mitigation Measure TER-2** (Section 3.5.4.4, Table 3.5-5).
- If an active nest is located, a restriction buffer in accordance with **Mitigation Measure TER-2** (Section 3.5.4.4, Table 3.5-5) would be established and the resource agencies would be consulted to obtain concurrence prior to conducting construction activities.

Incorporation of these elements into the Proposed Action and implementation of **Mitigation Measures TER-2** and **TER-3** would avoid or reduce impacts on birds during construction<sup>3</sup>. **Therefore, impacts on birds, including special-status bird species, during construction would be less than significant.**

### **Construction Impacts on Plants**

*Construction activities could result in the loss of special-status plants during construction.* Special-status plants occurring in construction areas could be destroyed by heavy equipment. Prior to the implementation of construction activities, a botanist approved by the resource agencies would conduct protocol-level surveys within construction areas for special-status plants during the peak blooming season prior to start

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<sup>3</sup> The discussion presented in this section includes both BMPs that would be incorporated during construction as well as mitigation measures in order to facilitate the development of compliance documentation for the Bald and Golden Eagle Protection Act. These BMPs are also described in Appendix B.

of construction. If any special-status plants occur within the construction areas, locations of these plants would be clearly marked and/or fenced to avoid impacts from construction equipment and vehicles where possible.

In addition, to avoid or reduce impacts on special-status plants from the introduction of invasive plant species, construction vehicles and equipment would be cleaned with compressed water or air within a designated containment area to remove pathogens, invasive plant seeds, or plant parts and dispose of them in an appropriate disposal facility. The Habitat Restoration Plan would include details for the installation of native plants to re-vegetate all areas disturbed during construction. Long-term maintenance and monitoring to control invasive species would be included.

It is important to note that analysis of effects to Applegate's milk-vetch (*Astragalus applegatei*) and other federally-listed plant species that could be affected by the Proposed Action are evaluated in a BA under Section 7 of the federal Endangered Species Act. Determination of impact significance for federally-listed plant species in this EIS/EIR is consistent with the findings of the BA.

Following any positive Secretarial Determination and during development of the Definite Plan, additional measures would be included as needed for "Survey and Manage" species to comply with the requirements of the applicable Land and Resource Management Plan for any activities on National Forest System lands.

Incorporation of these elements into the Proposed Action and implementation of **Mitigation Measures TER-1 and TER-4** would avoid or reduce impacts on special-status plants during construction<sup>4</sup>. **Therefore, impacts on special-status plants during construction would be less than significant.**

*Construction activities could result in adverse impacts on wildlife from riparian habitat loss.* Impacts from temporary loss of riparian habitat would affect wildlife that use this habitat, particularly several common amphibian species, such as Pacific giant salamander and several bird species, including several species of special-status riparian birds such as willow flycatcher, yellow warbler, and yellow-breasted chat. In addition, western pond turtle, a special-status reptile, could be affected by the loss of this habitat. As discussed below, there would be gains in riparian habitat at the reservoirs following dam removal and restoration. In addition, localized disturbance of riparian habitat downstream due to sedimentation is expected to be short-term, with colonization of riparian plant seedlings and subsequent re-vegetation of riparian areas within three years following implementation of the Proposed Action. **Therefore, impacts on wildlife using riparian habitat would not be significant.**

### **Long-Term Habitat Loss and/or Modification**

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<sup>4</sup> The discussion presented in this section includes both BMPs that would be incorporated during construction as well as mitigation measures in order to facilitate the development of compliance documentation for the Bald and Golden Eagle Protection Act. These BMPs are also described in Appendix B.

Permanent alteration of existing habitats would have long-term impacts on plants and animals that occur in these habitats, including special-status plants and wildlife species.

#### Loss of Aquatic Habitat at Reservoirs

*Removal of reservoirs could result in impacts on wildlife from the permanent loss of aquatic habitat.* Following dam removal, aquatic habitat at reservoirs would become riverine, riparian, and upland habitat depending on future hydrologic and physical (topographic) conditions. Water birds that use the reservoirs seasonally during migration and/or for overwintering would be affected by the loss of this aquatic habitat for nesting, foraging, loafing, and roosting. The loss of aquatic habitat would also reduce foraging opportunities for fish-eating birds including osprey, merganser, cormorant, egret, and heron. Changes in food availability for birds such as dabbling ducks that consume aquatic vegetation and invertebrates would occur. However, these species would utilize the river or other aquatic habitat outside the project area for foraging once the reservoirs are gone. Similarly, foraging habitat for swifts and bats would be reduced; however, swifts and bats would also feed in riverine habitat once the reservoirs are gone.

The loss of aquatic habitat at reservoirs would reduce habitat for western pond turtle. However, turtles would utilize future restored riverine habitat at the former reservoir areas as they do currently along the J.C. Boyle peaking reach, Iron Gate-Shasta River reach, and other areas. There are at least five known bald eagle nests near Copco and J.C. Boyle Reservoirs, and additional nest locations are located between these two areas and upstream (personal communication with R. Larson, USFWS, March 13, 2011). Since bald eagles primarily use the Lower Klamath NWR for preying on waterfowl, there would be some anticipated effects on bald eagles from loss of this reservoir habitat. However, bald eagles would utilize riverine habitat or other aquatic habitat outside the project area for foraging.

PacifiCorp estimated that decommissioning and removal of the Four Facilities would result in the loss of a total of about 2,404 reservoir acres (FERC 2007). Compared to the large reservoirs and wetland complexes of Upper Klamath Lake (approximately 77,000 acres), Tule Lake (approximately 13,000 acres), and Lower Klamath Lake (approximately 22,000 acres of which approximately 2,200 acres are permanently flooded), the project reservoirs represent a small amount of the available reservoir habitat in the Klamath Basin when wetland and aquatic habitat at the NWRs is at full capacity. Based on National Wetland Inventory data, there are approximately 380,000 acres of wetlands in the Oregon portion of the upper Klamath Basin (Larson and Brush 2010).

It is also important to note that under the Proposed Action, much of the aquatic reservoir habitat would be converted to upland and riparian habitat based on future hydrology and with active restoration activities (hydroseeding and planting) described above (DOI 2011a). Upland vegetation restoration would occur at a total of approximately 1,602 acres following reservoir drawdown: 195 acres at J.C. Boyle Reservoir, 632 acres at Copco 1 Reservoir, and 775 acres at Iron Gate Reservoir. Restoration of wetland/riparian habitat would occur at a total of 272 acres following reservoir drawdown: 52 acres at

J.C. Boyle Reservoir, 170 acres at Copco 1 Reservoir, and 50 acres at Iron Gate Reservoir (DOI 2011a).

At Copco 1 and Iron Gate Reservoirs there is approximately 1,400 acres of upland habitat types that are currently inundated by the reservoirs. These habitat types include grassland, juniper, oak woodland, mixed chaparral, pasture, orchard and agriculture (PacifiCorp 2004a). Removing the dams, specifically removal of Iron Gate and Copco 1 Reservoirs, would increase the amount of available acres of habitat within critical deer winter range in the long term, benefitting deer by expanding winter range habitat (personal communication with J. Hamilton, USFWS, January 7, 2011).

In addition, based on historic maps and aerial photos, PacifiCorp (2004a) estimated historic aquatic habitat types at the reservoirs to be approximately 125 acres at J.C. Boyle Reservoir, 119 acres at Copco 1 Reservoir, and 108 acres at Iron Gate Reservoir (Copco 2 Reservoir was not mapped). Thus, a total of approximately 350 acres of aquatic habitat occurred historically and would be expected to be available for restoration following reservoir drawdown.

**Therefore, while unavoidable impacts on wildlife, particularly waterfowl and other waterbirds, from the permanent loss of reservoir habitat would occur under the Proposed Action, these impacts would be less than significant.**

#### Modification of Riparian Habitat

*Dam removal could result in long-term impacts on riparian habitat from sedimentation in downstream reaches.* After the dams are removed and if sediment is allowed to flush downstream, the steep riverbank slopes along the reservoirs would cause the new river channel to conform to the pre-dam river channel alignment (Gathard Engineering Consultants [GEC] 2006). Riverbank stabilization and re-vegetation of riverbank with native plantings would be conducted at each reservoir after the drawdown is complete. This restoration would occur in areas with slopes less than 20 percent, and would entail transplanting and pole-planting of trees and woody shrubs with interspersed seeding of herbaceous species. In addition to erosion control, restoration would exclude invasive plant species from colonizing un-vegetated areas exposed by reservoir drawdown.

Thus, riparian habitat at reservoirs would increase with restoration following drawdown. PacifiCorp estimated that decommissioning and removal of the Four Facilities would add about 184 acres of riparian vegetation. This estimate was based on the assumption of an average riparian corridor width of 100 feet along the 3.6-mile length of the J.C. Boyle Reservoir, the 4.5-mile length of the Copco Reservoir, the 0.3-mile length of the Copco 2 Reservoir, and the 6.8-mile length of the Iron Gate Reservoir (FERC 2007).

The establishment of woody species along the riparian corridor is expected to take several years, following which there would be benefits to terrestrial wildlife, particularly riparian-associated species. With control and monitoring of invasive plants, there would also be benefits to native plant species.

In downstream reaches of the Klamath River, no adverse erosion of riverbanks would be anticipated based on expected flow rates. However, based on modeling conducted using the DREAM-1 modeling software to simulate downstream sediment deposition following dam removal, sedimentation would be likely to occur, particularly if the number of intense storms or snowmelt were low during the 2019-2020 season and in subsequent years. This sedimentation would be limited to downstream reaches as far as Cottonwood Creek. If rain and snowmelt levels were high, less sedimentation in downstream reaches would occur, as there would be more water in the system to flush out sediment (Stillwater Sciences 2008).

Sediment sampling in the reservoirs has indicated that the majority of accumulated sediment is fine-grained (coarse sand and finer) (DOI 2010). If the sediment is allowed to move downstream naturally, it is likely that some sedimentation would occur in deep pools or channel margins downstream during low-flow periods and cover wetland/riparian with a veneer of fine material (DOI 2011b). This short term wetland/riparian habitat alteration would be localized and would not be substantial. Additionally, this sediment would be flushed out during subsequent high flow events (see Section 3.11 Geology, Soils and Geologic Hazards). Sedimentation has the potential to create new surfaces for riparian plants to colonize, and result in beneficial effects on riparian habitat (Shafroth et al. 2002). Effects on existing riparian habitat from sedimentation would be short-term in nature, as riparian vegetation would quickly be re-established through colonization by seedlings of willows, cottonwoods, and other riparian species. This colonization occurs following disturbance during peak flows that creates substrate for seedlings, followed by declining spring and summer flows that occur during seed dispersal. Under this natural process, new riparian vegetation would become established within 3-5 years after disturbance (Riparian Habitat Joint Venture 2009). Based on this assessment, no permanent loss of riparian habitat is anticipated to occur in any river reaches. There would be gains in riparian habitat (approximately 184 acres) at the reservoirs through restoration efforts following dam removal and reservoir drawdown. **Both short- and long-term impacts on riparian habitat would be less than significant.**

#### Long-term Impacts on Wetlands

*Dam removal could result in loss of reservoir wetlands.* A substantial amount of the historical wetlands of the Upper Klamath Basin have been lost to agricultural developments and water diversions (Larson and Brush 2010). As a result, there is less wetland habitat for waterfowl than there was prior to development, but abundant food for dabbling ducks and geese that feed on small grains in fields surrounding the wetlands (Jarvis 2002). Under the Proposed Action, there would be unavoidable impacts on wetland habitat at the J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs (245 acres, Table 3.5-2). However, wetlands would be expected to become reestablished in some areas along the new river channel with adequate hydrology, soils, and vegetation. As these areas would be prone to colonization by invasive plant species, management and control of invasives would be needed.

Impacts on wetlands under the Proposed Action would be a significant impact because of the historical loss of wetlands and the regulatory framework of laws and regulations for wetland protection. **Mitigation Measure TER-5 would reduce this impact on wetlands to less than significant.** See Section 3.5.4.4.

Long-term Impacts on Wildlife Habitat from Tree and Vegetation Removal

*The Proposed Action would result in long-term impacts on wildlife habitat from tree and vegetation removal.* During construction, some trees and other vegetation that provides habitat for birds and other wildlife would be removed at construction areas, upland disposal sites, equipment staging areas, and access and haul roads. Following construction, restoration of this habitat would be conducted through the planting of native vegetation in accordance with a Habitat Restoration Plan approved by the resource agencies. In addition, if known nesting trees or platforms used by osprey or other raptors (except eagles) are removed, they would be replaced on a 1:1 basis as part of the Proposed Action. No known nesting sites for bald or golden eagles or northern spotted owl would be removed under the Proposed Action. **Therefore, long-term impacts on wildlife habitat from tree and vegetation removal would be less than significant.**

It is important to note that analysis of effects to northern spotted owl and other federally-listed species that could be affected by the Proposed Action are evaluated in a BA under Section 7 of the federal Endangered Species Act. Determination of impact significance for the northern spotted owl and other federally-listed species in this EIS/EIR is consistent with the findings of the Biological Assessment.

Long-term Impacts on Bats from Loss of Roosting Habitat

*The Proposed Action would result in long-term impacts on bats from loss of roosting habitat.* Impacts on bats would occur from the loss of dam structures and associated facilities used as roosting habitat. Based on surveys conducted by PacifiCorp in 2003, bats roost in all four dams or in their associated facilities and structures (FERC 2007). Multi-species colonies of bats, which have been documented using these structures, are likely to contain one or more special-status bat species, and regardless of listing status, the loss of a bat colony site or adverse effects to an active colony would be a significant impact. **Mitigation Measure TER-6 would reduce impacts on bats to less than significant.** See Section 3.5.4.4.

Long-term Impacts on Amphibian Habitat

*Dam removal could result in long-term impacts on amphibians from habitat degradation due to sedimentation in downstream reaches of the Klamath River.* Sediment inputs in downstream reaches could fill riffle substrate in some areas, reducing localized habitat for the larval phases of amphibian species such as Pacific giant salamander. However, most sediment is expected to be flushed out during subsequent high flow events (Stillwater 2008), and restoring a more natural sediment regime would be expected to benefit amphibian habitat in the long-term. In addition, removal of reservoirs would reduce populations of non-native bullfrogs which prey on native amphibians. **Therefore, long-term impacts on amphibian habitat would be less than significant.**

### Long-term Impacts on Special-Status Species at the Reservoirs

*The Proposed Action could result in impacts on special-status species from loss of aquatic habitat at reservoirs.* Permanent loss of wetland and aquatic habitat at reservoirs would adversely affect special-status species populations that use these habitats. Specifically, western toad and western pond turtle have been documented at the four reservoirs in the project area, and over 25 species of special-status birds use aquatic and wetland habitat and the reservoirs.

#### Bald Eagles at the Reservoirs

Loss of aquatic habitat following reservoir drawdown would result in impacts on bald eagles that nest at the reservoirs. These eagles could use riverine habitat once the reservoirs are gone, or move to other aquatic habitat such as the large reservoirs of the NWRs. **Therefore, long-term impacts on bald eagles would be less than significant.**

#### Great Blue Heron Colony at Copco Reservoir

Under the Proposed Action the drawdown and conversion of reservoirs to riverine habitat may adversely affect a great blue heron colony documented at the Copco Reservoir. This colony would use riverine habitat once the reservoirs are gone, or move to other aquatic habitat nearby. **Therefore, long-term impacts on great blue heron would be less than significant.**

#### Special-Status Plants at the Reservoirs

Wetland habitat at reservoir margins supports several species of special-status plants (Table 3.5-4). Many of these plants, including Applegate's milk-vetch, short-podded thelypodium, Columbia yellow cress, and salt heliotrope, occur at only the Keno Impoundment which would not be drawn down under the Proposed Action. However, there is potential for special-status plants to occur at the reservoirs that would be drawn down, and therefore there would be loss of habitat for these species once the reservoirs are removed. Protocol-level surveys for special-status species would be conducted prior to construction to determine the location of special-status plants. If found, **Mitigation Measure TER-4** (Section 3.5.4.4) would be implemented to reduce impacts. **Therefore, long-term impacts on special-status plants would be less than significant.**

### Impacts on Culturally Important Species

*The Proposed Action could result in impacts on culturally important species.* Willows, which are riparian-dependent plants, are culturally important to Indian Tribes who use them for basket-making. As discussed above, riparian habitat is expected to increase in the long-term at the reservoirs, and any loss of riparian habitat from sedimentation downstream of the dams is anticipated to be short-term in nature. Since willows are one of the first species to re-colonize following disturbance (Riparian Habitat Joint Venture 2009), impacts on these culturally important plants are not anticipated to be significant. No effects on other culturally important plants are anticipated. **Therefore, impacts on culturally important species would be less than significant.**

#### Effects on Wildlife Corridors

*The Proposed Action would result in impacts on wildlife corridors.* The Proposed Action would be expected to provide beneficial effects on terrestrial wildlife movement.

Removal of PacifiCorp structures and open water reservoirs and restoration of the pre-dam river channel would eliminate areas of wide deep water crossings that are a hindrance to large and small mammal movements from one side of the river to the other. More narrow and shallower water crossing points would be available for both large and small terrestrial species to cross the river. This would provide benefits in increasing the amount of habitat available for these species, making them less vulnerable to disease and other environmental stressors than before dam removal. Increased movement could also increase genetic diversity in previously separate populations. **Therefore, the Proposed Action would result in beneficial effects on wildlife corridors.**

#### Effects Related to Invasive Plant Species

*The Proposed Action could result in native vegetation impacts related to invasive plants.* Under the Proposed Action, there would be potential for invasive plant species to quickly re-colonize exposed reservoir bottoms and other disturbed soil areas and out-complete native plants. In addition, invasive plant seeds could be transported to downstream areas following removal of the dams, particularly those plants that disperse by water (Nilsson et al 2010, Merritt & Wohl 2002, Merritt et al. 2010, Merritt & Wohl 2002). A Reservoir Area Management Plan (DOI 2011a) would be implemented for restoration of native plants and habitat communities at the reservoirs. In addition, the Habitat Restoration Plan would be implemented for restoration of native habitats at upland areas disturbed by construction, including disposal sites, access and haul roads, and equipment staging areas. Other specific elements of construction include measures to prevent the introduction of invasive plant species. All construction vehicles and equipment would be cleaned with compressed water or air within a designated containment area to remove pathogens, invasive plant seeds, or plant parts and dispose of them in an appropriate disposal facility. Implementation of the Reservoir Area Management Plan and the Habitat Restoration Plan would include long-term maintenance and monitoring to control invasive species. See **Mitigation Measure TER-1** in Section 3.5.4.4.

It is noted that reed canarygrass, which is found along the margins of some of the reservoirs and in many riparian areas along the Klamath River, is an invasive plant that can colonize quickly and out-compete native plants. After draw down of the reservoirs, it is likely that populations of reed canarygrass along the reservoir margins would die (personal communication with R. Larson, USFWS, March 13, 2011).

In addition, seasonal high flows under the Proposed Action would contribute to improving the quality of riparian habitat in the J.C. Boyle bypass reach by decreasing the prevalence of reed canarygrass (Administrative Law Judge 2006).

Implementation measures during construction and restoration following construction in accordance with **Mitigation Measure TER-1** (Section 3.5.4.4) would avoid or reduce impacts related to invasive plants. **Therefore, impacts related to invasive plants would be less than significant.**

#### Installation of the Yreka Water Supply Pipeline

*The Proposed Action would require the Yreka water supply pipeline to be relocated, which could result in construction impacts on terrestrial resources.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and would have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline would either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Road Bridge below Iron Gate Dam. Surveys are still required to determine if the bridge is adequate to support the pipeline and the construction traffic from the decommissioning activities. A detailed discussion of the traffic impacts and road conditions concerns is provided in Section 3.22, Traffic and Transportation, and Mitigation Measure TR-1 addresses these concerns. Construction of a pipe bridge in the existing location or placing the pipeline along an existing road and bridge would have temporary construction impacts on terrestrial resources within construction areas. Elements incorporated into construction and implementation of **Mitigation Measures TER-1** through **TER-4** (Section 3.5.4.4), as necessary, would avoid or reduce these impacts. Habitat restoration in accordance with **Mitigation Measure TER-1** (Section 3.5.4.4) would reduce long-term impacts in construction areas to less than significant. **Therefore, impacts on terrestrial resources would be less than significant.**

#### Replacement of the Iron Gate Fish Hatchery Water Supply Pipeline

Under the Proposed Action, the Iron Gate Fish Hatchery would remain in place, but the water supply pipeline from the penstock intake structure to the fish hatchery would be removed with the dam. Under the KHSA, PacifiCorp is responsible for evaluating hatchery production options that do not rely on the current Iron Gate Hatchery water supply. PacifiCorp is also responsible for proposing and implementing a post-Iron Gate Dam Hatchery Mitigation Plan (Hatchery Plan) to provide continued hatchery production for eight years after the removal of Iron Gate Dam; and this Hatchery Plan would be developed with information from PacifiCorp's evaluation. However, PacifiCorp is not required to propose a Hatchery Plan until six months following an affirmative Secretarial Determination. The Lead Agencies do not currently know what PacifiCorp will propose in the Hatchery Plan and are unlikely to know unless there is an affirmative Secretarial Determination. An impact analysis of a hatchery production option that does not rely on the current Iron Gate water supply would be purely speculative at this point. Therefore, the potential environmental effects of implementing a hatchery production option that does not rely on the current Iron Gate water supply are not analyzed in this EIS/EIR.

#### Relocation of Recreation Facilities

*The Proposed Action would require the relocation of existing recreation facilities, which would require the construction of new facilities along the river bank.* Recreation facilities, such as campgrounds and boat ramps, currently located on the reservoir banks would be relocated down slope to be near the new river bed once the reservoir is removed. Impacts specific to the relocation of the Recreation Facilities are discussed in Section 3.20, Recreation. Temporary construction impacts on terrestrial resources could occur at the existing recreation facility sites from contact between wildlife and equipment

and habitat disturbance. Elements incorporated into construction would avoid or reduce these effects, and **Mitigation Measures TER-1** through **TER-4** (Section 3.5.4.4) would be implemented, as necessary, to avoid or reduce impacts. The relocation would occur on lands that are currently inundated and provide no existing habitat to terrestrial species, and would not impede habitat restoration efforts. **Therefore, impacts on terrestrial resources would be less than significant.**

**Keno Transfer**

*Implementation of the Keno Transfer could cause impacts to terrestrial resources.* The Proposed Action includes the Keno Transfer, a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on terrestrial resources compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable laws and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

**East and West Side Facility Decommissioning**

*Decommissioning the East and West Side Facilities could cause adverse effects to terrestrial resources.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. The decommissioning action would not be expected to result in the disturbance of any currently undisturbed habitat. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

**KBRA**

Implementation of programs under the KBRA would increase the amount of water in the Klamath River and maintain the elevation of Upper Klamath Lake. Water allocations and delivery obligations would also be established for the Lower Klamath NWR and Tule Lake NWR. During implementation of KBRA actions described below, special-status species and their habitats would be protected through coordination with resource agencies for compliance with the Endangered Species Act and development of habitat conservation plans by non-federal parties.

The KBRA has several programs that could result in impacts on terrestrial resources, including:

- Phases I and 2 Fisheries Restoration Plan
- Fish Entrainment Reduction
- Wood River Wetland Restoration
- Water Diversion Limitations
- On-Project Plan
- Water Use Retirement Program (WURP)
- Interim Flow and Lake Level Programs

- Mazama Forest Project

### **Fisheries Restoration Plan- Phase I and Phase II**

*Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II could result in impacts on terrestrial wildlife and/or habitat.* The Fisheries Restoration Plan would include measures to restore riparian and floodplain vegetation throughout the Klamath Basin. Actions that could have impacts on terrestrial resources within the project area are described below.

#### *Floodplain Rehabilitation*

Floodplain rehabilitation may include activities such as riparian planting and understory thinning to facilitate the development of mature riparian stands. During construction, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these floodplain rehabilitation actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant. In the long term, terrestrial species that utilize riparian habitat are expected to benefit from floodplain rehabilitation and associated improvements to riparian habitat.**

#### *Wetland and Aquatic Habitat Restoration*

These activities may involve hydroseeding for creation of grass banks. During construction, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these habitat restoration actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant.**

#### *Woody Debris Placement*

These activities may involve the use of construction equipment to place large wood in the stream channel or along banks. During construction, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact

with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these woody debris placement activities could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant.**

#### *Fish Passage Correction*

These activities may include culvert upgrades or replacements. During construction, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these fish passage correction actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant.**

#### *Cattle Exclusion Fencing*

This would entail the construction of fencing along riparian areas. During construction, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these cattle exclusion fencing installation actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant. In the long term, terrestrial species that utilize riparian habitat are expected to benefit from the establishment of riparian vegetation.**

#### *Mechanical Thinning and Prescribed Burning*

The structure and species composition of many forested stands have been altered through fire exclusion and past and on-going timber management. This includes mixed conifer

forests, oak woodlands, and aspen. The alteration of these stands has resulted in the degradation of habitat for species associated with these vegetative communities. Additionally, many of these stands exhibit high amounts of surface and ladder fuels, increasing the potential for uncharacteristically severe wildfire. The following best management practices can reduce the effects on plants and wildlife related to vegetation management:

- Small diameter thinning of overstocked upland forests to promote development of structurally diverse stands with desired species composition and variable densities, and to reduce the risk of uncharacteristically severe wildfire.
- Prescribed burning in upland forested habitats to promote the development of understory growth and reduce the amount of small to medium diameter surface fuels.
- In oak stands, small diameter thinning (typically < 9" dbh) of dense oaks to promote the development of large structurally diverse oak trees.
- Removal of encroaching juniper (up to 15" dbh).
- Installing fencing around aspen stands to exclude livestock and allow for the passive restoration of aspen trees combined with planting of native shrubs.

These activities are anticipated to result in benefits to terrestrial wildlife from restoration of upland habitats. However, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these mechanical thinning and prescribed burning actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant.**

#### *Road Decommissioning*

Construction activities associated with road decommissioning could result in adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these road decommissioning actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility

removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant.**

#### *Gravel Augmentation*

Placement of gravel in the stream using backhoes could result in adverse effects on terrestrial species, including special status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The timing of and specific locations where these gravel augmentation actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant.**

Each of the actions under the Phase I Fisheries Restoration Plan would require separate project-level evaluations under National Environmental Policy Act (NEPA) and Federal Endangered Species Act (ESA), as appropriate.

#### **Fish Entrainment Reduction**

*Construction activities associated with Fish Entrainment Reduction could result in impacts on terrestrial wildlife and/or habitat.* Fish Entrainment Reduction would entail the installation of fish screens at various water diversion structures for the Klamath Reclamation Project. There could be adverse impacts on riparian vegetation and wildlife habitat within these localized construction areas. During construction, there could be adverse effects on terrestrial species, including special-status amphibians and reptiles, from direct contact with construction equipment and loss of habitat. There could be impacts on special-status bird species such as bald and golden eagle and northern spotted owl from disturbance during nesting. There could also be impacts on special-status plants if they occur in construction areas. The geographic location and timing of fish screen installation reduces the potential for any negative terrestrial resource effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. Implementation of construction-related BMPs would occur during fish screen construction to avoid or reduce these impacts. **However, impacts would be potentially significant. Implementation of Mitigation Measures TER- 1 through TER- 4 would reduce these impacts to less than significant. Impacts on terrestrial resources from specific construction activities would be further analyzed as a part of future environmental compliance, as appropriate.**

#### **Wood River Wetland Restoration**

*Modification of aquatic habitat from the Wood River Wetland Restoration project could result in impacts on terrestrial wildlife and/or habitat.* Implementation of this project

may reconnect subsided wetlands adjacent to Agency Lake to provide additional water storage. Therefore, this project is anticipated to benefit waterfowl, water birds, and other species that utilize wetlands and aquatic habitat through increased reliability of water to wetland habitat. The geographic location and timing of this project reduce the potential for any negative terrestrial resource effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. However, some adverse effects could also occur to some species, depending on whether habitats are managed as marsh or open water. **Impacts on terrestrial wildlife and/or habitat would be less than significant.**

#### **Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Program**

*The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat.* In general, additional water supply would be expected to increase the numbers of waterfowl using the National Wildlife Refuges.

Using the Water Resource Integrated Modeling System (WRIMS), the USFWS (2010) conducted an analysis of the effects of the Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs on three NWRs (Lower Klamath NWR, Tule Lake NWR, and Upper Klamath NWR). The following paragraphs provide a summary of the findings of that analysis.

#### **Lower Klamath NWR**

##### Impacts on Water Delivery Needed to Support Wetland Habitat

Lower Klamath NWR water demand was modeled using WRIMS to estimate quantities of water delivered to the refuge under both the No Action/No Project Alternative and the Proposed Action Alternative through both the Ady Canal and D-Plant (USFWS 2010). For each time step in the model, the total refuge demand was approximated based on the area of habitat and the water requirement for that habitat. Modeling results indicate water delivery to Lower Klamath NWR would be greater if KBRA was implemented than under the No Action/No Project Alternative. By estimating the amount of water needed per wetland habitat type, USFWS (2010) determined that the Refuge would support more wetland habitat if KBRA was implemented than under the No Action/No Project Alternative.

D-Plant pumping is critical to serving the needs of some marsh units at Lower Klamath NWR that cannot be reached from the Ady Canal. Due to recent increases in pumping costs coupled with shortages of agricultural water, D-Plant pumping, especially in the irrigation season, has been declining over time and water from D-Plant often does not arrive at Lower Klamath NWR in a timely manner and in the quantities needed (USFWS 2010). Implementation of the KBRA would allow Lower Klamath NWR water allocation to be delivered through either the D-Plant or the Ady Canal or a combination of both at the times and quantities needed for optimal management of wetland habitats (USFWS 2010).

In addition, there would be less uncertainty regarding water rights if the KBRA was implemented as compared to the No Action/No Project Alternative. Implementation of the KBRA would result in a higher potential for the NWRs to receive more water than under the No Action/No Project Alternative (USFWS 2010).

#### Impacts on Waterfowl

To determine impacts on migratory waterfowl, the fall carrying capacity for waterfowl on Lower Klamath NWR was approximated based on the assumption that food resources are the major component influencing waterfowl use of the refuge during the peak September and October migratory period. Estimates of food energy produced per acre in each wetland habitat type, the daily energy requirement per bird, the period of use, and the estimated acres flooded was used to determine the carrying capacity of the wetland for foraging dabbling and diving ducks. Results indicate that if the KBRA was implemented, Lower Klamath NWR would support a higher number of fall migratory dabbling and diving ducks, in addition to benefitting molting mallards, than under the No Action/No Project Alternative (USFWS 2010; Yarris et al 1994).

#### Impacts on Nongame Waterbirds

An estimate of the numbers of nongame waterbirds (broadly defined as shorebirds, gulls, terns, cranes, rails, herons, grebes, egrets, and ibis) that would be supported with implementation of the KBRA was also conducted based on the approximate number of waterbirds that could be supported in late summer on the Refuge in different water year types. Using this method, the Refuge would support higher numbers of nongame waterbirds if the KBRA was implemented than the No Action/No Project Alternative. Furthermore, because wintering bald eagles in the Klamath Basin forage predominantly on waterfowl, the KBRA would result in higher numbers of wintering bald eagles than the No Action/No Project Alternative (USFWS 2010).

#### Impacts on Habitat Management

If the KBRA was implemented, lease land farming would continue, and 20 percent of the net lease revenues would be available to the Refuge for habitat enhancement. In contrast, under the No Action/No Project Alternative, all lease revenues would continue to be under the jurisdiction of Reclamation, some of which may or may not be available for habitat enhancement work on the Refuge (USFWS 2010).

Implementation of the Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs as part of the KBRA would result in beneficial effects on wetland habitat, waterfowl, nongame waterbirds, and habitat management at Lower Klamath NWR. The geographic location of Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs reduce the potential for any terrestrial resource effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. **Therefore, there would be beneficial effects on terrestrial resources from implementation of KBRA at Lower Klamath NWR.**

#### **Tule Lake NWR**

#### Impacts on Water Delivery Needed to Support Wetland Habitat

Water for wetland habitats in Sumps 1(A) and 1(B) of the Tule Lake NWR are primarily provided as return flows from private lands. With implementation of the KBRA, water for refuge wetlands and agricultural habitats would be derived from the agricultural allocation and shortages are expected to occur relatively infrequently as compared to the No Action/No Project Alternative, under which water shortages are expected in greater than 20 percent of years. Thus, KBRA implementation would result in more wetland habitat than the No Action/No Project Alternative (USFWS 2010).

#### Impacts on Waterfowl

Waterfowl use of the refuge currently depends upon wetland habitats provided in Sumps 1(A) and 1(B) and the “Walking Wetlands” program, which incorporates wetlands into commercial crop rotations, and food provided from Refuge agricultural lands (USFWS 2010). If the KBRA was implemented, there would be less uncertainty in agricultural water deliveries to Refuge wetlands and agricultural lands than under No Action/No Project. There would also be more certainty in water for the “Walking Wetlands” program that provides wetland-related food and habitats for migratory dabbling ducks and geese. Therefore, if KBRA were implemented there would be more wetland habitat and food resources for migratory waterfowl (USFWS 2010). In contrast to the Upper Klamath, due to the change in the water regime with the KBRA, there would be a benefit to molting mallards (Yarris et al 1994).

#### Impacts on Nongame Waterbirds

Nongame waterbirds are dependent on wetland habitats on Tule Lake NWR, which are dependent on agricultural return flows. Increased certainty of agricultural water deliveries with implementation of the KBRA would therefore have a beneficial effect on wetland habitats and the nongame waterbirds that depend on them than the No Action/No Project Alternative (USFWS 2010).

#### Impacts on Habitat Management

With implementation of the KBRA, there would be less uncertainty in the ability to manage Sump 1(B) than under No Action/No Project. In addition, 20 percent of the net lease revenues to the Refuge would be available for habitat enhancement with KBRA implementation (USFWS 2010).

Implementation of the Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs as part of the KBRA would result in beneficial effects on wetland habitat, waterfowl, nongame waterbirds, and habitat management at Tule Lake NWR. The geographic location of Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs reduce the potential for any terrestrial resource effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. **Therefore, there would be beneficial effects on terrestrial resources from implementation of KBRA at Tule Lake NWR.**

#### **Upper Klamath NWR**

#### Impacts on Wetland Habitat from Water Delivery

Based on modeled water elevations for future years, water elevations in Upper Klamath Lake would be low enough to leave refuge wetlands dry during the fall migration period (September-October) in 82 percent of years with implementation of the KBRA as compared to 68 percent of years under the No Action/No Project Alternative (USFWS 2010). Thus implementation of the KBRA would actually be an adverse impact compared to the No Action/No Project Alternative, if no other measures are taken.

#### Impacts on Waterfowl

Male and female mallards molt at slightly different times of the year and mallards of both sexes depend on wetlands to escape predators during molting. Male mallards begin the molt in mid July with females initiating the molt approximately 30 days later. During the 30 day molting period, mallards (and other waterfowl species) lose all wing feathers and are incapable of flight. Dry conditions can have an adverse effect on the survival of individuals. Based on modeled Upper Klamath Lake elevations, under the KBRA Alternative water is present in refuge wetlands in all but 3 percent of future years in July and 38 percent of future years in August. Under the No Action Alternative/No Project Alternative, refuge wetlands become dry more often in July (20 percent of years), and August (59 percent of years). Thus, implementation of the KBRA would have a beneficial effect on molting male mallards in July and August compared to conditions under the No Action/No Project Alternative.

For female mallards, the effect is somewhat reversed, since refuge wetlands would be dry in a higher proportion of years in September with KBRA implementation (82 percent of years) compared to the No Action/No Project Alternative (68 percent of years). It is important to note that breeding mallards are monogamous and females (due to lower survival rates) form a smaller proportion of the population. Thus, the welfare of female mallards is more important to the viability of the species and this represents an adverse impact of KBRA implementation compared to the No Action/No Project Alternative (USFWS 2010). In addition, due to the large concentration of diving ducks and marine ducks in fall and winter, there may also be concern for effects of the KBRA on diving ducks and marine ducks in the fall and winter.

#### Impacts on Nongame Waterbirds

With KBRA implementation, water elevations in Upper Klamath Lake would be sufficient to support breeding nongame waterbirds in a higher number of future years than under the No Action/No Project Alternative. The primary breeding period for nongame waterbirds extends from March through July. For successful breeding, refuge wetlands must remain flooded during this time period. With KBRA implementation, water would be present in Refuge wetlands during more of this period than without KBRA implementation (USFWS 2010).

Implementation of the Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs as part of the KBRA would result in beneficial effects on nongame waterbirds at Upper Klamath NWR. The geographic location of Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level

Programs reduce the potential for any negative terrestrial resource effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. **While there is potential for adverse impacts on wetland habitat and some waterfowl, there would be beneficial effects on other waterfowl and nongame waterbirds as compared to the No Action/No Project Alternative. Combined, these impacts would be less than significant.**

#### Juniper Removal under WURP

The WURP program could include juniper removal in order to increase inflow to Upper Klamath Lake. There could be adverse impacts on terrestrial wildlife, including nesting migratory birds, from removal of juniper trees. The geographic location and timing of these juniper removal actions reduce the potential for any negative terrestrial resource effects generated by this action from contributing to the effects of the hydroelectric facility removal actions analyzed above. Measures implemented during construction as described for the Proposed Action would avoid or reduce this impact; however, this impact would be potentially significant. **Implementation of Mitigation Measure TER-2 would reduce this impact to less than significant.**

In the long-term, WURP is anticipated to result in long-term benefits to terrestrial wildlife, particularly waterfowl and waterbirds that utilize Upper Klamath Lake.

#### **Mazama Forest Project**

*The Mazama Forest Project could result in adverse impacts on terrestrial resources.* The Mazama Forest Project would transfer 90,000 acres of privately owned timberland back to the Klamath Tribes. With ownership of the lands, the tribe could hunt, harvest timber, or use the land for other purposes. Additionally the Mazama Forest Project would not be expected to contribute to any terrestrial resource effects generated by the hydroelectric facility removal action. **No changes to existing conditions for terrestrial resources are anticipated.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

Under the Partial Facilities Removal of Four Dams Alternative, only the primary structure of the four dams would be removed, while auxiliary dam and hydroelectric features would remain in place. Drawdown of reservoirs would still occur and sediment behind the dams would be flushed downstream by river flows. Following partial facilities removal, riverbank stabilization and replanting activities would be conducted and the KBRA would be fully implemented, as with the Proposed Action.

#### **Temporary Construction Impacts**

Temporary construction impacts on terrestrial resources under the Partial Facilities Removal Alternative would be very similar to those described for the Proposed Action. There would be temporary construction impacts that would adversely affect local populations of common plants and wildlife in construction areas. Elements incorporated into construction would avoid or reduce these effects. These effects would be short-term in nature and less than significant for most common species. Temporary construction impacts on special-status species would be similar to those under the Proposed Action.

**Mitigation Measures *TER-1* through *TER-4*** (Section 3.5.4.4) would be implemented, as necessary, to avoid or reduce impacts as under the Proposed Action. **Therefore, temporary construction impacts on terrestrial resources from the Partial Facilities Removal Alternative would be less than significant.**

#### **Long-Term Impacts**

As with the Proposed Action, there would be the same adverse effects related to loss of aquatic and wetland habitat at the reservoirs under the Partial Facilities Removal Alternative. **Mitigation Measure *TER-5*** would reduce impacts from permanent loss of wetlands, if it occurs, to less than significant. **Mitigation Measure *TER-6*** would reduce impacts on bats from the loss of roosting habitat from the removal of structures to less than significant. See Section 3.5.4.4 for a description of Mitigation Measures.

As described above for the Proposed Action, there would also be benefits to wildlife from gains in upland and riparian habitat following establishment of newly planted areas and with control and monitoring of invasive plants. Riparian habitat at the reservoirs would be restored and any riparian habitat destroyed by sedimentation downstream would be expected to re-establish within a few years; therefore, impacts on riparian habitat would be less than significant. Remaining PacifiCorp facilities would still pose a barrier to terrestrial wildlife movement in some places; however, drawdown of the reservoirs would benefit some terrestrial species by eliminating those barriers. Impacts related to invasive plants at the reservoir sites and other construction areas would be reduced to less than significant with implementation of the Reservoir Area Management Plan and Habitat Restoration Plan (**Mitigation Measure *TER-1***). **Therefore, long-term impacts on terrestrial resources from the Partial Facilities Removal Alternative would be less than significant.**

#### **Keno Transfer**

The effects of the Keno Transfer would be the same as those described for the Proposed Action.

#### **East and West Side Facility Decommissioning**

The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action.

#### **KBRA**

The Partial Facilities Removal Alternative would include full implementation of the KBRA. Therefore, impacts and benefits related to KBRA actions would be the same as under the Proposed Action, discussed above.

#### **Alternative 4: Fish Passage at Four Dams**

Under the Fish Passage at Four Dams Alternative, all four dams and hydroelectric facilities would remain in place and fish passage facilities would be constructed around each. Reservoirs would remain in place. The KBRA would not be implemented.

The provisions of the USFWS Biological Opinion (USFWS 2007) for the relicensing of the Klamath Hydroelectric Project may be in effect under the Fish Passage at Four Dams

Alternative. These include a number of environmental measures to address impacts on terrestrial resources. One is a vegetation resource management plan for restoration of disturbed sites and riparian habitat restoration, protection of special-status plants, and long term monitoring. In addition, a wildlife resource management plan would be required to provide: wildlife crossings, deer winter range management, a plan to address avian electrocution hazards, amphibian breeding habitat, bald eagle and osprey habitat, road closures, turtle basking sites, bat roosting structures, surveys for special-status species, and long term monitoring (USFWS 2007).

### **Temporary Construction Impacts**

Short-term construction activities would occur associated with the installation of fish passage at the four dams. Construction areas would likely be similar to, but smaller than those required for demolition of all four dams under the Proposed Action or the Partial Facilities Removal Alternative. The same or similar elements would be incorporated into construction activities to avoid or reduce impacts on wildlife and plants, including special-status species, and sensitive habitats. **Mitigation Measures TER-1 through TER-4** (Section 3.5.4.4) would be implemented, as necessary, to avoid or reduce impacts as under the Proposed Action. **Therefore, temporary construction impacts on terrestrial resources from the Fish Passage at Four Dams Alternative would be less than significant.**

### Long-Term Impacts

Under the Fish Passage at Four Dams Alternative, reservoirs would remain in place and there would be no anticipated sedimentation in downstream reaches that would affect riverine areas. As with the No Action/No Project Alternative, the KBRA would not be implemented under the Fish Passage at Four Dams Alternative. Therefore, there would continue to be uncertainty regarding water deliveries to the NWRs, and subsequent impacts on terrestrial resources within the Lower Klamath NWR, Tule Lake NWR, and Upper Klamath NWR.

Although detailed plans are not yet available, construction of the fish passage facilities would not likely result in permanent loss of wetlands. There would also be no anticipated long-term impacts on terrestrial wildlife, including special-status species, from operation of the fish passage facilities. Existing barriers to terrestrial wildlife movement presented by the dams and associated facilities would remain. There would be potential for impacts related to invasive species in areas disturbed by construction, although much less so than under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative where reservoirs are drawn down. Implementation of the Habitat Restoration Plan (**Mitigation Measure TER-1** (Section 3.5.4.4) in construction areas would avoid or reduce impacts related to invasive species. **Therefore, long-term impacts on terrestrial resources from the Fish Passage at Four Dams Alternative would be less than significant.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

The Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative includes the removal of two of the Four Facilities (Copco 1 and Iron Gate). Copco 1 Reservoir and Iron Gate Reservoir would be drawn down. This alternative also includes development and/or improvement of fish passage at Copco 2 and J.C. Boyle Dams. Since the J.C. Boyle and Copco 2 Reservoirs store much less sediment than do the Copco 1 and Iron Gate Reservoirs, the amount of sediment released to the river system would be similar under the Fish Passage at Two Dams Alternative as under the Proposed Action.

#### **Temporary Construction Impacts**

Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative there would be temporary construction impacts similar to those of the Proposed Action at the Copco 1 and Iron Gate facilities. Construction impacts would also occur at Copco 2 and J.C. Boyle with the construction of fish passage facilities there. Construction areas would likely be smaller than those required for demolition of all four dams under the Proposed Action or the Partial Facilities Removal Alternative. The same or similar elements would be incorporated into construction activities to avoid or reduce impacts on wildlife and plants, including special-status species, and sensitive habitats.

**Mitigation Measures *TER-1* through *TER-4*** (Section 3.5.4.4) would be implemented, as necessary, to avoid or reduce impacts as under the Proposed Action. **Therefore, temporary construction impacts on terrestrial resources from the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less than significant.**

#### **Long-Term Habitat Loss and Modification**

Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, two reservoirs would remain in place and two would be drawn down. As with the No Action/No Project Alternative, the KBRA would not be implemented under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. Therefore, there would continue to be uncertainty regarding water deliveries to the NWRs, and subsequent impacts on terrestrial resources within the Lower Klamath NWR, Tule Lake NWR, and Upper Klamath NWR.

Although detailed plans are not yet available, construction of the fish passage facilities would not likely result in permanent loss of wetlands. **Mitigation Measure *TER-5*** (Section 3.5.4.4) would reduce impacts from permanent loss of wetlands, if it occurs, to less than significant. In addition, permanent loss of wetlands at Copco 1 and Iron Gate Reservoirs would be offset by restoration activities. As described above for the Proposed Action, there would also be benefits to wildlife from gains in upland and riparian habitat at Copco 1 and Iron Gate Reservoirs following establishment of newly planted areas and with control and monitoring of invasive plants.

As with the Proposed Action, there could be sedimentation in downstream reaches that would have impacts on riparian areas, although this is anticipated to be short-term and not considered a significant long-term impact (Stillwater 2008). There would be impacts on terrestrial wildlife, including special-status species, from the loss of aquatic habitat at the Copco 1 and Iron Gate Reservoirs, but these impacts would be less than significant,

as described for the Proposed Action. **Mitigation Measure TER-6** (Section 3.5.4.4) would reduce impacts on bats from the loss of roosting habitat to less than significant. Some vegetation that provides habitat for terrestrial species would be removed, but elements incorporated into construction and **Mitigation Measure TER-1** (Section 3.5.4.4) would avoid or reduce these impacts to less than significant, as with the Proposed Action. Existing barriers to terrestrial wildlife movement presented by the two remaining dams, Copco 2 and J.C. Boyle Dams, would remain. Implementation of the Habitat Restoration Plan in construction areas would avoid or reduce impacts related to invasive species. **Therefore, long-term impacts on terrestrial resources from the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less than significant.**

#### **3.5.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequence Summary**

###### **TER-1: Habitat Restoration Plan**

To restore native vegetation communities and wildlife habitat in areas disturbed by construction, a Habitat Restoration Plan will be developed once the Definite Plan is prepared and construction areas are delineated. The Habitat Restoration Plan will be separate from the Reservoir Area Management Plan (DOI 2011a), which describes restoration of the reservoir areas. The Habitat Restoration Plan will cover all areas disturbed by construction, including upland sediment disposal sites, access and haul roads, pipeline corridors, and equipment staging areas. The Habitat Restoration Plan will include maintenance and monitoring requirements to be conducted for a minimum of three years following hydroseeding and/or planting of native species in areas disturbed by construction. Measures to remove and control noxious weeds and other invasive plants will be included. The Habitat Restoration Plan will outline the performance standards to be met, and the corrective actions to be taken if performance standards are not met.

###### **TER-2: Nesting Bird Surveys<sup>5</sup>**

If, during preconstruction surveys, an active nest of a special-status bird species (e.g., northern spotted owl, osprey, willow flycatcher) or migratory bird is identified, a restriction buffer would be established in consultation with the resource agencies to ensure nests are not disturbed from construction. This may include evaluation of noise levels at the nesting site for special-status species such as northern spotted owl. Once the Definite Plan is prepared and construction areas are delineated, detailed plans for nesting bird surveys and measures to be implemented if active nests are found will be developed in consultation with USFWS, ODFW, and CDFG. See **Mitigation Measure TER-3** for mitigation related to bald and golden eagles.

Table 3.5-5 lists the restriction buffers for many common raptor species with potential to occur within or near construction areas. *Buffer zones* are defined as seasonal or spatial

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<sup>5</sup> The discussion presented in this section includes both BMPs that would be incorporated during construction as well as mitigation measures in order to facilitate the development of compliance documentation for the Bald and Golden Eagle Protection Act. These BMPs are also described in Appendix B.

areas of inactivity in association with individual nests or nesting territories. *Spatial buffers* are defined as radii from known occupied and unoccupied nest sites. *Seasonal buffers* are restrictions on the times when human activities may occur within the spatial buffers (USFWS 2002). All restriction buffers would be established as appropriate and in consultation with USFWS, ODFW, and CDFG.

**Table 3.5-5. No Surface-Disturbing Activity Spatial Buffers and Seasonal Timing Restriction Stipulations for Raptor Nests**

Species	Spatial Buffer (miles)	Seasonal Timing Restriction
Bald eagle	1.00	Jan 1 – Aug 31
Golden eagle	1.00	Jan 1 – Aug 31
Northern goshawk	0.75	March 1 – Aug 15
Northern harrier	0.75	April 1 – Aug 15
Cooper's hawk	0.75	March 15 – Aug 31
Ferruginous hawk	1.00	March 1 – Aug 1
Red-tailed hawk	0.75	March 15 – Aug 15
Sharp-shinned hawk	0.75	March 15 – Aug 31
Swainson's hawk	0.75	March 1 – Aug 31
Turkey vulture	0.75	May 1 – Aug 15
Peregrine falcon	1.00	Feb 1 – Aug 31
Prairie falcon	0.75	April 1 – Aug 31
Merlin	0.75	April 1 – Aug 31
American kestrel	0.05 (300 feet)	April 1 – Aug 15
Osprey	0.75	April 1 – Aug 31
Burrowing owl	0.25 to 0.75	March 1 – Aug 31
Flammulated owl	0.75	April 1 – Sept 30
Great horned owl	0.75	Dec 1 – Sept 30
Long-eared owl	0.75	Feb 1 – Aug 15
Northern saw-whet owl	0.75	March 1 – Aug 31
Short-eared owl	0.75	March 1 – Aug 1
Northern pygmy-owl	0.75	April 1 – Aug 1
Western screech-owl	0.75	March 1 – Aug 15
Barn owl	0.062 to 0.25	Feb 1 – Sept 15

Source: USFWS 2002

When active raptor nests (with eggs or young) are located within the disturbance buffer for that species, and if construction is scheduled to occur in the vicinity during the nesting period, then additional considerations will include the following:

- Line-of-sight considerations- if the nest is visually obscured from construction activities by substantial vegetation (i.e., a forest or woodlot), or by geographic relief (e.g., a ridgeline), or any other type of visual barrier, then construction may continue. However, the nest will be monitored continuously throughout the nesting season to assure that the birds are not disturbed to a level that jeopardizes or alters the outcome of the nest. Initially, the birds will be monitored for signs of disturbance, and bird behavior will be compared to pre-construction levels. Monitoring in these cases will include determining and reporting to USFWS the ultimate fate of the nest. Birds nesting in locations that are visually protected from the construction site are not automatically protected from disturbance; their level of response to disturbance will depend on the species, tolerances of individual birds, type of activity, noise level, and distance from the activity. If birds appear to be disturbed by construction, regardless of species, then the USFWS Migratory Bird Program will be contacted to seek solutions to this issue.

### **TER-3: Impacts to Nesting Habitat of Bald and Golden Eagle and Other Migratory Birds<sup>6</sup>**

Mitigation to reduce impacts on Bald and Golden Eagle and Other Migratory Birds from loss of nesting habitat will include the following:

- Complete a two-year survey for bird use patterns prior to construction activities. Surveys will be conducted by a qualified avian biologist and will include any facilities to be removed or modified to determine bird use patterns. Surveys will be conducted during the time of year most likely to detect bird usage;
- Before approval of any site specific implementation plan, develop an Eagle Conservation Plan in coordination with USFWS;
- If deemed necessary and before approval of any site specific implementation plan, a permit from the USFWS will be obtained if project activities are anticipated to result in take under the Bald and Golden Eagle Protection Act.

#### **Mitigation to Avoid Mortality and Disturbance**

If surveys indicate part of the construction footprint or facilities slated for removal is utilized by bald or golden eagle or other migratory bird, then these mitigations will be employed to minimize disturbance and mortality to those birds:

- Where ever possible, clearing, cutting, and grubbing activities shall be conducted outside the eagle breeding period (January 15 through August 15);

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<sup>6</sup> The discussion presented in this section includes both BMPs that would be incorporated during construction as well as mitigation measures in order to facilitate the development of compliance documentation for the Bald and Golden Eagle Protection Act. These BMPs are also described in Appendix B.

- Where clearing, cutting, and grubbing work cannot occur outside the migratory bird nesting season (March 20 through August 20), a qualified avian biologist shall survey those areas to determine if any migratory birds are present and nesting in those areas;
- If nesting migratory birds/eagles are found, one of the following measures shall be taken to minimize impacts to nesting birds; 1) modification of the project footprint to avoid the nest permanently, 2) protection of the nest until the young have fledged, or 3) implementation of measures included in the Eagle Conservation Plan in coordination with USFWS.

#### **Monitoring Measures to Determine Success and Corrective Action Measures**

If project activities are anticipated to result in take under the Bald and Golden Eagle Protection Act, five years of monitoring by qualified avian biologists will be conducted following completion of deconstruction activities. The mitigation will be deemed successful if there is no net loss of eagles within the project area.

If this standard is not met, the Dam Removal Entity will consult with the USFWS and CDFG or ODFW, as appropriate, to ascertain the potential need for further mitigation.

#### **TER-4: Special-Status Plants**

Once the Definite Plan is prepared and construction areas are delineated, detailed plans for protocol-level surveys for special-status plants will be developed in consultation with USFWS, ODFW, and CDFG. If, during preconstruction surveys, any special-status plants are found to occur within the construction areas, the size and location of all identified occurrences would be mapped on the final construction plans, and impact acreages would be quantified based on proposed limits of disturbance. Compensation measures are expected to be a combination of the relocation, propagation, and establishment of new populations in conservation areas within the project site at a 1:1 ratio or at a 2:1 ratio in approved off-site habitat preservation areas, as determined in consultation with the resource agencies.

#### **TER-5: Permanent Loss of Wetlands at Reservoirs**

Under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, there would be loss of wetlands from the drawdown and permanent removal of reservoirs. Based on PacifiCorp surveys (PacifiCorp 2004a), there could be unavoidable impacts on 245 acres of wetland habitat at the J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs (Table 3.5-2). If it is determined that under the Clean Water Act a Section 404 Permit is required, a Compensatory Wetland Mitigation Plan will be developed and implemented in accordance with the requirements of the United States Army Corps of Engineers (USACE).

If one is required, the Compensatory Wetland Mitigation Plan will include creation and/or preservation of wetlands at an off-site conservation bank or other approved mitigation site in consultation with USACE and the resource agencies. Compensation

wetlands will be required to meet or exceed the functions and quality of the wetland habitat lost at the reservoirs. A monitoring plan will be required to assess whether the compensation wetlands are functioning as intended. Specific performance standards for hydrologic, floral, and faunal parameters will be proposed to determine success of the created wetlands. The monitoring plan would specify the corrective measures/modifications to be implemented in the event that monitoring indicates that the performance standards are not being met. Monitoring will occur for at least five years and until success criteria are met, and as required by USACE and the resource agencies.

In addition, a maintenance plan will be required for the wetland preservation/mitigation areas describing the measures to be implemented to assure that they are maintained as wetland habitat in perpetuity. The maintenance plan will address buffering from adjacent uses, fencing, access erosion control, and weed eradication.

#### **TER-6: Impacts on Special-Status Bats from Loss of Roosting Habitat**

Mitigation to reduce impacts on special-status bats from loss of roosting habitat will include the following:

- For the two years immediately prior to construction activities, qualified bat biologists will conduct bat surveys at facilities to be removed or modified to determine bat use patterns. Surveys will be conducted during the time of year most likely to detect bat usage.

#### Mitigation to Avoid Mortality and Disturbance

If surveys indicate a facility is utilized as a bat roost, then one of two mitigations will be employed to minimize disturbance and mortality to roosting bats:

- The facility shall be removed or modified outside the bat roosting and breeding period (November 1 to March 1); or
- Bat exclusion methods to seal-up facility entry sites (e.g., blocking and netting or installing sonic bat deterrence equipment) will occur prior to March 1 of the year the facility will be removed or modified.

#### Mitigation for Loss of Roosting Habitat

To reduce impacts on bats from the permanent loss of roosting habitat, five free-standing bat roosts will be constructed in consultation with bat specialists and the resource agencies. Experienced contractors will perform the installation of bat roosts. The structure will be placed in full sun at least 30 feet above ground. The structure will be concrete with high thermal mass and will meet the specifications of Bats in American Bridges (Keeley and Tuttle 1999) and California Bat Mitigation Techniques, Solutions, and Effectiveness (H.T. Harvey and Associates 2004).

#### Monitoring Measures to Determine Success and Corrective Action Measures

Five years of monitoring by qualified bat biologists will be conducted following installation of the bat roosts to determine the pattern and amount of use by bats. The mitigation will be deemed successful if one or more of the bat roosts, are utilized by at

least 600 bats (combined use at all five facilities) as either day or night roosts, or some combination, for at least two years.

If this standard is not met, the Dam Removal Entity will consult with the USFWS and CDFG or ODFW, as appropriate, to ascertain the potential need for further mitigation.

#### **Effectiveness of Mitigation in Reducing Consequence**

Proposed mitigation measures would be effective in reducing impacts on terrestrial resources to less than significant. Effectiveness would be evaluated through monitoring incorporated into the mitigation measures. If monitoring results indicate that mitigation measures are not effective in reducing impacts, corrective action would be taken, as described in the mitigation measures.

#### **Agency Responsible for Mitigation Implementation**

The Dam Removal Entity will be responsible for implementing the mitigation measures.

#### **Remaining Significant Impacts**

With the implementation of mitigation measures, there would be no significant impacts to terrestrial resources.

#### **Mitigation Measures Associated with Other Resource Areas**

Several other mitigation measures involve construction work, including mitigation measures H-2 (flood-proof structures), GW-1 (deepen or replace affected wells), WRWS-1 (modify or screen affected water intakes), REC-1 (develop new recreational facilities and access to river), TR-6 (assess and improve roads to carry construction loads), and TR-7 (assess and improve bridges to carry construction loads). During these construction activities, there could be impacts on terrestrial resources, including impacts on special-status species, wetlands, or effects related to the spread of invasive plants. Elements incorporated into construction would avoid or reduce these effects, as described for the Proposed Action. **Mitigation Measures *TER-1* through *TER-5* (Section 3.5.4.4) would be implemented, as necessary, to avoid or reduce impacts. Therefore, impacts on terrestrial resources from mitigation measures associated with other resource areas would be less than significant.**

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## 3.6 Flood Hydrology

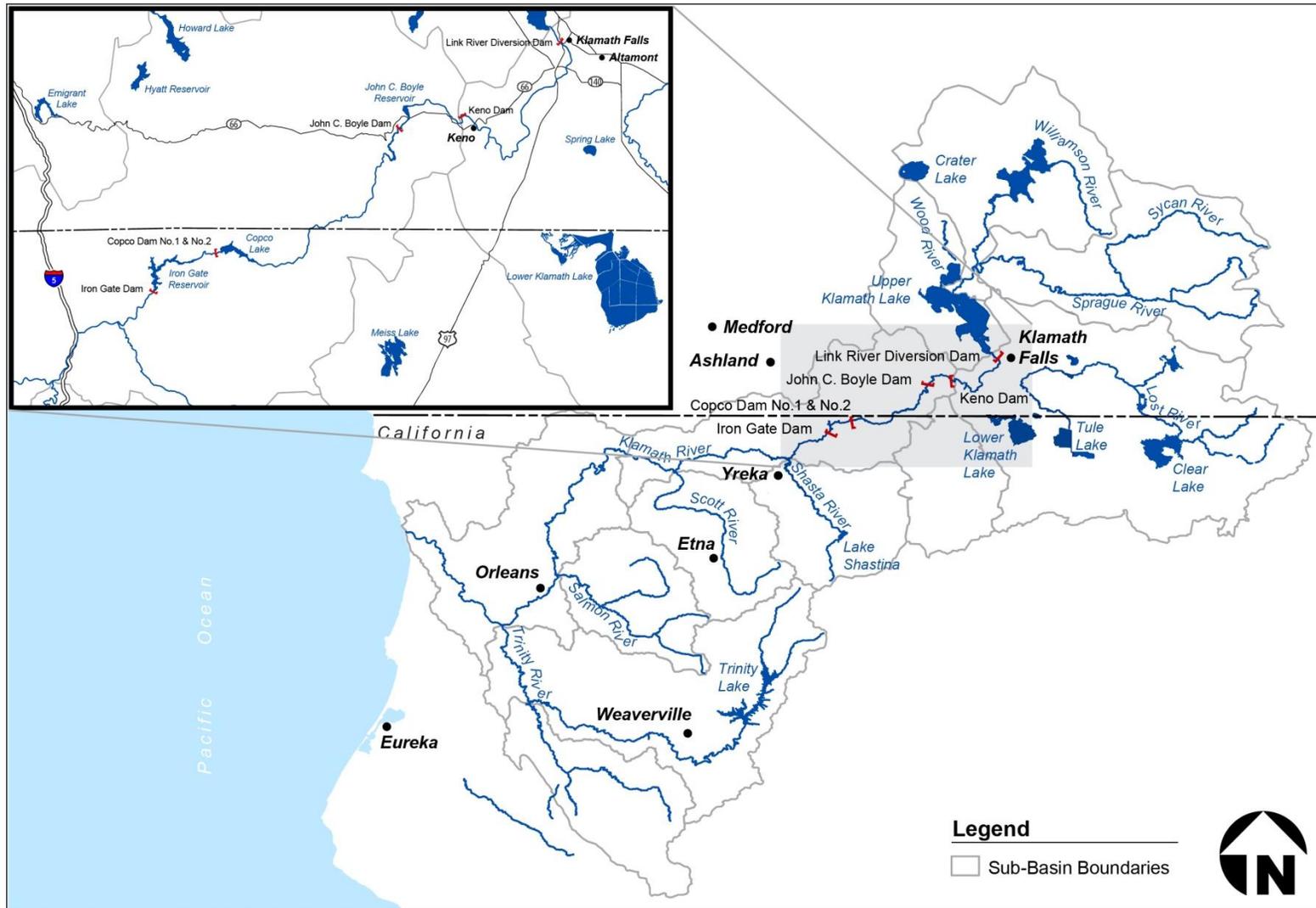
This section is focused on flooding effects from the Proposed Action and alternatives. The surface water hydrology within the Klamath Basin has a complicated and complex history; however, only elements of the hydrology related to the alternatives' potential flood impacts are described in this section. Other sections of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) discuss groundwater (Section 3.7), water quality (Section 3.2), and water supply/water rights (Section 3.8).

### 3.6.1 Area of Analysis

The area of analysis for this section includes the Klamath River and tributaries that define the Klamath Basin, which lies in portions of three Oregon counties (Klamath, Jackson, and Curry) and five California counties (Modoc, Siskiyou, Del Norte, Humboldt, and Trinity). Upper Klamath Lake, formed by the Link River Dam, is in Oregon and releases water into the Link River. About one mile below the Link River Dam, the river flows into Keno Impoundment/Lake Ewauna. The Keno Impoundment/Lake Ewauna is controlled by the Keno Dam in Keno, Oregon. The Klamath River begins at the outlet of Keno Dam and flows over 250 miles into the Pacific Ocean near Klamath, California (see Figure 3.6-1).

The Upper Klamath Basin is upstream from Iron Gate Dam and includes Upper Klamath Lake and its tributaries, Link River, the Keno Impoundment/Lake Ewauna, and the Hydroelectric Reach (from J.C. Boyle Dam to Iron Gate Dam). Several facilities control water supply in the Upper Klamath River, the Klamath Hydroelectric Project, and Reclamation's Klamath Project via several diversions from the Upper Klamath River (Federal Energy Regulatory Commission [FERC] 2007).

The Lower Klamath Basin includes the areas of the Klamath Basin downstream of Iron Gate Dam to the Pacific Ocean. Tributaries to the Lower Klamath Basin include the Shasta, Scott, Salmon, and Trinity Rivers. The Klamath Estuary, on the northern California coast, completes the system and eventually outlets to the Pacific Ocean (FERC 2007). Section 3.6.3.2 describes basin hydrology in more detail. The areas downstream from J.C. Boyle Reservoir are discussed in more detail because they may experience project-level impacts from the Klamath Hydroelectric Settlement Agreement (KHSA) (or alternatives). Upstream areas are discussed in less detail because these areas are upstream of the proposed dam removal activities associated with the KHSA. The potential Klamath Basin Restoration Agreement (KBRA) impacts are analyzed at a program level in this EIS/EIR.



W:\RFP\RTS\ERS\Doc of Interest\Klamath\Figures\Figure 3.6-1 Affected Area Hydrology Map.mxd 05/11/11 JLT

Figure 3.6-1. Flood Hydrology Affected Area

### **3.6.2 Regulatory Framework**

Flood hydrology within the area of analysis is regulated by several federal, state, and local laws and policies, which are listed below.

#### **3.6.2.1 Federal Authorities and Regulations**

- National Flood Insurance Program

##### **National Flood Insurance Program**

The National Flood Insurance Program (NFIP) is regulated by the Flood Insurance and Mitigation Administration under the Federal Emergency Management Agency (FEMA). The program was established as part of the National Flood Insurance Act of 1968 and includes three components: Flood Insurance, Floodplain Management and Flood Hazard Mapping (FEMA 2002).

Through the voluntary adoption and enforcement of floodplain management ordinances, U.S. communities participate in the NFIP. The NFIP makes available federally backed flood insurance to homeowners, renters and business owners in participating communities. The NFIP promotes regulations designed to reduce flood risks through sound floodplain management. NFIP maps identify floodplains and assist communities when developing floodplain management programs and identifying areas at risk of flooding.

In 1973, the Flood Disaster Protection Act was passed by Congress. The result of this was the requirement for community participation in the NFIP to receive federal financial assistance for acquisition or construction of buildings and disaster assistance in floodplains. It also “required federal agencies and federally insured or regulated lenders to require flood insurance on all grants and loans for acquisition or construction of buildings in designated Special Flood Hazard Areas” within participating communities (FEMA 2002).

Later, in 1994, the two acts were amended with the National Flood Insurance Reform Act, which included a requirement for FEMA to assess its flood hazard map inventory at least once every 5 years. FEMA prepares floodplain maps based on the best available science and technical information available. However, changes to the watershed or the availability of new information may cause the need for a map revision. When a revision is required, the applicable community works with FEMA to develop the map revision through a Letter of Map Amendment (LOMA) or a Letter of Map Revision (LOMR) (FEMA 2002).

In order for communities to participate in the NFIP they must adopt and enforce floodplain management criteria. The local counties in which dam removal would cause hydrologic effects, Klamath County in Oregon and Siskiyou County in California, participate in the NFIP (FEMA 2002).

### **3.6.2.2 Affected County Flood Codes and Ordinances**

- Klamath County Code (Klamath County Land Development Code Article 59) (Klamath County)
- Siskiyou County Code (Article 54, Chapter 6) (Siskiyou County)
- Siskiyou County Code (Policy 27, Chapter 10) (Siskiyou County)

#### **Klamath County, Oregon**

Article 59 of the Klamath County Land Development Code includes the Flood Hazard Overlay in accordance with the NFIP. It includes provisions for development within and around designated flood hazard areas and defines those areas according to the Flood Insurance Rate Map prepared by FEMA. It also includes provisions for alterations of watercourses and waterway development that preclude any diminishment of the flood carrying capacity of a water course (Klamath County 2010a). The *Klamath County Comprehensive Plan* (2010b) establishes goals and policies for areas subject to natural disasters and hazards; this includes identifying flood prone areas on maps to protect life and property from natural disasters and hazards. The Comprehensive Plan specifies that “the County will continue to participate in the FEMA NFIP.”

#### **Siskiyou County, California**

Siskiyou County has policies related to flood hazards within its County General Plan (1997). These policies refer to flood boundaries shown on FEMA flood hazard maps and regulate development within and near flood hazard areas (Siskiyou County 1997). Article 54 of the Siskiyou County Zoning Ordinance (Chapter 6) further defines the regulations within District F (Floodplain Combining Districts) where areas experience inundation by periodic overflow and backwater (Siskiyou County 1986). Chapter 10 of Planning and Zoning Code addresses Flood Damage Prevention and provides for requirements to notify the Federal Insurance Administration of alteration or relocation of watercourses and also addresses other issues related to Flood Damage Prevention. Land Use Policy 27 states the following:

“No residential or industrial development shall be allowed on water bodies. Exceptions may be considered for water supply, hydroelectric power generation facilities, public works projects necessary to prevent or stabilize earth movement, erosion, and the enhancement of migratory fish and other wildlife, light commercial, open space, non-profit and non-organizational in nature recreational uses, and commercial/recreational uses.” (Siskiyou County 1990)

### **3.6.3 Existing Conditions/Affected Environment**

This section describes the hydrologic conditions of surface water and wetlands in the Klamath Basin. Figure 3.6-1 shows the area of analysis. The setting section includes a description of basin hydrology including precipitation, reservoirs, major rivers and tributaries; lakes; springs and seeps providing measurable flow; historic stream flows; and flood hydrology. Available data of existing average daily and monthly river flows

and their relationship to Reclamation's Klamath Project and PacifiCorp's Klamath Hydroelectric Project are also described throughout this section.

### **3.6.3.1 Historical Hydrologic Conditions**

#### **Pre-Dams and Pre-Klamath Project Hydrology**

Several studies have been conducted to determine the natural flow conditions of the Klamath Basin hydrology (Bureau of Reclamation [Reclamation] 2005); however, these studies are limited by a lack of data. Prior to development of dams and implementation of Reclamation's Klamath Project, the Upper Klamath Basin contained lakes and large areas of marshes and wetlands. The Upper Klamath Lake was not much larger than its current size; however, Tule Lake and Lower Klamath Lake were much larger. Springs, snowmelt, and groundwater dominated rivers carrying water from the Cascades and other highlands in the Upper Basin contributed greatly to Upper Klamath Lake, the Klamath River, and the wetlands and marshes in that area (Akins 1970). The elevation of Upper Klamath Lake was originally controlled by a natural rock reef dam at the outlet of the lake. Water then flowed 1.3 miles down the Link River to Keno Impoundment/Lake Ewauna. Within this stretch of river, Keno Impoundment/Lake Ewauna developed because of a natural rock reef dam near Keno, Oregon. This was and still is the beginning of the Klamath River.

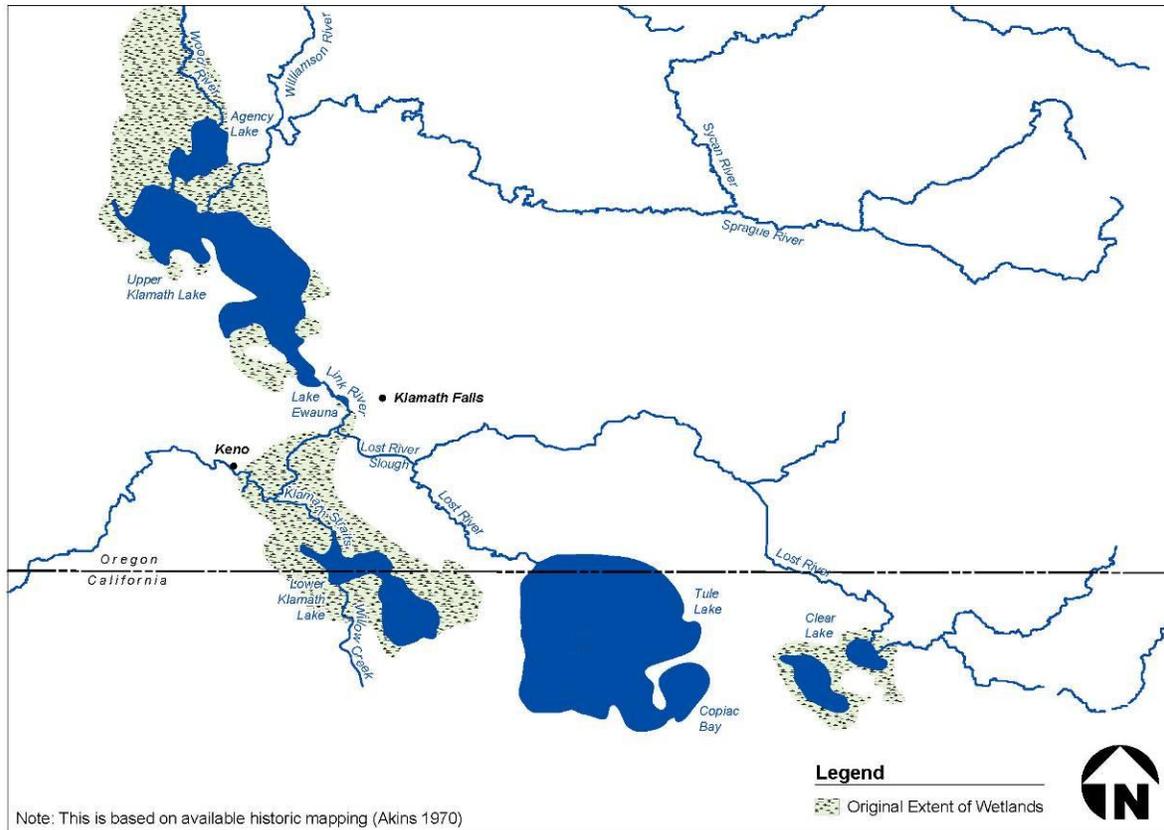
During high flow events out of Upper Klamath Lake, some water was captured and would flow down the Lost River Slough and into Tule Lake, another natural sump and wetland area. Water that flowed into the Klamath River reached another split near Keno (Akins 1970).

During flood conditions, water would also back up from the Keno Reef (near Keno, Oregon) and flow into the Klamath Straits and down to Lower Klamath Lake. The Lower Klamath Lake and Tule Lake areas once contained large areas of wetlands and marshes. The Lost River flowed from Clear Lake to Tule Lake. Now, a diversion provides water from the Lost River to the Klamath River (Akins 1970). Figure 3.6-2 shows the historic wetlands and configuration of the Upper Basin.

The presence of both historic Tule and Lower Klamath Lake influenced flows in the Klamath River. Lower Klamath Lake (approximately 30,000 acres of open water and 55,000 surface acres of marsh) was connected to the Klamath River through the Klamath Straits. When the river began to rise in the spring during high water flow events, water overflowed into this lake and marsh and, as the river fell in the fall some of the water flowed back out of the lake (Weddell et al. Undated). Lower Klamath Lake provided some short term storage by reducing the total volume of water leaving the upper watershed as well as delaying the peak flow. Tule Lake received overflow during high flow periods from the Klamath River near Klamath Falls, Oregon. Tule Lake was a terminal lake system; the overflow through the Lost River Slough reduced peak flows in the Klamath River in late winter and spring (Abney 1964).

Below the Keno Reef, the Klamath River flowed freely with no dam controls. The J.C. Boyle, Copco and Iron Gate Reservoirs did not exist. Dams along major tributaries

entering the river also did not exist and the water flowed to the river, then to the Klamath Estuary and eventually to the Pacific Ocean.



**Figure 3.6-2. Historical Upper Klamath Basin Hydrology Before Dams, National Wildlife Refuges, and Reclamation's Klamath Project**

### **Historical Uses Affecting River Flows**

During the early part of the 19<sup>th</sup> century, the Klamath Basin was home to seven Indian Tribes (see Section 3.13, Cultural and Historic Resources). These tribes depended on the Klamath River to produce salmon, steelhead, and other fish, which contributed to their survival and culture. During this time period, the river system had no dams, and the wetland areas of the upper basin including Upper Klamath Lake, Tule Lake and Lower Klamath Lake had not been altered (FERC 2007).

When the U.S. Congress passed the Reclamation Act of 1902 and the Reclamation's Klamath Project was authorized in 1905, the first major hydrologic changes to the mainstem of the Klamath Basin occurred. The Reclamation Act supported development in the "arid West" by allowing the federal government to fund irrigation projects (Department of the Interior [DOI] 2011b), and settlers reclaimed wetlands for agricultural use during the period of 1917 to 1949 (FERC 2007). In 1905, the Oregon and California legislatures and the U.S. Congress passed the Cession Act for all necessary legislation

to begin Reclamation's Klamath Project (DOI 2011a). Afterwards, Reclamation began building its Klamath Project, which led to the construction of the Link River Dam, several hundreds of miles of irrigation ditches and large canals and pumping plants to divert water from the Klamath River watershed for agricultural use (FERC 2007).

In 1908, President Roosevelt created the Lower Klamath Lake National Wildlife Refuge (NWR). Later, in 1928, the Tule Lake and Upper Klamath Lake NWRs were also created, and a portion of the water from the Upper Klamath Lake was diverted to these NWRs (FERC 2007). Historic wetland areas were drained to accommodate agricultural development; however, some of the historic wetland areas around Upper Klamath Lake have more recently been returned to Upper Klamath Lake.

Development of hydroelectric plants in the Klamath Basin began as early as 1891 in the Shasta River canyon to provide electricity for the City of Yreka. In 1895, another facility was constructed on the east side of the Link River supplying power to Klamath Falls, Oregon. Additional power suppliers developed facilities in the area on Fall Creek and the West Side plant on the Link River (FERC 2007). Chapter 1 provides additional historical detail regarding the Klamath Hydroelectric Project.

Concern over the effects of these dams on salmon and suckers grew over the years. The shortnose and Lost River suckers were listed as endangered under the Endangered Species Act in 1988 (FERC 2007). The Southern Oregon/Northern California Coast coho salmon were reviewed in 1996 and listed as threatened in 1997. Oregon Coast coho salmon were listed in 1998. The listings were reaffirmed and uplisted to endangered in 2005 (National Oceanic and Atmospheric Administration [NOAA] Fisheries Service 2005). Section 3.3, Aquatic Resources, provides background information and an analysis of effects on these endangered species.

### **3.6.3.2 Basin Hydrology**

This section describes reservoirs, rivers, and creeks in the affected environment and lists historic average stream flows. Various springs and seeps occur in the vicinity of Iron Gate, Copco and J.C. Boyle Dams and contribute flows to surface water. Springs around Upper Klamath Lake provide inflow to many of the streams feeding the lake and also provide stability for area wetlands (Akins 1970). Section 3.7.3.1, describes the locations of springs and seeps in more detail. Some measurable inflows from springs and seeps to various surface waters are described below. Figure 3.6-1 shows the major reservoirs and rivers in the Klamath Basin.

#### **Precipitation**

The Upper Klamath Basin receives rain at all elevations and snow at elevations above 4,000 feet during the late fall, winter, and spring. Snow is the primary form of precipitation in the upper watershed. Depending on the elevation and location, the amount of precipitation ranges from approximately 10 to more than 50 inches per year. From 1907 through 1997 the average annual precipitation at Klamath Falls was 13.4 inches and from 1959 to 2009 it was 20 inches at Copco 1 Dam (DOI 2011b). Peak stream flows generally occur during snowmelt runoff around March through May. After the runoff has stopped, flows drop to low levels in the late summer or early fall. Fall

storms may increase flows compared with the lower summer flows. Generally, conditions in the Upper Klamath Lakes area are drier than the area where the Klamath River reaches the ocean. The reaches downstream of the Klamath River's confluence with the Shasta River receive higher levels of precipitation than other reaches in the Klamath Basin (FERC 2007). Average annual precipitation is 49 inches at Happy Camp from 1914 to 2010 and 80 inches at Klamath between 1948 and 2006 (Desert Research Institute Website 2011).

### **Upper Klamath Basin**

#### **Upper Klamath Lake and Link River Dam**

Link River Dam was constructed by PacifiCorp for Reclamation in 1921 at the natural outlet of Upper Klamath Lake. This dam is operated by PacifiCorp under an agreement with Reclamation. Upper Klamath Lake has an active storage capacity ranging from 502,347 acre feet at the existing reservoir to 597,817 acre feet including areas restored by levee and dike breaches at Agency Lake, Barnes Ranch, Tulana Farms, and Goose Bay (Greimann 2011). Currently, Reclamation manages Upper Klamath Lake in accordance with United States Fish and Wildlife Service (USFWS) and NOAA Fisheries Service biological opinions based on current and expected hydrologic conditions (DOI 2011c).

Outlets from Upper Klamath Lake include the Reclamation A Canal, PacifiCorp's East and West Side development canals and the Link River Dam. Water that passes through the East and West Side development canals re-enters the Link River downstream of the dam where it eventually enters Keno Impoundment/Lake Ewauna (FERC 2007).

#### **Reclamation's Klamath Project**

Operation of Reclamation's Klamath Project affects Klamath River flows and Upper Klamath Lake water surface elevations. Section 3.8, Water Supply/Water Rights, describes the scope of Reclamation's Klamath Project in more detail, including the water supply diversions and amount of water diverted. Reclamation is required to implement a management plan to address biological opinions and fish concerns. To help accomplish this, Reclamation issues an annual operations plan describing flow requirements at various exceedance levels stated in biological opinions (Reclamation 2010). The biological opinions include requirements for targeted flows for Iron Gate Dam releases and water surface elevations in Upper Klamath Lake. Annual operations plans for Reclamation's Klamath Project must plan for flows and water surface elevations that are adequate for the continued existence of salmon and suckers. This is accomplished, in part, by using the fall and winter flow variability program "to enhance flow variability to mimic the natural hydrologic response that would naturally occur" (NOAA Fisheries Service 2010) and increased spring discharge in select average and wetter exceedances. Table 3.6-1 describes flow release requirements in cubic feet per second (cfs) from 2010 to 2018 measured below Iron Gate Dam under the biological opinion (NOAA Fisheries Service 2010). Each year, under the flow variability program, the hydrology exceedance is determined based on watershed modeling that considers "hydrologic and climatological information, including data from tributaries within the PacifiCorp Hydroelectric Project Reach (Keno Dam to Iron Gate Dam)." A team comprised of representatives from NOAA Fisheries Service (NMFS), NOAA Weather Service, USFWS, United States Geological

Survey (USGS), California Department of Fish and Game, the Karuk, Hoopa Valley and Yurok Tribes, PacifiCorp and Reclamation make this determination. Exceedance level calculations are affected by many factors including water use upstream of Upper Klamath Lake and Reclamation's Klamath Project demand when sufficient water supply is available (NOAA Fisheries Service 2010).

The “Exceedance Level” column represents hydrologic conditions ranging from very dry to very wet conditions. A 90 percent exceedance level represents a flow that is exceeded 90 percent of the time (dry conditions). A 10 percent exceedance level represents a flow that is exceeded only 10 percent of the time (wet conditions). Exceedance level calculations are affected by many factors including water use upstream of Upper Klamath Lake and Reclamation's Klamath Project demand when sufficient water supply is available (NOAA Fisheries Service 2010).

The flow requirements included in Table 3.6-1 describe the flow release requirements during the corresponding year type during the time periods indicated. As Table 3.6-1 shows, the flow release rate allowed under the biological opinion for releases from Iron Gate Dam in July of a very dry year (represented by a 90 percent exceedance) would be 840 cfs. Reclamation is required to release adequate flows from Upper Klamath Lake and regulate these flows at Keno Dam to allow PacifiCorp to meet these flow requirements at Iron Gate Dam.

**Table 3.6-1. Biological Opinion Requirements for Iron Gate Dam Releases (cfs)**

Exceedance Level	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug. 1-5	Aug. 16-31	Sept.
95%	1,000	1,300	1,260	1,130	1,300	1,275	1,325	1,175	1,025	805	880	1,000	1,000
90%	1,000	1,300	1,300	1,245	1,300	1,410	1,500	1,220	1,080	840	895	1,000	1,000
85%	1,000	1,300	1,300	1,300	1,300	1,450	1,500	1,415	1,160	905	910	1,001	1,000
80%	1,000	1,300	1,300	1,300	1,300	1,683	1,500	1,603	1,320	945	935	1,005	1,006
75%	1,000	1,300	1,300	1,300	1,300	2,050	1,500	1,668	1,455	1,016	975	1,008	1,013
70%	1,000	1,300	1,300	1,300	1,300	2,350	1,500	1,803	1,498	1,029	1,005	1,014	1,024
65%	1,000	1,300	1,300	1,300	1,323	2,629	1,589	1,876	1,520	1,035	1,017	1,017	1,030
60%	1,000	1,300	1,300	1,309	1,880	2,890	2,590	2,029	1,569	1,050	1,024	1,024	1,041
55%	1,000	1,300	1,345	1,656	2,473	3,150	2,723	2,115	1,594	1,056	1,028	1,028	1,048
50%	1,000	1,300	1,410	1,751	2,577	3,177	3,030	2,642	1,639	1,070	1,035	1,035	1,060
45%	1,000	1,300	1,733	2,018	2,728	3,466	3,245	2,815	1,669	1,077	1,038	1,038	1,066
40%	1,000	1,300	1,837	2,242	3,105	3,685	3,485	2,960	1,682	1,082	1,041	1,041	1,071
35%	1,000	1,300	2,079	2,549	3,505	3,767	3,705	3,115	1,699	1,100	1,050	1,050	1,085
30%	1,000	1,434	2,471	2,578	3,632	3,940	3,930	3,225	1,743	1,118	1,053	1,053	1,089
25%	1,000	1,590	2,908	2,627	3,822	3,990	4,065	3,390	2,727	1,137	1,058	1,058	1,097
20%	1,000	1,831	2,997	2,908	3,960	4,160	4,230	3,480	2,850	1,152	1,066	1,066	1,135
15%	1,000	2,040	3,078	3,498	4,210	4,285	4,425	3,615	2,975	1,223	1,093	1,093	1,162
10%	1,000	2,415	3,280	3,835	4,285	4,355	4,585	3,710	3,055	1,370	1,126	1,126	1,246
5%	1,000	2,460	3,385	3,990	4,475	4,460	4,790	3,845	3,185	1,430	1,147	1,147	1,281

Source: NOAA Fisheries Service 2010

Notes:

cfs: cubic feet per second

### **Keno Impoundment/Lake Ewauna and Keno Reach**

Keno Impoundment/Lake Ewauna existed before the construction of Keno Dam due to a natural blockage (Akins 1970). The Keno Dam is owned and operated by PacifiCorp. Before the dam, in 1908, water from the Keno Impoundment/Lake Ewauna was reported to overflow the natural blockage and enter the Lost River Slough when the water surface elevation was at approximately 4,085 feet (FERC 2007). The currently normal water surface elevation is 4,085 feet (USGS 2009a) at the Keno Impoundment/Lake Ewauna. The Keno Impoundment/Lake Ewauna is a long and narrow lake that begins where the Link River ends, 1.3 miles downstream of the Link River Dam, and ends at Keno Dam. The majority of the water entering Keno Impoundment/Lake Ewauna comes from Upper Klamath Lake through the Link River. Several facilities upstream of Keno Dam transport water to or from the river including: the Lost River Diversion Channel, North Canal, Klamath Straits Drain, and the Ady Canal. Additional facilities that divert water for private agricultural lands are also on the reach between Keno Dam and J.C. Boyle Reservoir (FERC 2007).

### **J.C. Boyle Reservoir**

J.C. Boyle Reservoir is approximately 5 miles downstream of Keno Dam. PacifiCorp operates J.C. Boyle Reservoir to produce hydroelectric power. Current operations of the reservoir follow Interim Measures from the Interim Conservation Plan effective as of February 2010. Water is spilled from the dam during high flow months of January through May and when inflow “exceeds the capacity of the J.C. Boyle powerhouse and low flow requirements” (FERC 2007).

### **J.C. Boyle Bypass Reach**

The J.C. Boyle Bypass Reach is a 4.3-mile section of the Klamath River between the J.C. Boyle Dam and Powerhouse; it flows at a steep grade. At 0.5 miles downstream of the dam, flows are increased by groundwater entering the bypass reach. The average accretion due to groundwater inflow/spring inflow is 220 to 250 cfs and varies seasonally and from year to year (FERC 2007).

### **J.C. Boyle Peaking Reach**

The J.C. Boyle Peaking Reach is downstream of the J.C. Boyle powerplant, so flows vary based on releases from the plant. Typically, the reach has high flows during the day as a result of powerhouse flows used to provide peak energy demand. The powerhouse flows may be reduced to zero at night when J.C. Boyle Reservoir is refilled. The powerhouse ramps up flow for either a one-unit operation (up to 1,500 cfs) or a two-unit operation (up to 3,000 cfs). Normal daily average flows in the peaking reach during periods with no power generation range from 320 to 350 cfs (80 cfs from the fish ladder, 20 cfs from the juvenile fish bypass system). A minimum monthly flow rate of 302 cfs has been recorded in the month of August based on data from 1959 to 2010 (USGS 2011). Additional water enters the reach from springs.

Commercial whitewater rafting and boating occurs during the same months as peak power demands, May through October. The water supply for this unique rafting

opportunity during the summer tourist season is from the peaking operations of J.C. Boyle powerhouse. Under PacifiCorp's current annual FERC license, upramping and downramping occur at a rate of 9 inches per hour for both (FERC 2007). PacifiCorp diverts some water from this reach for irrigation purposes (FERC 2007).

### **Copco 1 Reservoir**

PacifiCorp operates Copco 1 Reservoir for hydroelectric power generation through Copco 1 Dam. With the most active storage volume of all the project reservoirs of 6,235 acre feet for power production, Copco 1 Reservoir has a total storage capacity of 46,867 acre feet (DOI 2011c). This reservoir is deeper than both Keno Impoundment/Lake Ewauna and J.C. Boyle Reservoir (FERC 2007).

### **Copco 2 Reservoir and Bypass Reach**

Copco 2 Reservoir, a small impoundment, receives discharge from Copco 1 Reservoir through Copco 1 Dam and provides flow to Copco 2 Powerhouse through a 1.5-mile bypass reach. The maximum hydraulic capacity is 3,200 cfs in the powerhouse flowline controlling flows from Copco 1 Reservoir to Copco 2 Reservoir. Copco 2 Dam controls the flow from the reservoir, and only spills when inflow from the reservoir exceeds storage capacity. Spillage from the dam is rare and typically only happens from November through April. PacifiCorp releases between 5 to 10 cfs at the bypass reach under normal conditions. Copco 2 Powerhouse discharges water to Iron Gate Reservoir (FERC 2007).

### **Iron Gate Reservoir**

Iron Gate Reservoir is downstream from the Copco 2 Dam and also receives water from Jenny and Fall Creeks, which are tributaries to the Klamath River downstream of Copco 2 Dam and Iron Gate Reservoir. PacifiCorp operates Iron Gate Dam and Reservoir as a re-regulating facility for peaking operations at the other three hydroelectric power dams. Iron Gate Reservoir is the deepest of the four reservoirs in the Hydroelectric Reach. The total storage at this reservoir is approximately 58,794 acre feet of which 3,790 acre feet is available for power production (DOI 2011c). Iron Gate Powerhouse, at the base of the dam, has a maximum hydraulic capacity of 1,735 cfs. Cool water is diverted from the reservoir to the Iron Gate Fish Hatchery, downstream of the dam (FERC 2007). USGS gage station 11516530 on the Klamath River, downstream of Iron Gate Dam, provides flow monitoring data regarding compliance with NOAA Fisheries Service biological opinions. Bogus Creek and effluent from the hatchery enter the river upstream of the gage and downstream of the dam (USGS 2009b). Table 3.6-1 lists the flow requirements measured downstream of Iron Gate Dam.

### **Lower River Basin**

The Lower Klamath Basin includes the river area downstream from Iron Gate Dam, which includes 190 miles of river flowing to the Klamath Estuary and then to the Pacific Ocean. The major tributaries entering the river include the Shasta, Scott, Salmon and Trinity Rivers. The Klamath Basin is heavily influenced by these four rivers because 44 percent of the average annual runoff is provided by them (FERC 2007). Below are brief descriptions of these four rivers and other reaches along the Lower Klamath River.

### **Shasta River**

The Klamath River receives water from the Shasta River approximately 13.5 miles downstream of Iron Gate Dam. The watershed includes high mountain peaks, forested terrain and agricultural land. Peak flows, near the Shasta River's confluence with the Klamath River, are in the winter with minimum flows during July and August. Dwinnel Dam, approximately 25 miles upstream of its confluence with the Klamath River, resulted in the creation of Lake Shastina. Additional diversion dams and smaller dams are located between Dwinnel Dam and the Klamath River (FERC 2007).

### **Scott River**

The Klamath River receives water from the Scott River approximately 33.6 miles downstream of the Klamath River's confluence with the Shasta River. The watershed includes the Salmon Mountains, which are heavily forested creating a rain shadow for the rest of the watershed. The valley is comprised of land for grazing and agriculture. Average monthly flows entering the Klamath River from the Scott River are 4 to 5 times higher in the winter and spring months than from the Shasta River; however, minimum flows are similar during August and September (FERC 2007).

### **Klamath River at Seiad Valley**

A USGS flow gage is on the Klamath River at Seiad Valley, downstream of its confluence with the Scott River. During the low flow months of August through November, approximately 75 percent of the water flowing past this gage is attributed to Iron Gate Dam releases. During the high flow months of April through June approximately 50 percent of the water flowing past this gage is attributable to Iron Gate Dam releases (FERC 2007).

### **Salmon River**

Approximately 77 miles from the Klamath River's confluence with the Scott River, the Salmon River enters the Klamath River. The Salmon River flows through the Klamath National Forest and many designated wilderness areas. The region surrounding the Salmon River is forested with some agricultural activity. High monthly average flows (3,375 cfs) occur in January, which is the winter peak for flooding as rain and rain on snow events occur. In April and May, the Salmon River has a high monthly average flow (2,660 and 2,630 cfs, respectively) from snowmelt at higher elevations. The Salmon River has its lowest monthly average flow at about 200 cfs in September, which is later than for other tributaries upstream including the Shasta River where lowest monthly average flow occurs in July (FERC 2007).

### **Klamath River at Orleans**

USGS gage no. 11523000 is at Orleans, downstream of the Klamath's confluence with the Salmon River and other smaller tributaries within the Lower Klamath watershed. This area receives a high amount of precipitation compared to other reaches upstream of the Shasta River; therefore, higher flows than in upstream reaches occur here in the winter and spring months. Iron Gate Dam releases account for approximately 20 percent of the flow during these high flow periods and over 50 percent of the flow during the late summer and fall (FERC 2007).

### **Trinity River**

The Trinity River is the largest tributary to the Klamath River and is downstream of the Klamath River's confluence with the Salmon River and Orleans. It is heavily forested and receives a heavy amount of precipitation. Peak average monthly flows into the Klamath River occur in February and March at approximately 11,000 cfs and flows decrease to a low of 500 cfs in September (FERC 2007).

### **Klamath River at Klamath**

A USGS gage no. 11530500 is at the mouth of the Klamath River where it meets the estuary within the Lower Klamath watershed. During low flow periods, the releases from Iron Gate Dam account for approximately 40 percent of flow during September to October. However, the area surrounding the Klamath River reach downstream of its confluence with the Trinity River receives a heavy amount of precipitation, and during the winter months approximately 85 percent of the flow comes from other sources than Iron Gate Dam releases (FERC 2007).

### **Klamath River Estuary**

The Klamath River estuary is within the Redwood National Park and spans approximately 4 to 5 miles upstream of the mouth. The tidal influence normally extends approximately 4 miles upstream from the mouth during high tides greater than 6 feet upstream of the U.S. Highway 101 bridge. Past studies have observed the formation of a sill at the river mouth in late summer or early fall causing a standing water backup up to 6 miles upstream. During high tides saltwater was observed in the summer and early fall from the mouth upstream ranging approximately 2.5 to 4 miles depending on the time period samples were taken. The saltwater recedes during low tides (Wallace 1998).

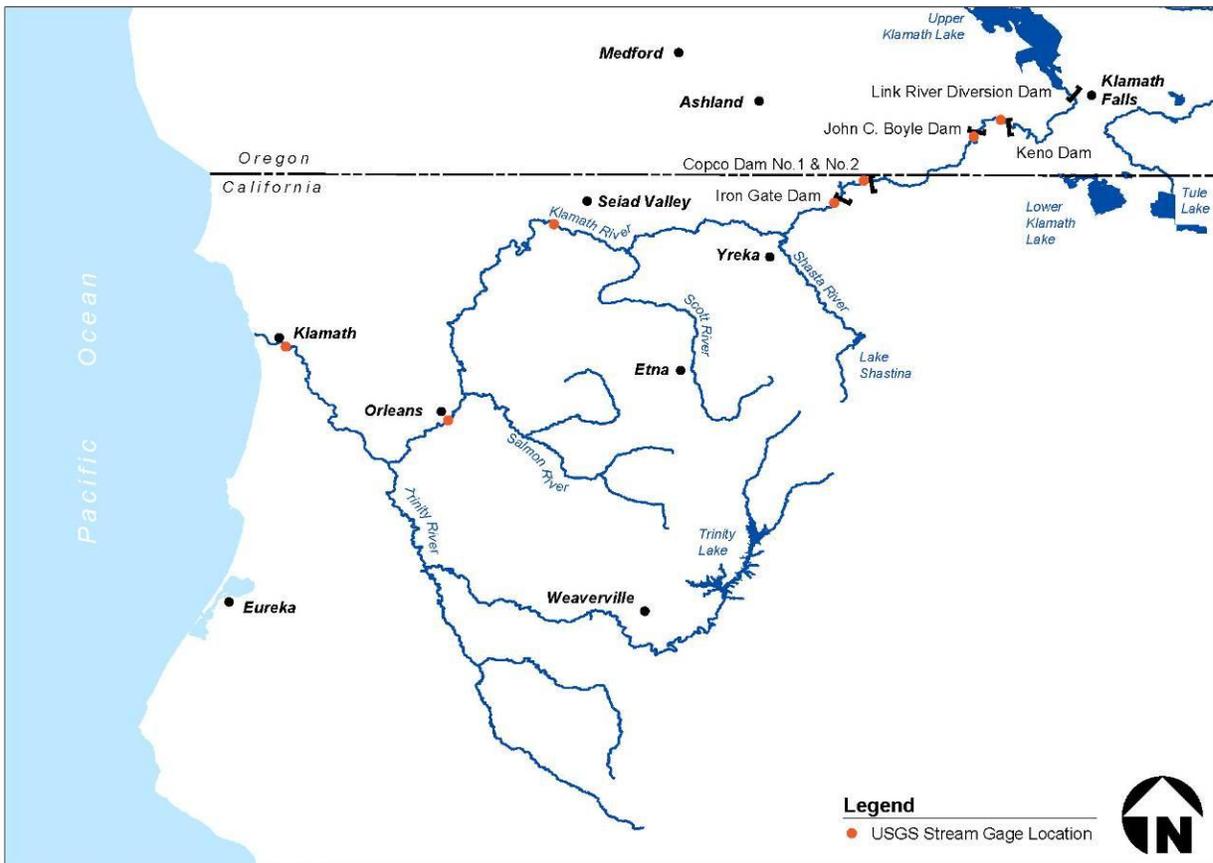
#### **3.6.3.3 Historic Stream Flows**

The USGS operates several stream gages on the Klamath River (Table 3.6-2 and Figure 3.6-3). As noted above, summer and early fall periods (July through October) generally have much lower flows than the months of the spring runoff. Tributaries downstream of Iron Gate Dam contribute substantial amounts of flow. Figure 3.6-4 shows historical daily average stream flows at several locations on the river using USGS monitoring data from 1961-2009 (USGS 2011). Flows are substantially higher during wet years; Table 3.6-3 shows historic average monthly flows during wetter years (represented by flows exceeded ten percent of the time) using the same USGS data (USGS 2011).

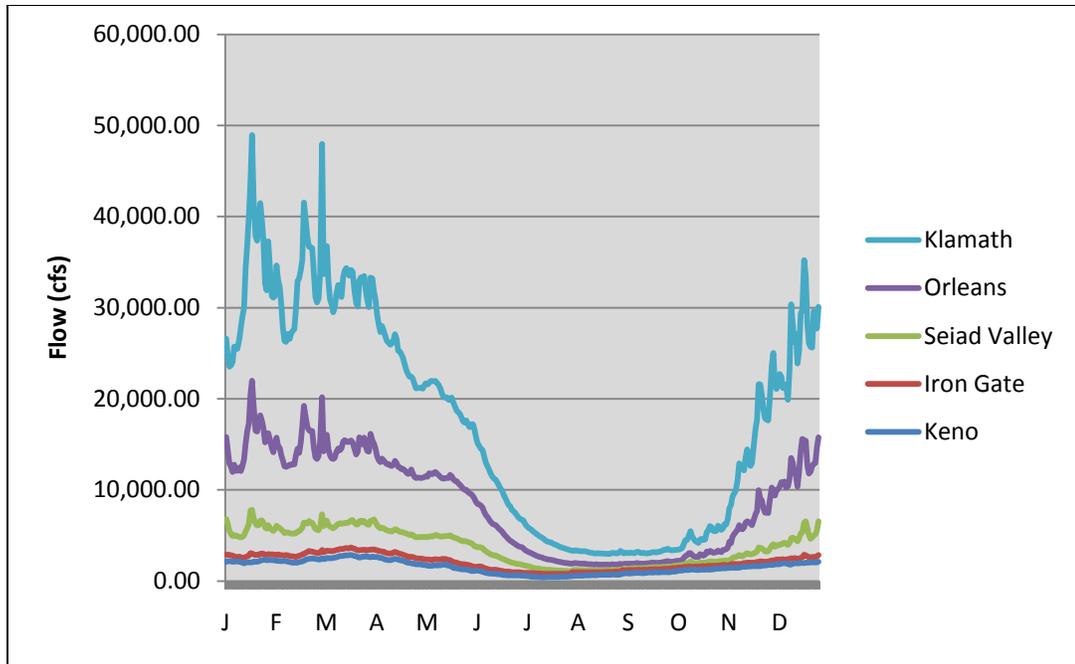
**Table 3.6-2. USGS Gages on the Klamath River**

USGS Gaging Station	Station Name	Drainage Area (miles <sup>2</sup> )	Latitude	Longitude	Gage Elevation (feet)	Period of Record (Water Years)
11509500	Klamath River at Keno, OR	3,920	42°08'00"	121°57'40"	3,961	1905-1913 1930-2009
11510700	Klamath River below John C. Boyle Power Plant near Keno, OR	4,080	42°05'05"	122°04'20"	3,275	1959-2009
11512500	Klamath River below Fall Creek near Copco, CA	4,370	41°58'20"	122°22'05"	2,310	1924-1961
11516530	Klamath River below Iron Gate Dam, CA	4,630	41°55'41"	122°26'35"	2,162	1961-2009
11520500	Klamath River near Seiad Valley, CA	6,940	41°51'14"	123°13'52"	1,320	1913-1925 1952-2009
11523000	Klamath River at Orleans, CA	8,475	41°18'13"	123°32'00"	356	1927-2009
11530500	Klamath River near Klamath, CA	12,100	41°30'40"	123°58'42"	5.6	1911-1927 1932-1994, 1996, 1998-2009

Source: DOI 2011c



**Figure 3.6-3. USGS Stream Gage Locations**



Source: USGS 2011

**Figure 3.6-4. Daily Average Flows at Five USGS Stream Gages on Klamath River**

**Table 3.6-3. Historic Monthly Average Flows (cfs) in Wetter Years (10% Exceedance Level) during Water Years 1961-2009 on the Klamath River**

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.
Keno Dam	2053	2625	3304	3645	4703	5691	4543	3046	1525	755	788	1225
J.C. Boyle Dam	2271	2824	3449	3720	4727	5741	4766	3346	1823	1010	1035	1441
Iron Gate Dam	2447	3047	3994	4544	5567	6429	5487	3918	2003	1059	1094	1582
Seiad Valley	3070	4606	9372	11866	11129	11658	9516	8077	5262	1985	1461	1903
Orleans	4031	11635	28185	33198	23710	25697	20345	18408	11277	4060	2343	2418

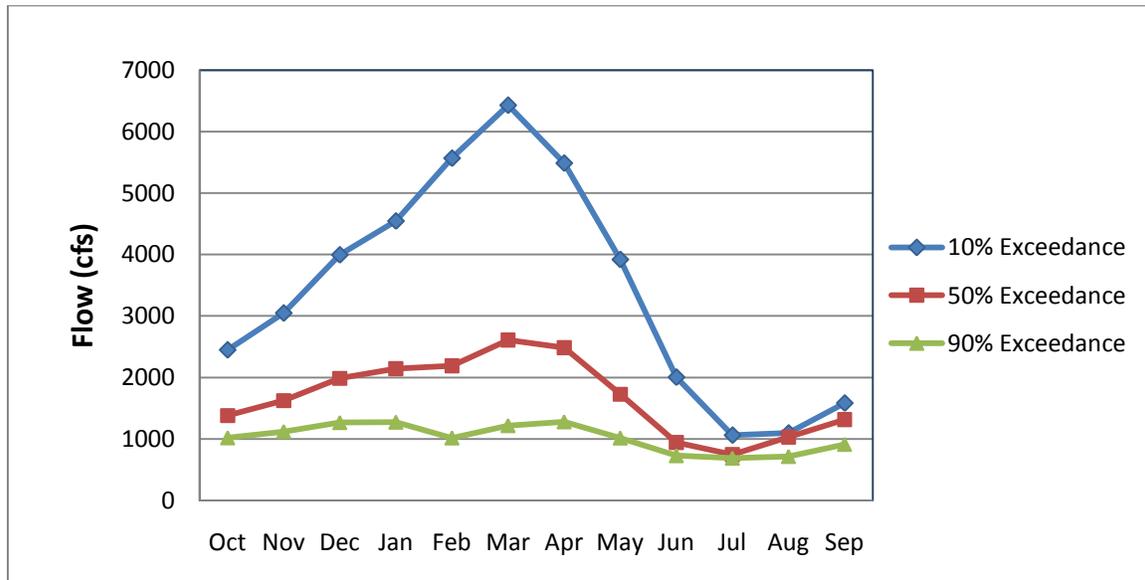
Source: USGS 2011

Table 3.6-4 shows the daily average flows at the four dams. The column indicating “% of time equaled or exceeded” indicates the hydrologic conditions, with 99 percent being an extremely dry year and 1 percent being an extremely wet year. Figures 3.6-5 and 3.6-6 show average daily flows in different year types downstream from Iron Gate and J.C. Boyle Dams. The gage downstream of J.C. Boyle Dam is also downstream of the return of flow from the J.C. Boyle power plant.

**Table 3.6-4. Annual and Seasonal Daily Flows**

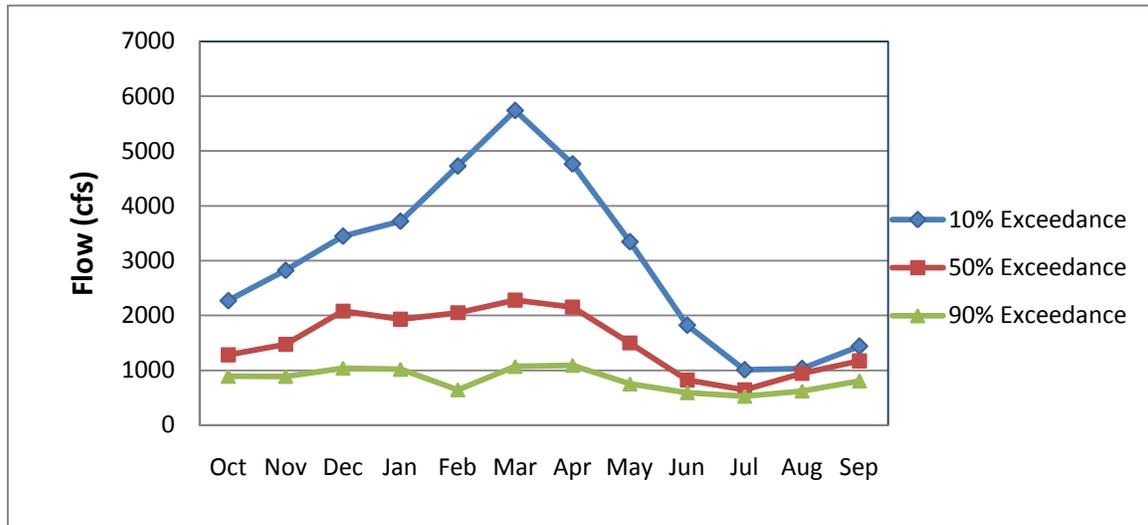
% of time equaled or exceeded	Discharge (cfs)							
	Annual				Seasonal (July 1 – Nov 31)			
	Keno	Boyle	Copco	Iron Gate	Keno	Boyle	Copco	Iron Gate
99	152	331	290	528	147	325	294	441
95	297	522	529	716	292	473	524	701
90	431	635	643	741	417	592	604	725
80	645	802	882	955	621	725	823	846
70	821	962	1,088	1,040	737	856	973	1,000
60	990	1,130	1,269	1,320	901	960	1,150	1,030
50	1,180	1,260	1,483	1,360	1,020	1,060	1,273	1,130
40	1,440	1,480	1,730	1,700	1,180	1,180	1,470	1,320
30	1,800	1,810	2,104	1,977	1,390	1,280	1,670	1,350
20	2,390	2,660	2,640	2,980	1,580	1,490	1,905	1,510
10	3,120	3,200	3,350	3,870	1,960	1,890	2,300	1,840
5	4,320	4,530	4,486	5,500	2,450	2,710	2,720	2,920
1	6,875	7,660	7,295	9,167	3,300	3,970	3,536	4,350

Source: DOI 2011c



Source: USGS 2011

**Figure 3.6-5. Stream Flows Downstream from Iron Gate Dam in Wet, Average, and Dry Years**



Source: USGS 2011

**Figure 3.6-6. Stream Flows Downstream from J.C. Boyle Dam in Wet, Average, and Dry Years**

Table 3.6-5 shows the flows associated with different flood levels in the basin. Peak flows at Iron Gate Dam are substantially greater than peak flows at J.C. Boyle Dam, because of the tributaries that enter the Klamath River in the Hydroelectric Reach, and peak flows continue to increase substantially as tributaries enter the Klamath River. The 10-yr discharge at Seiad Valley, which is downstream of the Scott River, is 56,500 cfs. The 10-yr discharge at the mouth is close to 300,000 cfs.

**Table 3.6-5. Flood Frequency Analysis on Klamath River for 10-yr to 100-yr Floods based upon Full Period of Record<sup>1</sup> of Each Gage**

Gaging Station	Drainage Area (miles <sup>2</sup> )	Discharge (cfs)				
		Gage Base	10-yr	25-yr	50-yr	100-yr
Keno	3,920	4,000	8,642	10,350	11,200	11,800
Boyle	4,080	4,000	9,058	11,050	12,220	13,150
Copco	4,370	5,400	10,750	12,720	13,730	14,470
Iron Gate	4,630	N/A	15,610	21,460	26,280	31,460
Seiad	6,940	N/A	56,540	93,400	131,000	179,300
Orleans	8,470	N/A	163,100	230,300	287,000	348,900
Klamath	12,100	N/A	298,300	392,900	466,900	543,300

Source: DOI 2011c

Notes:

<sup>1</sup> Keno Dam 1905-1913, 1930-2009; J.C. Boyle Dam 1961-2009; Copco 1 Dam 1930-1961; Iron Gate Dam 1961-2009. Data for all gages except Iron Gate Dam was extended using equations to match the period of record for Keno Dam.

Key:

cfs: cubic feet per second

#### **3.6.3.4 Flood Hydrology and River Flood Plain**

The active storage capacity at Upper Klamath Lake is approximately 597,817 acre-feet and includes areas restored by levee and dike breaches at Agency Lake, Barnes Ranch, Tulana Farms, and Goose Bay (Greimann 2011). Active storage at Keno, J.C. Boyle, Copco 1, Copco 2 and Iron Gate reservoirs totals approximately 12,244 acre-feet (FERC 2007). Approximately 98 percent of the active surface water storage along the Klamath River is provided by Upper Klamath Lake behind Link River Dam. Keno, J.C. Boyle, Copco 1, Copco 2 and Iron Gate Dams provide approximately 2 percent of the active storage on the river.

During extremely wet years, increased flows occur in the Klamath River and its tributaries, and surface water elevations rise in Upper Klamath Lake. Agency Lake, Barnes Ranch, and the Nature Conservancy-owned lands provide over 108,000 acre feet of storage area due to breaching of dikes and levees. During these periods, there is little surplus storage at the four dams to help control flooding. Decreased irrigation demands may allow for more water in Upper Klamath Lake to be stored for future use depending on the decisions to balance spring flushing flows with fall migration flows. The biological opinions included provisions for average and wet years that increase minimum flow requirements at Iron Gate Dam and surface water elevations at Upper Klamath Lake and Agency Lake/Barnes Ranch to reflect the natural flow conditions during wetter years and provide storage for surplus water. The Klamath River overtops its banks during flood years and inundates the floodplain. Additional descriptions of area geomorphology are in Section 3.11, Geology, Soils and Geologic Hazards.

FEMA has prepared flood risk mapping for portions of the Klamath River in Siskiyou, Del Norte and Humboldt Counties and provides access to these maps via their web mapping service or can be downloaded from their website. The revised Flood Insurance Rate Map (FIRM) and Flood Insurance Study for Siskiyou County was released on January 19, 2011, however, this update did not include new flood analysis along the Klamath River. FEMA flood analysis for the river is based on studies and cross sections developed prior to 1985 and later revised in 1987.

#### **3.6.3.5 Risks of Dam Failure**

Dams are manmade structures and do exhibit some risks of failure that could result in flooding downstream. According to the Association of State Dam Safety Officials (ASDSO), dams fail due to one of five reasons (ASDSO 2011).

- Overtopping caused by water spilling over the top of dam;
- Structure failure of materials used in dam construction;
- Cracking caused by movements like the natural settling of dam;
- Inadequate maintenance and upkeep; or
- Piping – when seepage through a dam is not properly filtered and soil particles continue to progress and form sink holes in the dam.

In California, weighted point systems are used during inspections to classify both the hazard or damage potential and condition of the dam. Once classified, the frequency of inspection and return period for hydrology studies is selected. The classifications used for damage potential are extreme, high, moderate and low and refer to the possibility of loss of life and property downstream of the dam if it were to fail. The classifications of the condition of the dam are poor, fair, good, and excellent and are determined based on the age, general condition, geologic and seismic setting. Dams may be reclassified after improvements or other changes have occurred (ASDSO 2000).

Siskiyou County is in the process of developing a Multi-Jurisdictional Hazard Mitigation Plan which will address, among other issues, flood and dam failure hazards. Maps are currently available which describe dam inundation areas at J.C. Boyle and Iron Gate dams as well as a domino effect, depicting the inundation area if multiple dams were to fail at the same time (Siskiyou County Website 2011). The FERC staff have conducted safety inspections of the dam structures as part of the licensing program over the past 50 years. Every five years J.C. Boyle, Copco 1 and Iron Gate dams are inspected and evaluated by an independent consultant and reports documenting the evaluation are submitted to the FERC for review (FERC 2007).

### **3.6.4 Environmental Consequences**

The flood hydrology section of the EIS/EIR will discuss the changes to river flows that would occur during implementation of the alternatives, including the Proposed Action.

#### **3.6.4.1 Environmental Effects Determination Methods**

The No Action/No Project Alternative would include operations similar to current operations. PacifiCorp would operate the Klamath Hydroelectric Project as it did before the Secretarial Determination process began, under the operational requirements of the March 2010 biological opinion. The action alternatives would vary operations by removing facilities or installing fish ladders to provide fish passage.

The assessment of the environmental impacts on flood hydrology that would result from implementation of the alternatives determines whether changes in stream flows could cause flooding or inundation areas in the watershed. The impact assessment is based on the hydrologic modeling completed by the Lead Agencies. The modeling covered the No Action/No Project Alternative and the Proposed Action. The Lead Agencies used a one-dimensional HEC-RAS model that assessed hydrologic conditions for these two alternatives. The Lead Agencies also analyzed modeling output to determine how frequently the current FEMA floodplain is inundated and how the floodplain could change under the Proposed Action. This information was included within the *Draft Hydrology, Hydraulics and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration* (DOI 2011c). The model results under the No Action/No Project Alternative and the Proposed Action provide adequate information to estimate the relative effects of the other alternatives not modeled.

The model results included predictions of the river flows that would occur if the Four Facilities were removed. The river flows would be the same for long-term future conditions for the Partial Facilities Removal of Four Dams Alternative as those modeled for the Proposed Action. The Fish Passage at Four Dams Alternative, however, would leave the dams in, but would include fish passage at each facility. Flows downstream of Iron Gate Dam would be the same under the Fish Passage at Four Dams Alternative as the No Action/No Project Alternative; however, flows within the hydroelectric reach would change to account for flows through fish ladders and flows in the bypass reaches. The predicted flows under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to the No Action/No Project Alternative at the two remaining dams and less than modeled flows under the Proposed Action at the removed dams. The flows within the hydroelectric reach for the Fish Passage at Four Dams and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Dam alternatives are addressed qualitatively because the model does not simulate these flows. The modeling effort provided useful information for assessing the impacts on flood hydrology in the long-term, but provides limited information about the construction period. Flood risks associated with dam removal activities are described qualitatively and quantitatively using the SRH-1D modeling results completed by DOI, and the analysis includes the measures incorporated to reduce these risks.

#### **3.6.4.2 Significance Criteria**

For the purposes of this EIS/EIR, impacts would be significant if they would substantially increase the risks of exposing people or structures to loss, injury or death involving flooding as measured by changes in the FEMA 100-year floodplain.

#### **3.6.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

*The No Action/No Project Alternative could alter river flows and result in changes to flood risks.* Under the No Action/No Project Alternative (a Negative Determination), the Four Facilities would remain in place and operations similar to the current operations would be in effect. The PacifiCorp Klamath Hydroelectric Project and Reclamation's Klamath Project would be operated as they were before the Secretarial Determination process began, including operation requirements under the March 2010 biological opinion. PacifiCorp would operate indefinitely under annual FERC licenses. For the purpose of this EIS/EIR, however, the No Action/No Project Alternative includes operations that would be similar to current operations.

Table 3.6-6 shows modeled average monthly wet year flows at multiple points along the river under the No Action/No Project Alternative. Wet year flows are represented by the modeled 10 percent exceedance (flows are exceeded only ten percent of the time). The No Action/No Project Alternative flows are based on model results and the affected environment flows (Table 3.6-3) are based on historic monitoring data. The monthly flows described in the two tables (Tables 3.6-6 and 3.6-3) vary because the sources used to develop the data are different, but the flows are generally similar. Peak flows would likely exceed the average monthly flows in Table 3.6-6; however, the peak flows would be similar to those currently experienced because the No Action/No Project Alternative would not change operations.

**Table 3.6-6. Modeled Average Monthly Flows (cfs) in Wetter Years (10% Exceedance Level) on the Klamath River under the No Action/No Project Alternative**

	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Sept.
Keno Dam	1022	1925	2867	3113	3859	4979	4752	3003	2493	894	794	901
J.C. Boyle Dam	1249	2159	3054	3396	4099	5265	5102	3482	2948	1178	1033	1113
Iron Gate Dam	1372	2351	3383	3939	5150	6145	5835	3910	3184	1344	1149	1207
Seiad Valley	1822	3898	7747	9511	10523	10987	9911	8486	6435	2388	1534	1482
Orleans	3283	10977	26536	29451	22477	26116	19837	18272	13067	4540	2415	2115

In addition to the model results described above, the Lead Agencies also modeled flood events that meet criteria for a 100-year flood using daily average flows under the No Action/No Project Alternative condition and the Proposed Action (Appendix J). The “WithDams\_100yr” shown on the maps in Appendix J depicts the No Action/No Project Alternative condition (DOI Undated). All of the areas depicted on this map are within Siskiyou County. The FEMA 100-year flood area corresponds fairly closely with the Lead Agencies’ modeling of flood risks both with and without dams which reinforces the fact that the four dams were not constructed for the purpose of flood risk reduction. However, there are some differences between the FEMA and the Lead Agencies’ No Action/No Project Alternative 100-year inundation zones. These differences are attributable to the use of different hydrographic base data for flood events and the use of enhanced elevation data by the Lead Agencies. The Lead Agencies’ analysis is based on LiDAR data with elevation values sufficient to support 2 foot contours along the reach of the Klamath River from Iron Gate to Happy Camp.

Detailed imagery was used to identify structures within the modeled No Action/No Project Alternative 100-year inundation zone. Structures include mobile homes, houses, farm sheds, bridges, and other features large enough to cast a shadow, including hay stacks. Imagery from 2010 and 2009 was used and compared which revealed that many of the structures are mobile homes that move annually or seasonally. Within the FEMA 100-year floodplain, there are 481 structures that include bridges. The Lead Agencies’ modeling of the 100-year flood inundation area under the No Action/No Project Alternative revealed 671 structures to be at risk.

The No Action/No Project Alternative includes operations that are the same as the existing operations; therefore, the No Action/No Project would not cause any changes to flooding from the affected environment. Although the Lead Agencies’ mapping of the 100-year inundation area varies compared to FEMA mapping, this difference can be attributed to the use of different base data and the Lead Agencies’ use of enhanced elevation data. FEMA is in the process of updating FIRMs using enhanced elevation data, but has not accomplished this near the Klamath River. Under the No Action/No Project

Alternative, the Four Facilities would not be removed and the actual 100-year flood inundation area would not change. The risks of dam failure would be same under the No Action/No Project alternative as under the existing conditions. **There would be no change from existing conditions from flood risk.**

*Ongoing restoration actions could affect flood hydrology.* Under the No Action/No Project Alternative, some restoration actions in the Klamath Basin are currently underway and would be implemented regardless of the Secretarial Determination on the removal of the Four Facilities. Table 3.6-7 lists the restoration actions affecting flood hydrology that would occur under the No Action/No Project Alternative. Several of these projects involve breaching levees and dikes upstream and around Upper Klamath Lake, thereby re-establishing hydrologic connections and providing additional storage that could potentially absorb some flood-related increases in inflows. The hydrologic model used to determine effects to flood hydrology under the No Action/No Project Alternative considered the expanded storage capacity described in Table 3.6-7 specifically related to evaporation and changes to consumptive use (DOI 2011c). **Overall, the ongoing restoration actions would cause no change from existing conditions from flood hydrology related to the affected environment.**

**Table 3.6-7. No Action/No Project Alternative Resource Management Actions Affecting Flood Hydrology on the Klamath River**

Component	Implemented Actions	Effects on Flood Hydrology
Williamson River Delta project	Restore wetlands for endangered fish and improve water quality in Upper Klamath Lake. The project involved breaching levees where the river flows into Upper Klamath Lake. Two miles of levees were breached in 2007 restoring approximately 3,500 acres of wetlands. Another 1,400 acres were flooded in 2008. Project would provide 28,800 AF of additional storage in Upper Klamath Lake. No additional levee breaching is proposed under this project	No impact, measures have already been implemented and are described as an existing condition.
Agency Lake and Barnes Ranches	Project to use the diked and drained portions of the ranches as interim pumped storage and ultimately to reconnect to Agency Lake by breaching dikes to add 63,770 AF of additional storage to Upper Klamath Lake. Actions include 1) complete land transfer between Reclamation and USFWS, 2) USFWS to study options to enhance water management flexibility for water storage and fish and wildlife habitat, and 3) complete NEPA analysis and ESA consultation on preferred option.  Agency Lake Ranch and Barnes Ranch together comprise approximately 9,796 acres between Agency Lake and the Upper Klamath NWR. Options for water management could include using diked areas for pumped storage or breaching levees to reconnect former wetland areas to Agency Lake.  Specific options to be developed and studied under separate NEPA evaluation.	Beneficial effect because more incidental flood protection could be provided.

Key:

AF: acre feet

ESA: Endangered Species Act

NEPA: National Environmental Policy Act

NWR: National Wildlife Refuge

USFWS: United States Fish and Wildlife Service

**Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

*Drawdown of reservoirs could result in short-term increases in downstream surface water flows and result in changes to flood risks.* Reservoir drawdown activities would begin on November 1, 2019 at Copco 1 Dam, and on January 1, 2020 at J.C. Boyle and Iron Gate Dams, at which times hydroelectric power generation would cease. At Copco 2 Dam, reservoir drawdown activities would begin on June 1, 2020 to allow for continued hydroelectric power generation at this site until dam removal must begin. Releases at all of the dams during reservoir drawdown periods would be in accordance with Dam Removal Plans developed by the Lead Agencies and with applicable biological opinions and operation plans. The Dam Removal Entity (DRE) would control the releases that would vary by reservoir depending on the type of dam, discharge capacity, water year type, and the volume of water and sediment within the reservoir. The resultant reservoir water surface elevation after the initial drawdown would be generally higher in a wetter year than in a drier year at all the dams.

The reservoir drawdown plans were made with consideration for minimizing flood risks downstream. The DRE would carefully control drawdown to maintain flows that would not cause flood risks. Drawing down the reservoirs would increase storage availability in J.C. Boyle, Copco 1, and Iron Gate Reservoirs. If a flood event occurred during drawdown, the DRE would retain flood flows using the newly available storage capacity and continue drawdown after flood risks have ended. Existing conditions do not allow these reservoirs to assist in flood prevention in this manner.

At J.C. Boyle Dam, the DRE would begin reservoir drawdown activities in January while streamflows were still high. Controlled releases would initially be through the gated spillway and power penstock at normal release rates, depending on year type, plus additional flow of up to 100 cfs for reservoir drawdown. These releases would continue until the reservoir water surface elevation decreased to the lowest level possible for the streamflow occurring at that time. The DRE would then remove the stoplogs from one of two low-level culverts beneath the spillway, temporarily releasing additional water downstream at flows between approximately 1,900 and 2,700 cfs depending upon reservoir level. Penstock releases could be reduced if necessary to limit the total sudden increase in streamflow to between approximately 500 and 1,000 cfs. Once the reservoir water surface is stabilized at a lower level, the DRE would remove the stoplogs from the second low-level culvert, temporarily releasing additional water downstream at flows between approximately 1,000 and 1,900 cfs than the current flows at the time. After this, the reservoir would reach the lowest water surface elevation possible prior to removal of the dam embankment.

While the controlled releases during reservoir drawdown would be higher than simulated No Action/No Project Alternative releases during the same time period, they would not be likely to increase flood risks because they would be within the range of historic flows. A 10-year storm at J.C. Boyle results in an estimated flow of 9,058 cfs (see Table 3.6-5), and the maximum daily winter flow (January through March) is in excess of 8,000 cfs (USGS 2011). The average monthly flow below J.C. Boyle Dam from 1961-2009 was about 2,380 cfs in January, 2,450 cfs in February, and 2,890 cfs in March. Increasing the

flow temporarily during reservoir drawdown by up to an additional 1,900 cfs over the No Action/No Project Alternative by removal of the stoplogs from the diversion culverts would not cause flood damage downstream. The concrete spillway crest structure would be removed once the reservoir water surface elevation was drawn down sufficiently, to provide additional flood release capacity and avoid reservoir refill. The embankment dam crest and left abutment wall would be retained for flood protection until removal.

Removal of the J.C. Boyle Dam embankment would begin at the end of May 2020. By then, the minimum reservoir drawdown level would have been achieved and inflow would have decreased to summer levels averaging less than 1,000 cfs. Within four to six weeks, the majority of the embankment would be removed except for a portion of the upstream toe which would serve as an upstream cofferdam. The upstream cofferdam would be armored with rockfill to allow a controlled breach between about water surface elevation 3758 and the channel bottom at elevation 3740, to fully drain the reservoir by July 2020. Reservoir releases would temporarily exceed inflow by up to approximately 5,000 cfs, depending upon the rate of breach development, but would remain below the downstream channel capacity. Although the breach flow would quickly attenuate as it moved downstream due to the very small reservoir volume, the Iron Gate cofferdam would be breached before breaching J.C. Boyle as a precaution.

Although limited drawdown of Copco 1 Reservoir would begin in November 2019 to permit early removal of the spillway gates and crest structure, the primary drawdown and sediment release of Copco 1 Reservoir would begin at the same time as the J.C. Boyle Dam reservoir drawdown in January 2020 and would be affected by the additional upstream releases. Average inflow to Copco 1 Reservoir would be no more than 100 cfs greater than normal streamflow for drawdown between reservoir water surface elevations 2590 feet and 2529 feet over a five to six week period, resulting in a total reservoir release from the diversion tunnel averaging up to 400 cfs above streamflow. A 10-year storm is estimated to result in flows of approximately 10,750 cfs (see Table 3.6-5), and the average daily flow has exceeded 9,000 cfs (USGS 2011).

The concrete dam would be removed in 8-foot lifts while the reservoir was being drawn down, removing concrete in the dry by blasting as the water surface elevation lowered. The diversion tunnel would pass the entire streamflow for as long as possible, but its discharge capacity would continue to decrease as the reservoir head is reduced. When additional discharge capacity is required, notches would be blasted in the concrete dam near the left abutment to allow for overtopping flows. The extent of notching would be affected by the water year type: wet years would require more notching than normal or dry years. The sudden increase in reservoir releases during notching may be controlled by reducing the diversion tunnel discharge if necessary. Drawdown between reservoir water surface elevations 2529 and 2484 would occur within 30 days. By March 12, 2020 the reservoir would be drained to the normal level of Copco 2 Reservoir (elevation 2484) and a large portion of the concrete dam would have been removed. The final portion of the concrete dam would be removed following drawdown of Copco 2 Reservoir and during the summer low flow period.

Copco 2 Dam does not provide any meaningful storage and the reservoir is very small compared to the other reservoirs, with little or no impounded sediment. Normal streamflow would be diverted downstream from Copco 2 Dam to the bypassed river reach beginning in mid-May 2020 when dam removal would begin. No additional releases would be made from the upstream reservoirs during this time as they would have already been mostly drained. The DRE would use cofferdams to isolate areas of the small concrete dam during demolition and would remove them once they were no longer needed.

Reservoir drawdown at Iron Gate Dam would occur simultaneously with reservoir drawdown at J.C. Boyle and Copco 1 Dams. Normal inflows to the reservoir in January and February 2020 would be increased by up to an estimated 500 cfs due to upstream reservoir drawdown releases. Reservoir drawdown between water surface elevations 2328 and 2202 would occur within a 10½-week period by controlled releases through the modified diversion tunnel, at an average drawdown rate of 3 feet per day. The maximum downstream flow during drawdown of Iron Gate Reservoir could exceed normal streamflow at the site by up to 1,800 cfs. The average monthly flow below Iron Gate Dam from 1961-2009 was about 2,830 cfs in January, 2,940 cfs in February, and 3,430 cfs in March (USGS 2011). A 10-year storm is estimated to discharge approximately 15,610 cfs (see Table 3.6-5), and average daily winter flows have exceeded 10,000 cfs (USGS 2011). Increasing the flow during reservoir drawdown by up to an additional 1,800 cfs would not cause flood damage downstream. The modified diversion tunnel discharge capacity would range between approximately 3,200 and 8,500 cfs during reservoir drawdown. Should a large flood event occur during drawdown, the outlet capacity would be exceeded and the reservoir could partially refill. This would be similar to existing operations during a flood event.

The Dam Removal Plan requires that sufficient freeboard be maintained for the dam embankment at all times to prevent potential flood overtopping and embankment failure. The amount of freeboard would be determined according to water year type and surface water elevation during removal operations. Excavation of the dam embankment would begin in June 2020, during a period of reducing streamflow and with a minimum reservoir release capacity of approximately 7,500 cfs. During this time, the embankment dam crest would be lowered 55 feet from elevation 2348 to elevation 2293. In July, excavation of the dam embankment would continue at an average rate of between 14,000 and 18,000 cubic yards per day, lowering the dam crest from elevation 2293 to elevation 2250, with a minimum reservoir release capacity of approximately 5,800 cfs. The majority of the dam embankment volume would be excavated during the following 8 weeks, while maintaining a portion of the upstream toe at elevation 2205 to serve as an upstream cofferdam. This would provide a minimum flood release capacity in excess of 3,000 cfs in both August and September, which is greater than the maximum historical streamflow during this period and far exceeds the average monthly flow rates for August and September of 980 cfs and 1,250 cfs, respectively (USGS 2011). By late September, the reservoir would be drawn down to the maximum possible extent, minimal streamflow would be occurring, and drawdown releases from upstream reservoirs would have ended. The upstream cofferdam would be armored with rockfill to allow a controlled breach

between about water surface elevation 2189 and the channel bottom at elevation 2165, to fully drain the reservoir by September 2020. Reservoir releases would temporarily exceed inflow by up to approximately 5,000 cfs, depending upon the rate of breach development, but would remain below the downstream channel capacity. The breach flow would quickly attenuate as it moved downstream due to the very small reservoir volume. The upstream cofferdam at J.C. Boyle would not be breached until the natural river channel has been restored at the Iron Gate site.

This analysis uses the reservoir drawdown release rates at Iron Gate Dam to determine the level of significance of adverse impacts downstream because Iron Gate Dam has the largest reservoir, provides the highest amount of discharge, and is the most downstream of all of the dams that would be removed. The release rates that would occur during drawdown of the reservoir would be in accordance with the historical flow during an extremely wet year (1 percent exceedance capacity). Figure 3.6-5 shows historic and maximum flows at Iron Gate Dam under wet year, average year and dry year types. While the release rates that would occur during reservoir drawdown would be greater than the flows at the same time under the No Action/No Project Alternative, and in some months, above the historic monthly maximum flow (September), they would be lower than the overall peak flows in each reach. Because the flows would stay below historic peak flows, they would not change the floodplain or flood risks in comparison to the No Action/No Project Alternative. **Therefore, the impact from drawing down the reservoirs on flood risk would be less than significant.**

*The release of sediment stored behind the dams and resulting downstream sediment deposition under the Proposed Action could result in changes to flood risks.*

Approximately 41 to 65 percent of sediment behind J.C. Boyle Dam, 46 to 81 percent of sediment behind Copco 1 Dam, and 25 to 38 percent of sediment behind Iron Gate Dam would be eroded and flushed down the river during removal activities (DOI 2011c). The remaining sediment would be left in place after dam removal above the active channel. The Lead Agencies conducted an analysis of future geomorphology and sediment transport during and after dam removal for dry, median and wet start year scenarios. Most of the erosion would occur during the drawdown period from January 1, 2020 to March 2020 and afterwards the river bed in the reservoir reaches is expected to stabilize. Minor deposition would occur in some of the reaches downstream of dam removal activities, however none is expected downstream of Shasta River (DOI 2011c). The Geology and Soils analysis considers the effects of sediment deposition in more detail (see Section 3.11.4.3). Sedimentation would occur downstream from the Four Facilities, but the quantity would vary depending on year type. The magnitude of sediment deposition is relatively small compared to sediment loading from other existing sources along the Klamath River. Additionally, the sedimentation would be short-term following dam removal. Because the sediment deposition would be short-term and small in comparison with the No Action/No Project Alternative, it would not affect stream characteristics in a way that would substantively affect flood inundation or flood risks. **Therefore, sediment deposition would have a less than significant effect on flood risk.**

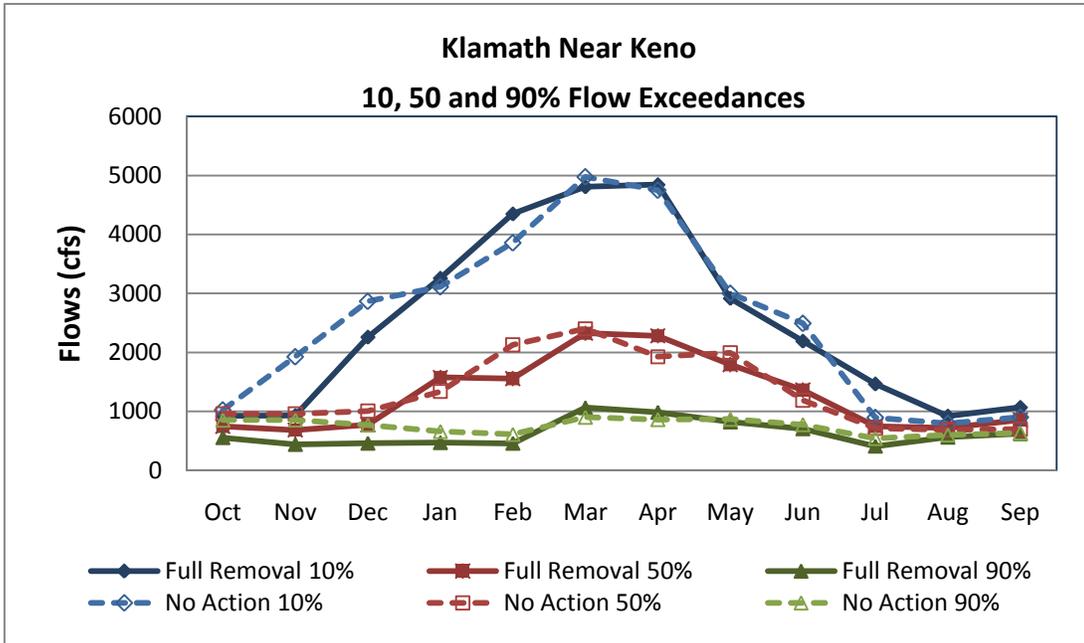
*Under the Proposed Action, the 100-year floodplain inundation area downstream of Iron Gate Dam could change between River Mile 190 and 171. Table 3.6-8 describes modeled flows on the Klamath River under the Proposed Action in wet water years (10 percent exceedance level) at multiple points on the river. These flows include all aspects of the Proposed Action, and the primary difference from the No Action/No Project Alternative is related to implementation of the KBRA. The bold numbers represent flows higher than the wet year flows under the No Action/No Project Alternative described in Table 3.6-6. Flows during wet years would be higher under the Proposed Action when compared to the No Action/No Project Alternative at all of these sites during the months of January and February and July to September. The Figures 3.6-7 to 3.6-11 graphically describe the comparisons in flows at 10, 50 and 90 percent flow exceedances between the No Action/No Project Alternative and the Proposed Action.*

**Table 3.6-8. Flood Flow Exceedance: Modeled Wet Water Year Flows on the Klamath River under the Proposed Action**

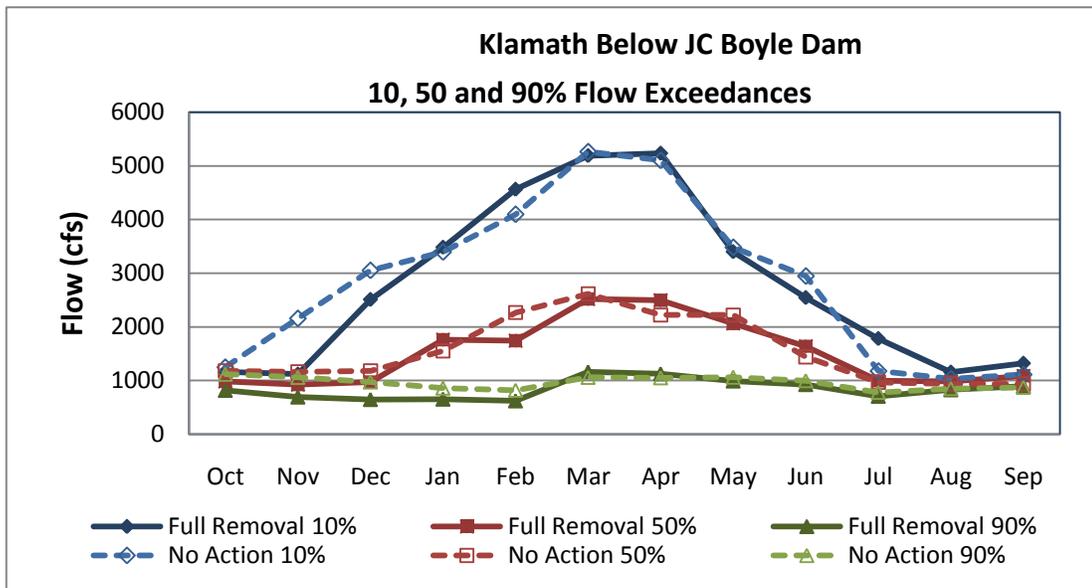
	<b>Oct.</b>	<b>Nov.</b>	<b>Dec.</b>	<b>Jan.</b>	<b>Feb.</b>	<b>March</b>	<b>April</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>Sept.</b>
Keno Dam	923	929	2,259	<b>3,258</b>	<b>4,349</b>	4,809	<b>4,845</b>	2,917	2,191	<b>1,465</b>	<b>920</b>	<b>1,067</b>
J.C. Boyle Dam	1,160	1,117	2,508	<b>3,481</b>	<b>4,562</b>	5,189	<b>5,233</b>	3,399	2,544	<b>1,780</b>	<b>1,155</b>	<b>1,320</b>
Iron Gate Dam	1,304	1,305	2,908	<b>4,192</b>	<b>5,219</b>	5,957	<b>5,960</b>	<b>3,966</b>	2,806	<b>1,939</b>	<b>1,292</b>	<b>1,449</b>
Seiad Valley	1,770	3,196	<b>8,319</b>	<b>11,090</b>	<b>10,803</b>	<b>11,025</b>	9,904	<b>8,509</b>	6,124	<b>3,018</b>	<b>1,695</b>	<b>1,724</b>
Orleans	3,195	10,153	<b>27,098</b>	<b>30,998</b>	<b>22,727</b>	<b>26,485</b>	<b>19,973</b>	<b>18,614</b>	12,629	<b>4,993</b>	<b>2,574</b>	<b>2,306</b>

Notes:

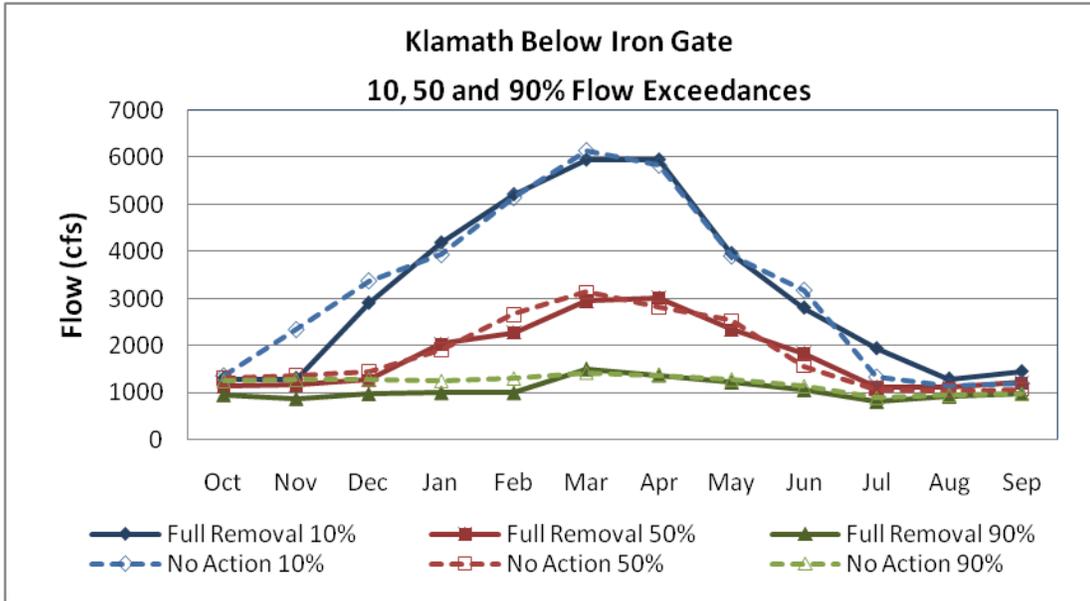
Bold numbers represent flows that are greater than the No Action/No Project Alternative.



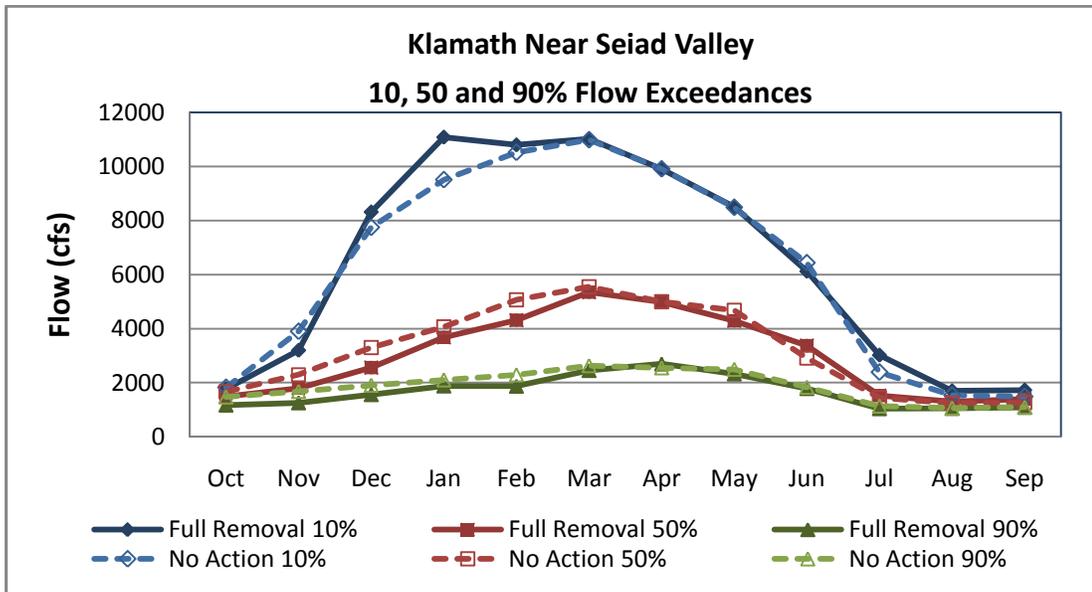
**Figure 3.6-7. Modeled Flow Exceedances under the No Action/No Project Alternative and Proposed Action Near Keno Dam**



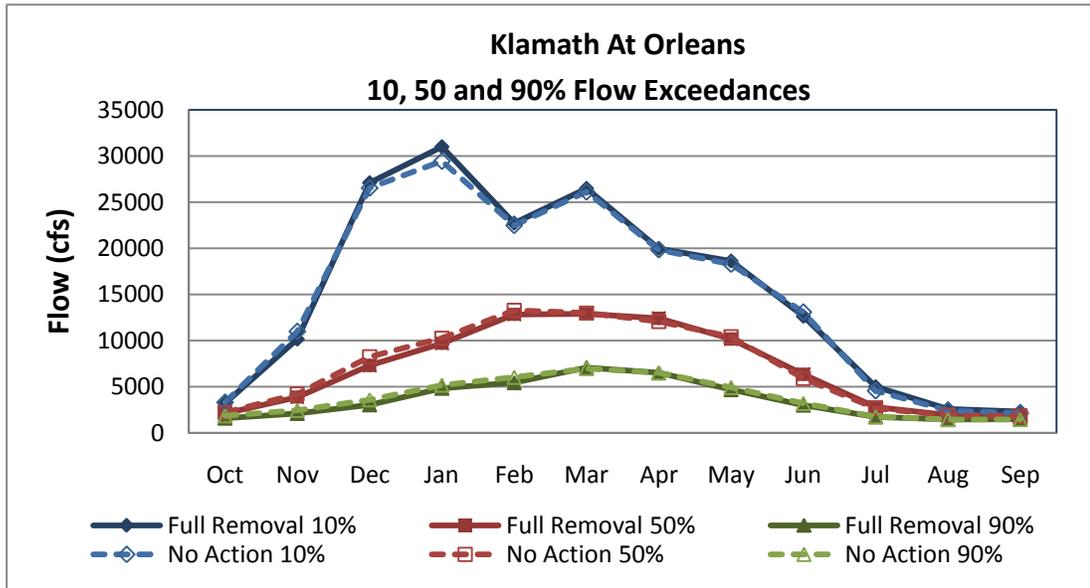
**Figure 3.6-8. Modeled Flow Exceedances under the No Action/No Project Alternative and Proposed Action Below J.C. Boyle Dam**



**Figure 3.6-9. Modeled Flow Exceedances under the No Action/No Project Alternative and Proposed Action Below Iron Gate Dam**



**Figure 3.6-10. Modeled Flow Exceedances under the No Action/No Project Alternative and Proposed Action Near Seiad Valley**



**Figure 3.6-11. Modeled Flow Exceedances under the No Action/No Project Alternative and Proposed Action at Orleans**

J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams provide only incidental flood protection during flood events. Table 3.6-9 shows peak flood flows and shows flood attenuation of less than 5 percent would have been provided by Iron Gate and Copco 1 Dams under the No Action/No Project Alternative. (J.C. Boyle and Copco 2 Dams have negligible capacity for flood attenuation.) Under the Proposed Action, the facilities would not be in place to provide this temporary reduction in flow.

**Table 3.6-9. Flood Attenuation of Iron Gate and Copco 1 Reservoirs**

Flood	Peak Flow No Action	Peak Flow Under the Proposed Action	% Reduction With Dams In
Synthetic 100-yr flood	31,460	33,800	6.9
1989	10,200	10,300	1.2
1993	11,100	11,400	2.7
1996	11,200	11,300	1.1
1997	20,500	21,400	4.0
2005	12,400	12,800	3.0

Source: DOI 2011c

Appendix J includes model results that show flood maps for the river reaches below Iron Gate Dam to Happy Camp. The series of figures show the 100-year floodplain under the No Action/No Project Alternative and the Proposed Action; the differences between the two floodplains are very minor. As described under No Action/No Project Alternative analysis, there are some differences in the current 100-year flood inundation areas between FEMA and the model. These differences are attributable to the use of different base data and the use of enhanced elevation data by the Lead Agencies. FEMA is in the process of updating FIRMs using enhanced elevation data but has not accomplished this near the Klamath River.

DOI determined the existing floodplain by computing the 100 year flood and then mapping the extent of that floodplain on the existing topography. The existing floodplain may be different than that proposed by FEMA because it is based upon more current information. DOI also determined the 100-yr floodplain after dam removal. Based upon the most current inventory of structures downstream of Iron Gate Dam to Humbug Creek over 24 residences are within the existing 100 year flood plain. Less than 6 residences and other structures such as garages are outside of this flood plain, but may be put into the 100 year floodplain after removal of the dams. However, the final determination of the future 100-yr floodplain after dam removal will be made by FEMA. The purpose of the analysis was to estimate the costs to mitigate the increase in flood risk. The existing bridges are within the 100-year floodplain; however, these structures would need to be evaluated to determine if they would still maintain enough clearance to not be inundated by flooding. Not all of the structures that could be exposed to increased flooding risks are permanent. However, an increase in risk to one habitable structure or bridge is considered to be significant according to the significance criteria. Mitigation measures H-1 and H-2 are described below.

Modeled flows represent average monthly conditions, but peak flows for fisheries and storms could result in greater flows for a short duration. Table 3.6-9 shows the flood attenuation during a 100-year storm, and the dams provide an even smaller percent attenuation during a peak flow event. During high flow periods, the existing flood control capacity with the four dams would do little to reduce flood damage. Therefore, there would be little change to flood control capacity after the four dams are removed.

When a large flood event is predicted, the National Weather Service provides river stage forecasts for the Klamath River for the USGS gages at Seiad Valley, Orleans and Klamath. They currently do not publish a forecast for river stage at Iron Gate gage. However, they work with PacifiCorp to issue flood warnings to Siskiyou County. After removal of Copco and Iron Gate Dams, it is likely that National Weather Service will publish a forecast at the Iron Gate gage location (DOI 2011c).

Both Klamath County (Klamath County 2010b) and Siskiyou County participate in the NFIP and rely on existing 100-year flood maps prepared by FEMA to plan for future development or management near flood prone areas. Regulations under the NFIP require participating communities to “inform FEMA of any physical changes that affect 100-year flood elevations...within 6 months of the date that such data are available.” This information is submitted in the form of a LOMA-F or LOMR by the community. FEMA

will review the submitted data and determine if a map revision is warranted and proceed accordingly (FEMA 2002). Removal of the four dams would change the 100-year flood inundation zone when compared to the current FEMA map. This would require either a LOMA-F or LOMR to be prepared by Klamath and Siskiyou Counties for areas within their jurisdictions. Both counties might require the DRE or other responsible agency to work with them to prepare the application. In Klamath County, the FEMA 100-year flood inundation area would change due to removal of J.C. Boyle Reservoir.

**The change to the 100-year floodplain inundation area downstream from Iron Gate Dam would increase the risks of flooding structures; therefore, the impact on flood hydrology would be significant. Mitigation Measures H-1 and H-2 would reduce the impact to flood hydrology to less than significant.**

*Removing the Four Facilities could reduce the risks associated with a dam failure.* The Four Facilities, collectively, store over 169,000 acre-feet of water when they are full. The dams are inspected regularly, and the probability for failure has been found to be low. However, if a dam failed, it could inundate a portion of the downstream watershed (Siskiyou County website 2011). Removing the Four Facilities would eliminate the potential for dam failure and subsequent flood damages. **Therefore, eliminating the dam failure risk associated with the Four Facilities would have a beneficial effect on flood hydrology.**

*The relocation of the Yreka water supply pipeline could affect river flows and result in changes to flood risks.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and would have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline could either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Bridge just downstream of Iron Gate Dam. The pipe bridge would be located above the 100 year flood line as the intention is to prevent the pipeline from being exposed to high velocity flows. Thus, the pipe bridge would not affect flood hydrology. If the pipeline was placed on the Lakeview Bridge, there would be no effect to flood hydrology from the placement of the pipeline that would be directly caused by the pipeline separate from the bridge. **Therefore, there would be no change from existing conditions from flood risk from the relocation of the Yreka water supply pipeline.**

*Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs would be removed following drawdown and could change flood hydrology.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities would be removed. These facilities would be well above the new river channel, and deconstruction would not place anything in the channel or otherwise impeded low or high flows in the Klamath River. **Therefore, there would be no change from existing conditions from flood hydrology from the removal of the recreational facilities.**

### **Keno Transfer**

*Implementation of the Keno Transfer could cause changes to operations affecting flows downstream of Keno Dam, which could cause changes to flood risks.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on flood hydrology compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice. **Implementation of the Keno Transfer would have no change from existing conditions from flood risks.**

### **East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause changes in flood risk downstream of the facilities.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

### **KBRA**

The KBRA, which is a component of the Proposed Action, encompasses several programs that could affect flood hydrology, including:

- Phases I and 2 Fisheries Restoration Plan
- Wood River Wetland Restoration
- Future Storage Opportunities
- On-Project Plan
- Water Use Retirement Program
- Emergency Response Plan
- Water Diversion Limitations
- Climate Change Assessment and Adaptive Management
- Interim Flow and Lake Level Program

### **Phases 1 and 2 Fisheries Restoration Plans**

*Implementation of the Fisheries Restoration Plans could change flows downstream of Upper Klamath Lake, which could result in changes to flood risks.* Actions within the floodplain and river channel including: floodplain rehabilitation, large woody debris replacement, fish passage correction, cattle exclusion fencing, riparian vegetation planting, and treatment of fine sediment sources could alter river hydraulics. The restoration actions are designed to improve aquatic and riparian habitat and the potential changes in river hydraulics are intended to improve the habitats' ability to support river fisheries. Changes in river hydraulics could generate minor changes in flood risks in and around the specific restoration locations. The timing of and specific locations where these resource management actions could be undertaken is not certain but it assumed that some

of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. **However, potential changes in river hydraulics are likely to generate a less than significant impact to flood risks. Implementation of specific plans and projects outlined in the Fisheries Restoration Plans will require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.**

#### **Wood River Wetland Restoration**

*Implementation of Wood River Wetland Restoration may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks. A study of future Wood River Wetland area management options would be conducted to provide additional water storage for a total of 16,000 acre-feet of storage capacity in or adjacent to Agency Lake. This additional storage upstream of Upper Klamath Lake is likely to decrease potential flood risks downstream of Upper Klamath Lake by potentially storing excess flows. The improvements in flood risk generated by implementation of the Wood River Wetland Restoration Project would not be expected to contribute to the effects of hydroelectric facility removal analyzed above. **Implementation of the Wood River Wetland Restoration Project is anticipated to have a beneficial effect on flood risks. Implementing Wood River Wetland Restoration will require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.***

#### **Future Storage Opportunities**

*Implementation of Future Storage Opportunities by Reclamation may cause changes to flows upstream and down downstream of Upper Klamath Lake, which could result in changes to flood risks. Reclamation plans to identify and study additional off-stream storage opportunities with a 10,000 acre-feet of storage milestone in implementation of KBRA. Offstream storage is likely to decrease potential flood risks by potentially storing excess flows. The improvements in flood risk generated by development of off-stream storage would not be expected to contribute to the effects of hydroelectric facility removal analyzed above. **Implementation of Future Storage Opportunities is anticipated to have a beneficial effect on flood risks. Implementing Future Storage Opportunities will require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.***

#### **On-Project Plan**

*Implementation of the On-Project Plan may change flows downstream of Upper Klamath Lake during dry years, which could result in changes to flood risks. The On-Project Plan supports full implementation of Water Diversion Limitations by taking actions to reduce water use for irrigation. These actions include: land fallowing and shifting to dryland crop alternatives, changes in land use and forage availability/types for terrestrial species, efficiency and conservation measures (i.e. drip irrigation), development of groundwater sources, or creation of additional storage. Reductions in water use under the On-Project Plan would not be expected to contribute to any changes in flood risk generated by the hydroelectric facility removal action. **Implementation of the On-Project Plan is likely to generate no change in flood risk when compared to existing conditions as it would be implemented during dry years during the irrigation season when flood risks are***

**low. Implementing the On-Project Plan will require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.**

#### **Water Use Retirement Program (WURP)**

*Implementation of the WURP would change flows upstream of Upper Klamath Lake, which could result in changes to flood risks.* The WURP is a voluntary program for the purpose of supporting fish populations restoration by permanently increasing inflow to Upper Klamath Lake by 30,000 acre-feet per year. A variety of management measures and irrigation water use changes would help to accomplish an inflow increase and are described in Section 2.4.3.9. Upper Klamath Lake storage has already increased after breaching of levees and dikes by the Williamson River Delta project which would be large enough to accommodate the inflow increase. Other KBRA measures described below would manage outflow to the Klamath River. Reductions in water use under the WURP would not be expected to contribute to any changes in flood risk generated by the hydroelectric facility removal action. **Implementation of the WURP is expected to generate no change in flood risks when compared to existing conditions because flow changes would be implemented during the irrigation season and not the flood season. Implementing the WURP will likely require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.**

#### **Emergency Response Plan**

*Implementation of an Emergency Response Plan could result in changes to flood risks in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.* The purpose of the plan is to prepare water managers for an emergency affecting the storage and delivery of water needed for KBRA implementation. The components of the Emergency Response Plan are described in Section 2.4.3.9 and include potential emergency response measures and processes to implement emergency responses. While use of an Emergency Response Plan could potentially reduce damage to property or loss of life due to a facility or dike failure, the intent of this plan is to allow for continued storage and delivery of water according to KBRA commitments and would not affect the probability of experiencing a flood. Additionally the Emergency Response Plan would not be expected to contribute to any changes in flood risk generated by the hydroelectric facility removal action. **Therefore, it is anticipated that implementation of the Emergency Response Plan would generate no change in flood risk when compared to existing conditions, although it would likely help to reduce damage to property or loss of life due to a flood event which would be a beneficial effect to flood risks. Implementing the Emergency Response Plan will likely require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.**

#### **Climate Change Assessment and Adaptive Management**

*Implementation of Climate Change Assessment and Adaptive Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks.* One of the main purposes of Climate Change Assessment and Adaptive Management is to respond to and protect basin interests from the adverse affects of climate change. Flood risks could be adversely impacted due to climate changes which increase river flows and/or flooding frequency. Klamath Basin Parties including

technical experts would be involved in the development of assessment and adaptive management strategies. Assessments and development of adaptive management strategies would be implemented continuously to respond to predicted climate changes. The improvements in flood risk generated by the Climate Change Assessment and Adaptive Management Program would be expected improve the effects of hydroelectric facility removal analyzed above. **While flood risks could be adversely impacted by climate change in general, implementation of Climate Change Assessment and Adaptive Management would help to reduce flood risks in the event of climate changes and be beneficial to flood risks. Implementing Climate Change Assessment and Adaptive Management will likely require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.**

#### **Interim Flow and Lake Level Program**

*Implementation of Interim Flow and Lake Program during the interim period would change river flows, which could result in changes to flood risks.* The goal of the Interim Flow and Lake Level Program is to “further the goals of the Fisheries Program” during the interim period. This would require changes in flows to accommodate fish needs during the irrigation season. These flow changes would be similar to what is currently recommended under biological opinions. Changes in water flows under the Interim Flow and Lake Level Program would not be expected to contribute to any changes in flood risk generated by the hydroelectric facility removal action. **Therefore, implementation of the Interim Flow and Lake Level Program would cause no change in flood risk from existing conditions because flow changes would not be implemented during the flood season.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

Under the Partial Facilities of Four Dams Alternative, impacts would be the same as for the Proposed Action. **The increased flood risks would be less than significant. The change in the 100-year floodplain downstream from Iron Gate Dam would increase the risks of flooding structures and would be significant. Mitigation measures H-1 and H-2 would reduce this impact to less than significant. Eliminating the dam failure risk would have a beneficial effect.**

#### **Keno Transfer**

The flood hydrology impacts of the Keno Transfer under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **East and West Side Facilities**

The surface water and hydrology impacts of the decommissioning the East and West Side canals under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

### **KBRA**

Under this alternative, the KBRA would be fully implemented and the potential effects would be the same as described for the Proposed Action. **Implementation of the KBRA would result in a less than significant impact to flood hydrology.**

### **Alternative 4: Fish Passage at Four Dams**

Under the Fish Passage at Four Dams Alternative, flows downstream of Iron Gate Dam would remain the same as for the No Action/No Project Alternative. The risk of dam failure and downstream flooding would be the same as under the No Action/No Project Alternative and existing condition. Within the Hydroelectric Reach, however, flows would change to accommodate the new fish ladders and requirements within the bypass reaches. Flows within the J.C. Boyle Bypass Reach would increase to meet fish needs in this area. Although the flows would increase compared to the No Action/No Project Alternative, the existing channel capacity is adequate to accommodate these increases. Flows downstream of Iron Gate Dam would not change. **Therefore, the effects from Fish Passage at Four Dams Alternative on flood hydrology would be less than significant because the river channel capacity can support flow increases and there would be no increased risks of flooding.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

*Drawdown of reservoirs could result in short-term increases in downstream surface water flows and result in changes to flood risks.* Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, short-term drawdown of reservoirs would occur at Copco 1 and Iron Gate dams, with the same effects as for the Proposed Action. No drawdown would occur in Klamath County because J.C. Boyle Reservoir would remain in place. As described in the Proposed Action, **drawdown-related impacts to flood risks for the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less than significant because flow changes would be within the historic range.**

*The release of sediment stored behind Copco 1 and Iron Gate dams and resulting downstream sediment deposition could result in changes to flood risks.* Approximately 46 to 81 percent of sediment behind Copco 1 Dam, and 25 to 38 percent of sediment behind Iron Gate Dam would be eroded and flushed down the river during removal activities (DOI 2011c). As was described and analyzed above for the Proposed Action, the magnitude of sediment deposition is relatively small compared to sediment loading from other existing sources along the Klamath River. Additionally, the sedimentation would be short-term following dam removal. Because the sediment deposition would be short-term and small in comparison with the No Action/No Project Alternative, it would not affect stream characteristics in a way that would substantively affect flood inundation or flood risks. **Therefore, sediment deposition would have a less than significant effect on flood risks.**

*The 100-year floodplain inundation area downstream of Iron Gate Dam could change between River Mile 190 and 105 (study area).* Removing Copco 1 and Iron Gate would result in a change in flows downstream of Iron Gate Dam. These changes would be less

than the Proposed Action, but could result in flooding to some structures in the 100-year floodplain. Additionally, flow requirements in the J.C. Boyle Bypass Reach would increase flows, but similar to the Fish Passage at Four Dams Alternative, these changes would be within the historic range of flows in this reach. **The change to the 100-year floodplain inundation area downstream from Iron Gate Dam would increase the risks of flooding structures; therefore, the impact on flood hydrology would be significant. Mitigation measures H-1 and H-2 would reduce the impact to flood hydrology to less than significant.**

*Removing Copco 1 and Iron Gate Dams could reduce the risks associated with a dam failure.* Copco 1 and Iron Gate Dams together store over 90,000 acre-feet of water when they are full. The dams are inspected regularly, and the probability for failure has been found to be low. However, if a dam failed, it could inundate a portion of the downstream watershed (Siskiyou County website 2011). Removing the dams would eliminate the potential for dam failure and subsequent flood damages. J.C. Boyle Dam would still be in place, and the potential for dam failure would be the same as in the No Action/No Project. The inundation area, however, could change because removal of the downstream facilities would affect flow patterns. **Overall, eliminating the dam failure risk associated with Copco 1 and Iron Gate Dams would have a beneficial effect on flood hydrology.**

*The relocation of the Yreka water supply pipeline could affect river flows and result in changes to flood risks.* Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, relocation of the Yreka water supply pipeline would occur at Iron Gate dam, with the same effects as for the Proposed Action. As described in the Proposed Action, **there would be no change from existing conditions from flood risks from the relocation of the Yreka water supply pipeline.**

*Recreational facilities currently located on the banks of Iron Gate and Copco reservoirs would be removed following drawdown and could change flood hydrology.* Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, recreation facilities would be removed at Iron Gate and Copco reservoirs, with the same effects as for the Proposed Action. **Therefore, there would be no change from existing conditions flood hydrology from the removal of the recreational facilities.**

*Construction of a new gage within the 100-year floodplain at Copco 2 Dam or J.C. Boyle Dam to measure flows could affect flood hydrology.* Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative a new gage would need to be developed at Copco 2 Dam or J.C. Boyle Dam to measure flows required to protect fish habitat downstream. Incorporation of environmental measures in the project would avoid construction-related impacts from construction in the floodplain. **The construction of a new gage would be a less than significant impact.**

*Changes in flows in the Hydroelectric Reach including the J.C. Boyle and Copco 2 bypass Reaches could affect flood hydrology.* Similar to the analysis stated under the Fish Passage at Four Dams Alternative, flows would change to accommodate the new fish ladders and requirements within the bypass reaches. As stated under the Fish Passage at

Four Dams Alternative, **the effects on flood hydrology would be less than significant because the river channel capacity can support flow increases and there would be no increased risks of flooding.**

#### **3.6.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequence Summary**

*Mitigation Measure H-1:* Prior to dam removal, the DRE will inform the National Weather Service, River Forecast Center, of a planned major hydraulic change (removal of four dams) to the Klamath River that could potentially affect the timing and magnitude of flooding below Iron Gate. The River Forecast Center is the federal agency that provides official public warning of floods. As needed, the River Forecast Center would update their hydrologic model of the Klamath River to incorporate these hydraulic changes so that changes to the timing and magnitude of flood peaks would be included in their forecasts. As currently occurs, flood forecasts and flood warnings would be publicly posted by the River Forecast Center for use by federal, state, county, tribal, and local agencies, as well as the public, so timely decisions regarding evacuation or emergency response could be made.

Prior to dam removal, the DRE will inform FEMA of a planned major hydraulic change to the Klamath River that could affect the 100-year flood plain. The DRE will ensure recent hydrologic/hydraulic modeling, and updates to the land elevation mapping, will be provided to FEMA so they can update their 100-year flood plain maps downstream of Iron Gate Dam (as needed), so flood risks (real-time and long-term) can be evaluated and responded to by agencies, the private sector, and the public.

*Mitigation Measure H-2:* The DRE will work with willing landowners to move or relocate permanent, legally established, permitted, habitable structures in place before dam removal. The DRE will move or elevate structures where feasible that could be affected by changes to the 100-year flood inundation area as a result of the removal of the Four Facilities.

##### **Effectiveness of Mitigation in Reducing Consequence**

These mitigation measures will be effective as they will identify the extent of the increased flood risks and take measures which will reduce the risks for loss, injury or death from flooding.

##### **Agency Responsible for Mitigation Implementation**

The DRE would be responsible for implementing mitigation measures H-1 and H-2.

##### **Mitigation Measures Associated with Other Resource Areas**

*Implementation of Mitigation REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam.* Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoir is removed. These facilities will not contribute to channelization of the river and thus increase flood risks, or

create infrastructure in the flood plain that would be at risk of damage during inundation. **Therefore, there would be no change from existing conditions to Flood Hydrology from the implementation of REC-1.**

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## 3.7 Groundwater

This section of the Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) describes the changes in groundwater levels and availability that would be caused by the Proposed Action and alternatives.

### 3.7.1 Area of Analysis

This EIS/EIR's area of analysis, or "project area," for groundwater as related to the Klamath Hydroelectric Settlement Agreement (KHSA) includes the area within 2.5 miles upstream of J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs. The project area lies within Klamath County, Oregon, and Siskiyou County, California. The project area for the Klamath Basin Restoration Agreement (KBRA) with respect to groundwater is the Klamath basin upstream of Copco 1 Dam. This is the area covered by a United States Geological Survey (USGS)-Oregon Water Resources Department (WRD) groundwater model designed to determine effects on groundwater from pumping water for irrigation purposes. No model exists for areas below Copco 1 Dam. Groundwater issues, such as changes in groundwater levels or recharge, are described in this section, 3.7 Groundwater. Issues related to geology are described in Section 3.11, Geology, Soils, and Geologic Hazards.

### 3.7.2 Regulatory Framework

Groundwater resources within the area of analysis are regulated by the state and local laws listed below.

#### 3.7.2.1 State Authorities and Regulations

- California Water Code (CWC §10750, §10753.7, §1702, §1706, §1727, §1736, and §1810) (California, State of)
- California Assembly Bill 3030 (CWC §10750 et seq.)
- California Senate Bill 1938 (Sections 10753.4 and 10795.4 of, to amend and renumber Sections 10753.7, 10753.8, and 10753.9 of, and to add Sections 10753.1 and 10753.7)
- Oregon Revised Statutes (Chapters 536 through 541) (Oregon, State of)
- California Department of Water Resources (DWR) Bulletin 118 (DWR 2003)

#### 3.7.2.2 Local Authorities and Regulations

- Siskiyou County Code (Title 3, Chapter 19) (Siskiyou County)

### 3.7.3 Existing Conditions/Affected Environment

#### 3.7.3.1 Groundwater Basin Hydrology Description

##### Regional Groundwater Conditions

The project area has few wells that completely characterize groundwater conditions. Gannett et al. 2010 completed the most recent and comprehensive attempt to estimate the

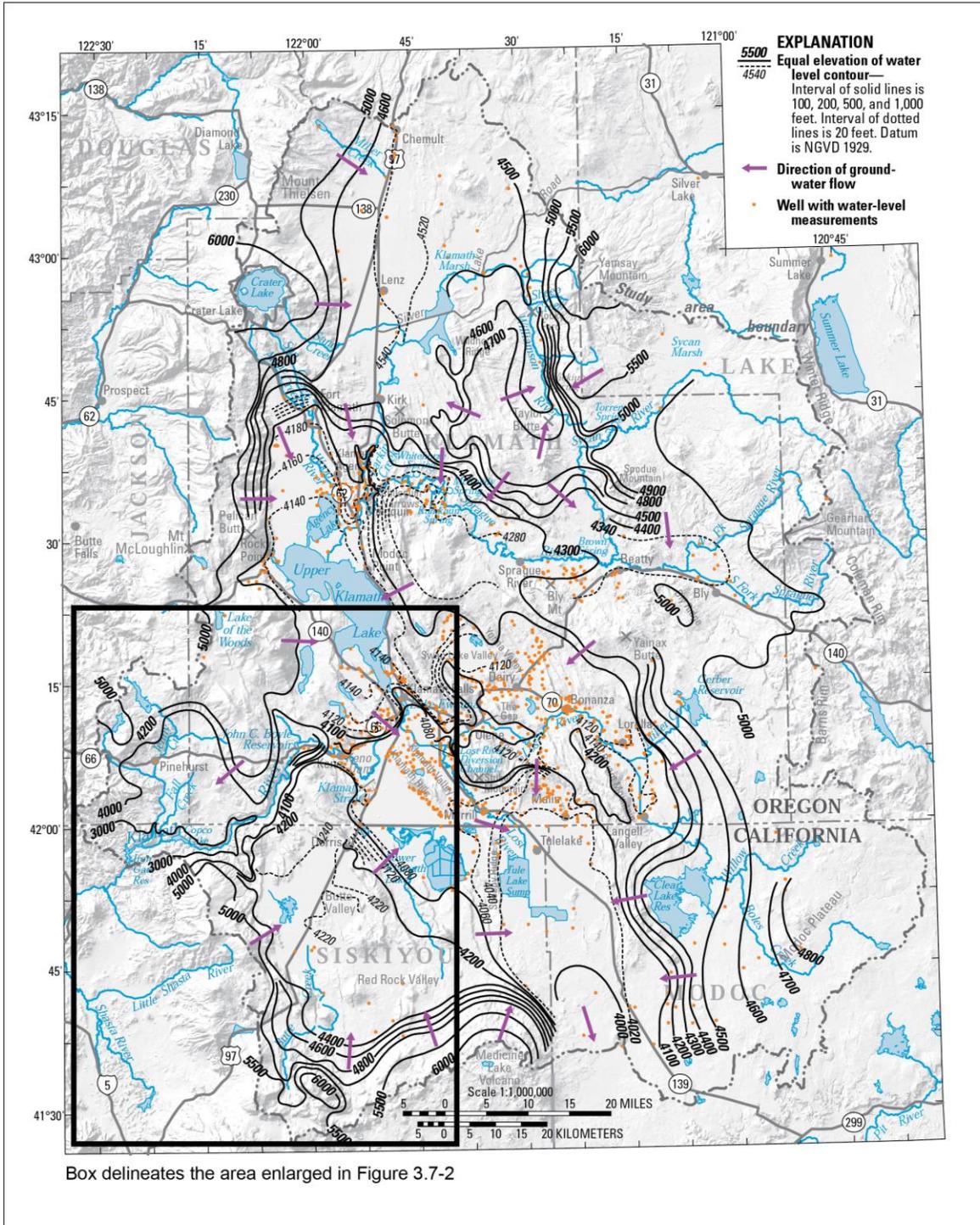
water level gradients and flow patterns within the project area upstream and downstream of the four dam sites. Figures 3.7-1 and 3.7-2 show a generalized groundwater flow map for the Upper Klamath Basin and portions of the Lower Klamath Basin. Figure 3.7-2 suggests that the regional groundwater flow patterns along the Klamath River downstream of Keno Dam are generally from the higher elevations (upland areas, mountain ranges, hills, etc.) toward the Klamath River, and from Keno Dam toward Iron Gate Dam (United States Department of the Interior [DOI] 2011a). Figure 3.7-2 suggests a groundwater divide exists under Keno Dam. The groundwater level contours suggest that the groundwater system above Keno Dam is isolated from the groundwater system below Keno Dam.

The Lead Agencies reviewed the area around the reservoirs on USGS topographic 7½-minute quadrangle maps (Iron Gate and Copco Quadrangles in California; Spencer Creek and Chicken Hills Quadrangles in Oregon) (DOI 2011a). Numerous springs, where groundwater discharges to the surface, are shown surrounding Iron Gate Reservoir. These springs occur at elevations from less than 50 to more than 300 feet (ft) above the reservoir level (DOI 2011a). The maps also show springs around Copco Reservoir. These springs are similarly less than 50 to more than 800 feet above the reservoir level (DOI 2011a).

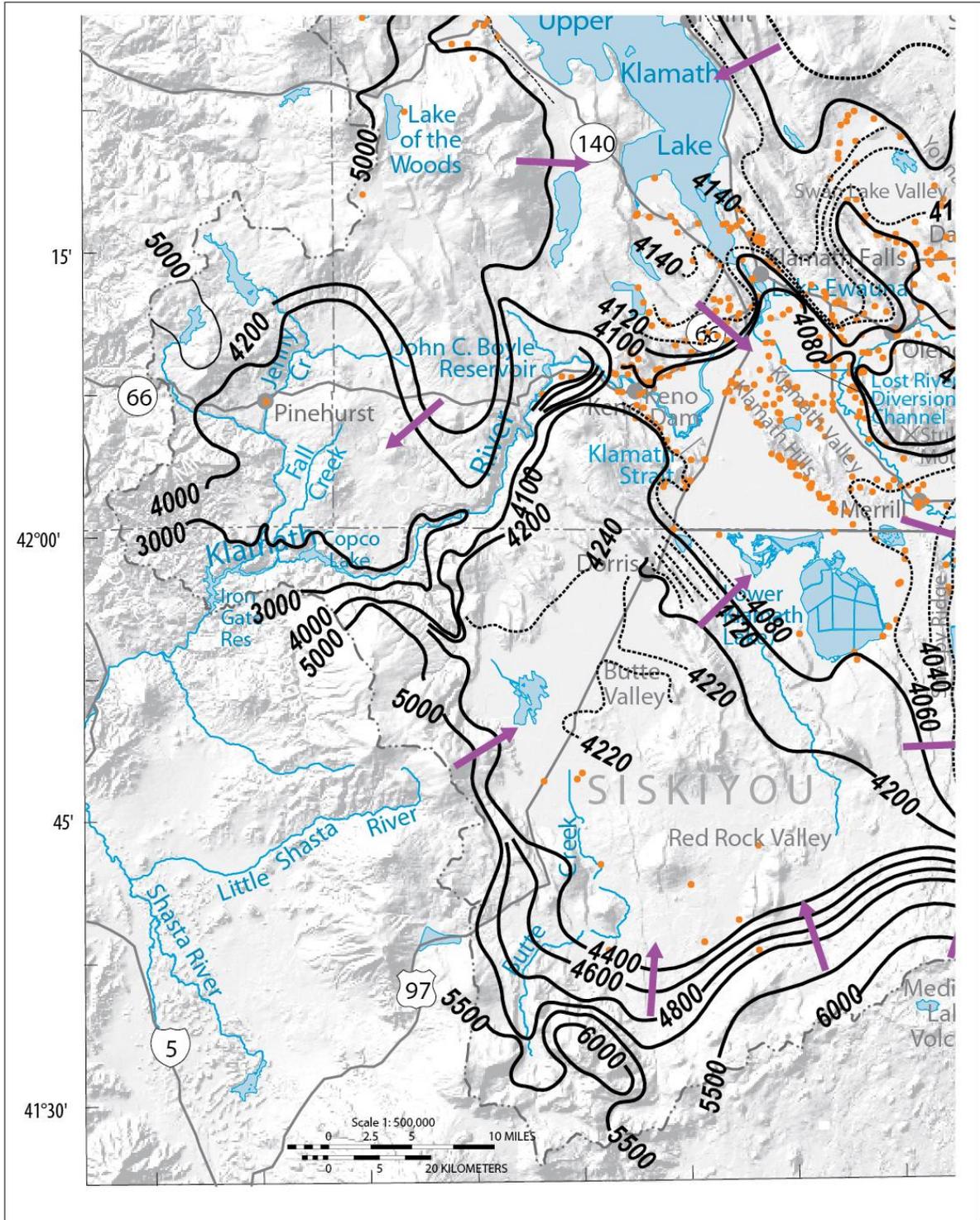
The USGS mapping shows a number of the small drainages that empty into Copco Reservoir have a spring at the headwater of the drainage. The maps show very few springs in the vicinity of J.C. Boyle Reservoir, and those that are shown are only a few tens of feet above the reservoir level (DOI 2011a). However, many of the small drainages that empty into J.C. Boyle Reservoir have a spring at the headwater of the drainage (e.g., Spencer Creek (Gannett et al. 2010)). The presence of springs in the area suggests local groundwater systems, and possibly a regional groundwater system, that are not receiving water directly from the reservoirs (DOI 2011a). That is, the water discharging from the springs is not thought to be reservoir water (DOI 2011a).

The flows from the springs and the location of the springs could be influenced indirectly by the presence of a reservoir because the reservoir could create higher groundwater levels adjacent to the reservoir. These higher groundwater levels could cause groundwater levels to be increased as compared to the condition where the reservoir was not in place. These increased groundwater levels could rise to the ground surface and affect the location of a spring and the volume of water discharging from the spring. The level of hydraulic connection between the reservoirs and the spring systems is not known (DOI 2011a).

A spring complex about one mile below J.C. Boyle Dam contributes substantial flow to the river (Gannett et al. 2010). The water discharging at this site may be originating from the local groundwater system. The flows could also be influenced by seepage from the reservoir that is flowing around or under the dam and coming to the surface at the spring site. It is likely that the flows from this spring complex are influenced by both the local groundwater system as well as leakage from the reservoir (DOI 2011a).



**Figure 3.7-1. Generalized Groundwater Potentiometric Surface Contour Map and Groundwater Flow Directions in the Upper Klamath Basin [after Gannett et al. 2010]**



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**Figure 3.7-2. Enlarged Portion of the Generalized Groundwater Potentiometric Surface Contour Map and Flow Directions for the Areas Around J.C. Boyle, Copco, and Iron Gate Reservoirs [after Gannett et al. 2010]**

### **Sources of Groundwater in Project Area**

Groundwater in the project area is likely fed by the infiltration and subsequent percolation of precipitation through the surface materials to the bedrock units. As Figures 3.7-1 and 3.7-2 show, at a regional scale, groundwater appears to flow into the project area near the four dams from upland areas toward the Klamath River and the reservoirs. The figures show an apparent groundwater divide in the area just upstream of J.C. Boyle/Keno Impoundment. These figures also show the regional trends in groundwater elevations and flow paths. Where groundwater levels are above the river and reservoir elevations, it is generally assumed that groundwater levels in the vicinity of the reservoirs are supported by the regional groundwater system more so than by reservoir leakage. However wells immediately adjacent (potentially extending up to a mile from the reservoirs under certain conditions) to the reservoirs are more likely influenced by reservoir leakage where such leakage exists.

Local groundwater in the project area is also fed by groundwater underflow from these upgradient areas. In the absence of barriers to vertical flow, surface water infiltration is a common source of recharge to groundwater systems. Rivers, lakes and other surface water bodies are common sources of site specific infiltration recharge. Aerial precipitation is more of a dispersed, wide extent source of infiltration recharge. Given a regional groundwater flow direction toward the river and reservoirs in the project area, reaches are more likely receiving water from the groundwater systems than they are losing water to the groundwater systems, while reservoirs are more likely to lose water to the groundwater (DOI 2011a). However, there are conditions where the reservoirs could be gaining water from the groundwater system(s) (DOI 2011a). The lack of data from groundwater wells in the area makes a more specific characterization of groundwater sources in the project area difficult.

### **Groundwater Sinks in Project Area**

In areas where surface water levels are lower than the adjacent groundwater level, groundwater can discharge to the surface water (e.g., rivers, streams, and reservoirs). This would be called a groundwater “sink” because groundwater flows towards it and is lost from the groundwater system. Gannett et al. (2010) estimates that groundwater adjacent to the Klamath River discharges to the river in the project area. An average discharge of 190 cfs of groundwater for the reach from Keno Dam to downstream of the J.C. Boyle Powerhouse and 92 cfs for the reach from there downstream to Iron Gate Dam is estimated (Gannett et al. 2010). These estimates are calculated for the length of each of these reaches based on gage data and changes in reservoir storage. These estimates may include some ungaged tributary inflows.

Groundwater pumping is also a typical process in the project area where water is removed from the groundwater system. In the project area, groundwater is pumped to the surface for domestic use and irrigation. Most domestic wells around the reservoirs are likely seasonal residences (i.e., owner’s official address is different than the well location address) and are not expected to be a major groundwater sink in the project area (DOI 2011a). Average well yields in Siskiyou County, California are just over 19 gpm while in Klamath County, Oregon the average yield is just over 22 gpm (DOI 2011a). Based on

completion dates on well logs for Siskiyou County, an average of five new wells per year have been installed in the project area since 1963. In Klamath County the average is about three new wells per year since 1976, including the area around Keno and Keno Dam, Oregon (DOI 2011a).

A large groundwater flow system exists in the Upper Klamath Basin (Gannett et al. 2010). Groundwater is recharged in areas in the Cascade Range and upland areas surrounding the basin. Groundwater flows from these areas toward the interior of the basin and subbasins (Figure 3.7-1). Many of the streams in the interior of the basin are at least partially fed by groundwater discharge (Gannett et al. 2010). Some streams are fed predominately by groundwater (i.e., baseflow) at a consistent rate throughout the year.

Groundwater is used in the Upper Basin to irrigate agricultural land as well as for domestic, industrial, and municipal purposes. Groundwater is used as a primary source of irrigation water where surface water is not available and also as a supplemental source when surface supplies are limited (Gannett et al. 2010).

Groundwater levels vary in response to both climatic and pumping conditions. Climatic variations can vary the groundwater level by five feet within the basin. The typical drawdown and recovery cycles caused by groundwater pumping can be from one to ten feet. Groundwater use in the Upper Basin has increased by 50 percent since 2001 primarily in the area surrounding Reclamation's Klamath Project. The increase in pumping has resulted in groundwater levels dropping 10 to 15 feet in portions of this area between 2001 and 2004 (Gannett et al. 2010).

#### **Local Groundwater Conditions**

The California DWR *Bulletin 118 – Update 2003, California's Groundwater*, delineates 515 groundwater basins and subbasins throughout the state. The area of analysis for the Proposed Action and alternatives does not fall within one of these delineated basins. The area is defined as a “groundwater source area” by the California DWR. A “groundwater source area” is “rocks that are significant in terms of being a local groundwater sources, but do not fit the [typical] category of basin or subbasin” (DWR 2003). The Klamath River from the Oregon-California Stateline to downstream from Iron Gate Dam is a predominantly non-alluvial river flowing through mountainous terrain. Downstream from the Iron Gate Dam, and for most of the river's length to the Pacific Ocean, the river maintains a relatively steep, high-energy, coarse-grained channel frequently confined by bedrock. Section 3.11, Geology, Soils, and Geologic Hazards, of this document describes project area geology in more detail.

Well information was obtained and reviewed from the databases of both the Oregon WRD and the California DWR to identify well logs for known domestic and irrigation wells within several miles upstream and downstream of the Four Facilities. Roughly 83 percent of the logs (300 out of 360 logs) had sufficient information to be able to identify with a reasonable amount of certainty the locations of these wells in relation to the reservoirs. Of the 300 logs for which reasonable coordinate data could be

determined, only 63 wells were within 2.5 miles of one or more of the three reservoirs, 25 near Iron Gate, 22 near Copco 1 and 2, and 16 near J.C. Boyle (DOI 2011a).

Using the local topography, reservoir bathymetry, and lithologic descriptions on the well logs, representative cross-sections across various spans of the reservoirs were generated such that each cross-section intersected at least one known well location. The cross-section for J.C. Boyle is presented below, and cross sections for Copco 1 and 2 and Iron Gate are presented in Appendix K. Each cross-section displays the topography, water surface elevation of the reservoir, well log ID, abbreviated well log lithology, and the static water level in the well. The water-bearing units in each well are presented in summary tables for each reservoir.

The discussions of potential or possible impacts to the local wells from the Proposed Action are predicated on the concept that in order to be impacted, the water-bearing unit that each well is tapping must be hydraulically connected to the reservoir – either by having the water-bearing unit exposed to the surface (i.e., daylight) within the reservoir walls or being hydraulically connected to the reservoir through a series of permeable layers between the reservoir and the water-bearing unit.

The potential for impacts to the wells is further predicated on the relative elevation differences between the static water level in the well(s) and the water surface elevation of the reservoir. Specifically, if the water-bearing unit being tapped by any given well is in hydraulic connection with a reservoir, then the static water level in the well should be similar or close to the water surface elevation in the reservoir. If the static water level is higher or lower than the reservoir level, and the water-bearing unit is not exposed along the reservoir walls, then it is likely that the water-bearing unit is reflecting a regional or local aquifer system influence in addition to, or in place of, the reservoir. If the water-bearing unit itself is entirely above the reservoir water levels, or is substantially deeper (more than three or four intervening impermeable units) than the lowest portion of the reservoir, then it would be unlikely that the water-bearing unit would be in hydraulic connection with the reservoir. It should be noted that the static water level in a well can vary from year to year based on preceding hydrologic conditions (i.e., climatic cycles, wet years vs. dry years).

### **J.C. Boyle Reservoir**

The bedrock surrounding and underlying the J.C. Boyle Reservoir is principally composed of moderately well bedded to massive, moderately well-consolidated volcanic rocks of the High Cascade Geomorphic Province. Lava flows dominate the landscape and geologic strata and form many of the ridges above the reservoir. In the downstream portion of the reservoir (downstream from the Highway 66 bridge) young lava flows line the sides of the reservoir (DOI 2011a). Section 3.11, Geology, Soils, and Geologic Hazards, provides additional geologic information.

The Oregon WRD well database identifies 50 wells within 2.5 miles of the J.C. Boyle Reservoir (Oregon WRD 2011). Sixteen of these 50 wells were able to be located geographically based on well addresses recorded on the drill logs or by comparing the

well log information to ownership parcel data supplied by Klamath County. Ten of those 16 wells were shallow Oregon Department of Transportation borings near bridge footings. Figure 3.7-3 shows the locations of the wells that could be located. The construction details for these wells are outlined in Appendix K.

Three cross-sections that intersected at least one of the six wells were developed. Figure 3.7-3 shows the locations of these cross-sections. Figures 3.7-4 and 3.7-5 show the cross-sections. The well parameters used to develop the cross-sections are summarized in Table 3.7-1.

The data in Table 3.7-1 suggests that the water-bearing volcanic units of the High Cascade are deeper than the bottom elevation of the reservoir (i.e., the pre-reservoir river bed) in wells 10059 and 51633. The static water level for each well is 50 to 100 ft below the bottom of the reservoir. The top of the water bearing layer and the static water level in well 14002 are similar to the elevation of the river bed (DOI 2011a). Therefore, the reservoir level is unlikely to affect these wells.

The lateral extent, homogeneity/inhomogeneity, and degree of fracturing, of the volcanic deposits in the region are variable. Some degree of hydraulic connectivity exists between the reservoir and water bearing strata near the reservoir which allows downward migration of reservoir water. There may also be a zone of similar horizontal hydraulic connectivity around the reservoir. The extent and degree of connectivity is uncertain based on the limited well data. Both wells 10059 and 14002 have significant amounts of clay recorded on the logs at depths between the top of their water bearing units and the equivalent depth of the old river bed that probably inhibits or significantly reduces the vertical migration of infiltration water from the reservoir. The extents of these clay units are uncertain (DOI 2011a).

Comparison of the elevations of the static water levels in the six wells near J.C. Boyle reservoir shows that two wells downstream of the dam (13628, 14002) have static water levels 20 to 40 feet below the pre-dam river bed elevation (at the dam site); the two wells (10514, 10059) furthest away from the reservoir (4,721 feet and 5,518 feet from the reservoir) have static water level elevations nearly 100 feet below the pre-dam upstream river bed elevation; and the two wells near the shore of the reservoir have static water level elevations 20 to 30 feet below the pre-dam river bed elevation at the dam site. The static water level elevations in the wells furthest from the reservoir are near or below the static water level elevations for the wells closer to the reservoir. No clear determination of any trends in vertical head gradients can be drawn from the data of these six wells (DOI 2011a).

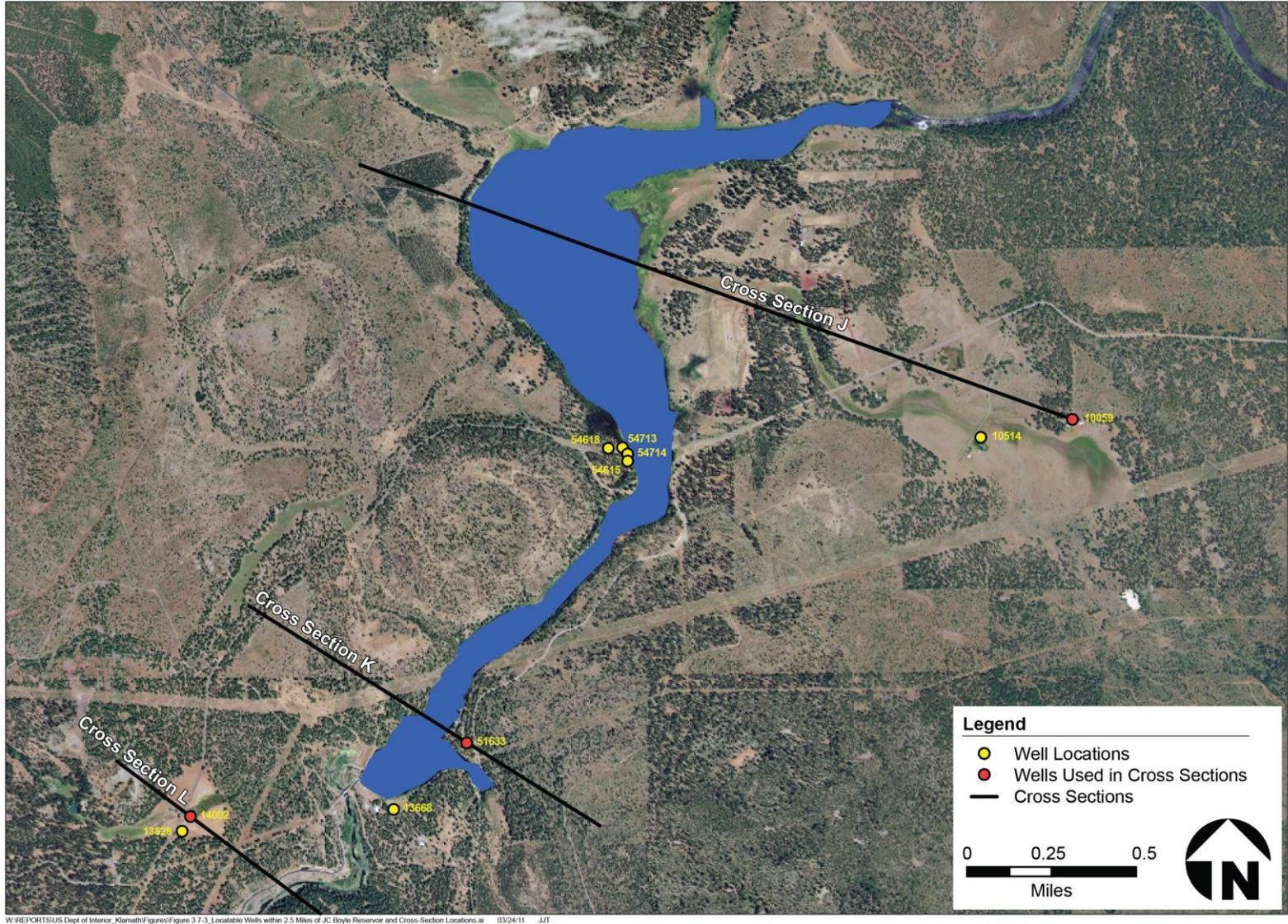


Figure 3.7-3. Locatable Wells within 2.5 Miles of J.C. Boyle Reservoir and Cross-Section Locations

**Table 3.7-1. Well Construction Information for Wells<sup>1</sup> within 2.5 Miles of J.C. Boyle Reservoir<sup>2</sup>**

Well ID <sup>3</sup>	Drill Date	Well Diameter (in)	Depth to top of perforated zone or bottom of surface casing in an open well (ft)	Depth to bottom of perforated zone (ft)	Depth of Well (ft)	Depth to 1st Water (ft)	Pumping Rate (gpm)	Depth to Static Water (ft)	Located on Cross-Section	Static Water Elevation (ft)	Water-Bearing Unit and Top Elevation (ft)
10059	6/29/1990	6	159 <sup>4</sup>	Open	281	77	12	222	J	3,686	Brown lava and clay from 203 to 223 ft bgs interspersed with black rock from 212 to 215 ft bgs, and gray rock and clay, and gray rock from 223 to 281 ft bgs with bubbly brown lava from 257 to 280 ft bgs; Elevation 3,705 ft
14002	8/10/1988	6	99 <sup>4</sup>	Open	238	181	25	178	L	3,698	Hard gray volcanic rock from 181 to 238 ft bgs; Elevation 3,695 ft
51633	10/19/2006	6	280 <sup>4</sup>	Open	315	126	55	126	K	3,701	Gray and brown basalt from 126 to 315 ft bgs interspersed with hard gray basalt, broken and fractured zones, and two ash layers; Elevation 3,700 ft

Source: DOI 2011a, DOI 2010.

Notes:

<sup>1</sup>Well list does not include Oregon Department of Transportation boreholes used for bridge footings.

<sup>2</sup>Reservoir stage is 3,787 ft AMSL; river bed elevation at the dam is 3,720 ft AMSL.

<sup>3</sup>All wells listed as domestic supply wells.

<sup>4</sup>Depth to the bottom of the surface casing or sanitary seal in holes/wells that are openKey:

Key:

AMSL: above mean sea level

bgs: below ground surface

in: inches

ft: feet

gpm: gallons per minute

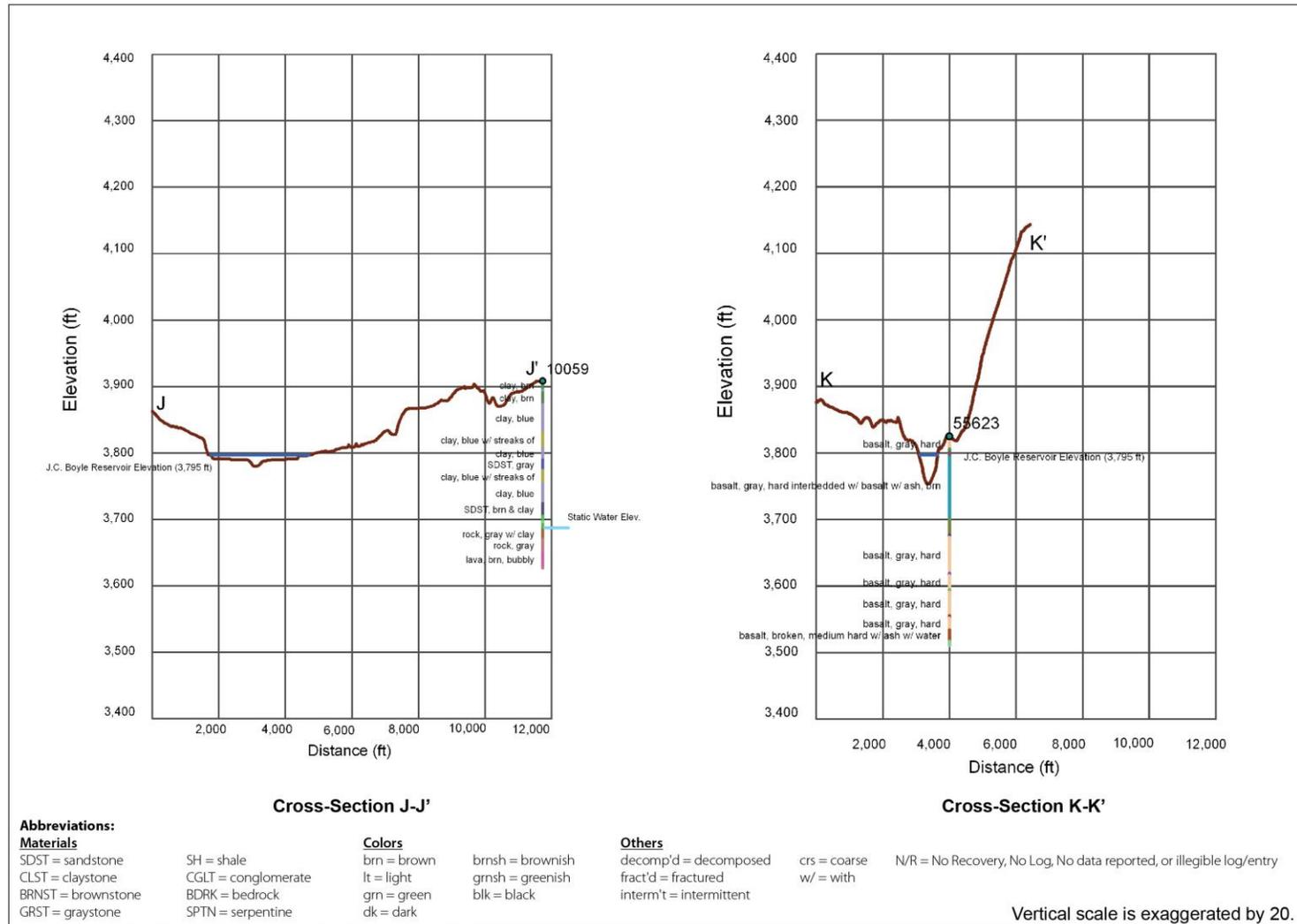
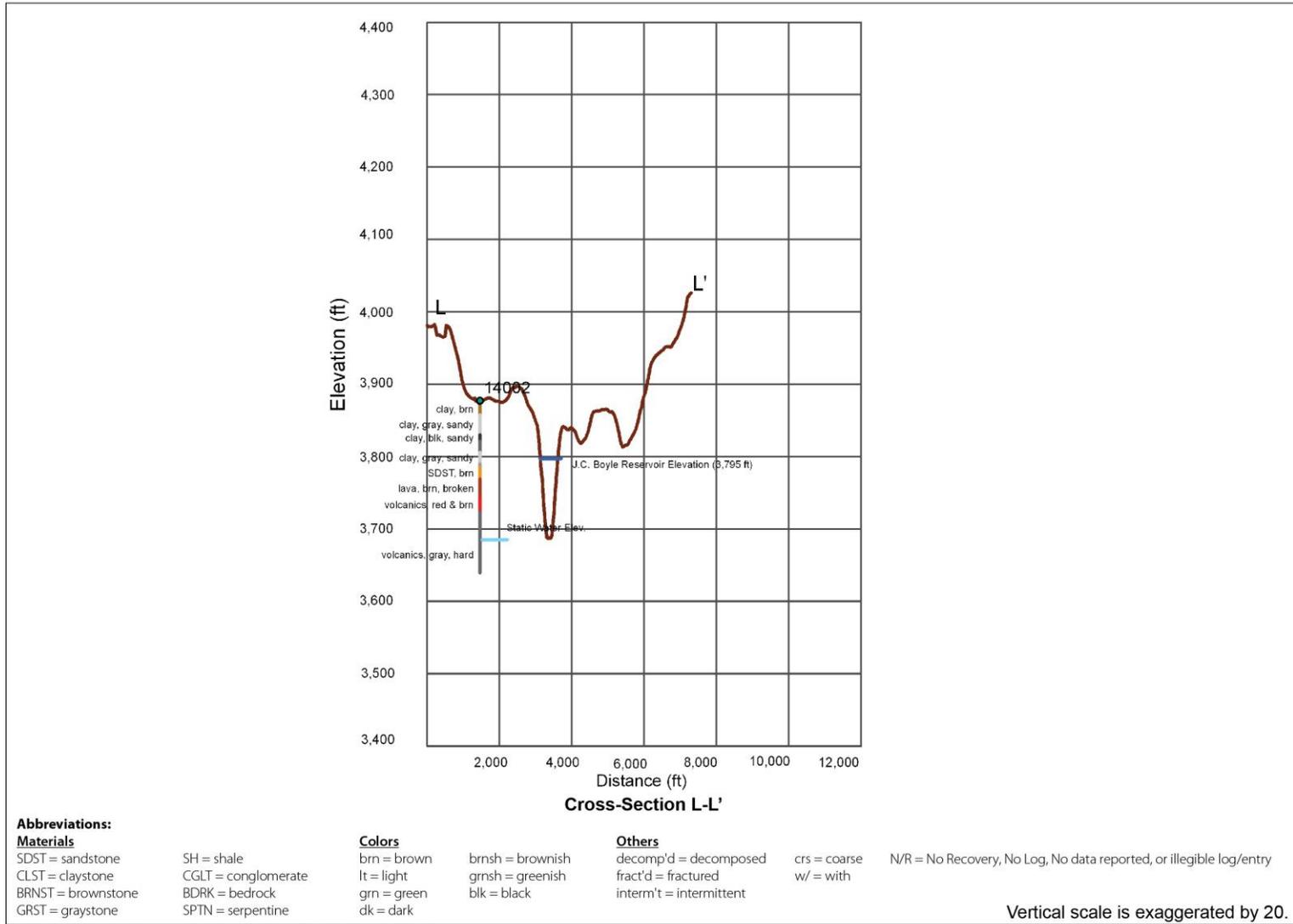


Figure 3.7-4. J.C. Boyle Reservoir Cross-Sections J and K



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**Figure 3.7-5. J.C. Boyle Reservoir Cross-Section L-L'**

### **Copco 1 and Copco 2 Reservoirs**

As described in Section 3.11, Geology, Soils, and Geologic Hazards, Copco Lake including the smaller impoundment at Copco 2 Dam, sits at the divide between the Western Cascade and the High Cascade geomorphic provinces. The Western Cascade is faulted and intruded by basaltic dikes and its composition of lower and higher permeable stratified rocks results in discrete aquifer units. The relationship between groundwater flow in and between the High Cascade and Western Cascade is complicated and not well understood but the groundwater utilized in the vicinity of Copco Lake is likely contained in the permeable units of the High Cascade or upper water bearing units of the eastern dipping Western Cascade based upon the generally shallow depth of known groundwater wells. The Western Cascade strata have the potential to contain geothermal reservoirs where capped by the High Cascade lava flows (Hammond 1983).

The identification of wells in the vicinity of the Copco Reservoirs followed the same method as for the J.C. Boyle Reservoir. The California DWR well database identifies 22 wells within 2.5 miles of the Copco Reservoirs. Figures and tables showing the locations and construction details of the 22 identified wells and the five cross-sections that were developed are provided in Appendix K.

The data for the wells in the cross-sections indicate that the water-bearing units and static water levels are above the bottom of the reservoir. All the wells near the Copco Reservoirs, with the exception of one well, have static water levels that are below the reservoir stage but above the river bed elevation at the dam site. Similarly, all the wells except one have elevations for the top of the water bearing unit below the reservoir stage and above the river bed elevation at the dam site. The two exceptions are two different wells. The top of the water bearing formation was not identified on the log for some wells. In this case, the elevation at which water was first encountered in the drilling is used as a substitute for the top of the water bearing unit.

The average static water level for all wells less than 300 feet from the reservoir is 2,591 feet while the average static water level for all wells greater than 400 feet from the reservoir is 2,680 feet (DOI 2011a). These levels suggest that there is downward groundwater flow near the reservoir (i.e., groundwater is flowing down toward the reservoir). Because groundwater is flowing toward the reservoir, this information suggests that the water level in the reservoir does not have a significant lateral influence on groundwater levels in the area around J.C. Boyle reservoir (DOI 2011a).

### **Iron Gate Reservoir**

Iron Gate Reservoir overlies the volcanic units of the Western Cascade which like Copco 1 Reservoir have been faulted and intruded by basaltic dikes (Hammond 1983). The relationship between groundwater flow in the units of the Western Cascade is complicated and not well understood. Specific groundwater well data provides the best understanding of the occurrence of groundwater in the vicinity of Iron Gate Reservoir.

The identification of wells in the vicinity of Iron Gate Reservoir followed the same method as for the J.C. Boyle, Copco 1, and Copco 2 Reservoirs. The California DWR well database identifies 25 wells within 2.5 miles of the Iron Gate Reservoir. Figures and tables showing the locations and construction details of the 25 identified wells and the five cross-sections that were developed are provided in Appendix K.

The well data shows that the static water level (when recorded) is above the reservoir stage with only two exceptions (wells 781723, 99834). The static water level for all the wells is also above the elevation of the river bed at the dam site with only one exception (781723). The data in Appendix K shows that the estimated elevation of the top of the water bearing unit (recorded on 13 of the 25 logs) is above the reservoir stage in 10 of the 13 wells. The top of the water bearing unit is between the reservoir stage and the reservoir bottom in two wells. The top of the water bearing unit is below the reservoir bottom in only one well (781723).

Wells further away from Iron Gate Reservoir have higher static water levels and generally higher top of water bearing unit elevations than wells closer to the reservoir. These elevations indicate groundwater flow direction is towards the reservoir in agreement with the regional groundwater gradients (Gannett et al, 2010). Wells within 2,000 feet of the reservoir have static water levels very close or above to the reservoir stage (one exception, well 334387) indicating a potential flow direction toward the reservoir. The current well dataset cannot determine conclusively whether Iron Gate Reservoir has any vertically downward or horizontal seepage (DOI 2011a).

### **3.7.4 Environmental Consequences**

The section analyzes the environmental consequences on groundwater from implementation of the Proposed Action or its alternatives. Effects to groundwater quality are not expected because groundwater discharges to surface water in the majority of the area. Impacts to water quality are discussed in detail in Section 3.2, Water Quality.

#### **3.7.4.1 Environmental Effects Determination Methodology**

The method for this analysis was to compare the effects of the Proposed Action and alternatives to the existing conditions. This analysis used the groundwater information presented in Section 3.7.3 to evaluate potential effects on existing wells and on groundwater's influence on surface water resources in the project area.

#### **3.7.4.2 Significance Criteria**

For the purposes of this EIS/EIR, impacts would be significant if they would result in the following:

- Lowering of the local groundwater table level so the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted.

- Substantially interfering with groundwater levels or groundwater recharge so there would be changes to the groundwater/surface water interaction that would adversely affect surface water conditions or related resources.

Land subsidence caused by aquifer collapse can be caused by many processes such as the dewatering of fine grained materials (i.e., clays) or collapse of the structure of an aquifer (i.e., through dissolution or piping). Although land subsidence as a result of changes in groundwater levels is a common significance criterion, it is not considered in this EIS/EIR given that land subsidence would not be an effect of the Proposed Action or alternatives because water levels would not be lowered in areas of substantial clay deposits and the rock types of the aquifer are not susceptible to collapse in the area of analysis.

#### **3.7.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

*Under the No Action/No Project Alternative, there would be no change in project dam and associated facility operations and no impacts on groundwater resources.* Under the No Action/No Project Alternative, J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams and their associated facilities would remain in place and be operated similarly as they have been during historical operations. Therefore, the No Action/No Project Alternative would not change the elevation of surface water in the reservoirs outside of historical ranges. Groundwater levels would be expected to remain consistent with historic values. **Therefore, no changes from existing conditions relative to the elevation of the groundwater table in the vicinity of the reservoirs would be expected.**

*Under the No Action/No Project Alternative, there could be increased groundwater storage.* Activities associated with the No Action/No Project Alternative include certain resource management actions that are currently approved and ongoing, and which would continue to be implemented. Actions that could affect groundwater resources include Agency Lake and Barnes Ranches. These actions would provide new storage to store additional surface water supplies. In some years, when water is available, groundwater use could decrease. Stored surface water would also increase seepage into underlying groundwater basins. **This would be a beneficial effect to groundwater resources.**

##### **Alternative 2: Full Facilities Removal of Four Dams (the Proposed Action)**

*Under the Proposed Action, groundwater levels in existing wells adjacent to the reservoirs could decline in response to the drop in surface water elevation when the reservoirs are removed.* The water-bearing units from which most of the existing domestic or irrigation wells pumps are either below the elevation of the original river channel, are exposed along reservoir walls, or are above the reservoir stage. There is limited data to fully characterize the degree of hydraulic connection between these water bearing units and the reservoirs.

Some of the water-bearing units that are tapped by existing domestic or irrigation wells are above the reservoir elevation and are at elevations similar to those of mapped springs. These springs are likely fed by the same water-bearing units supplying the wells and

neither would likely be significantly impacted by the removal of the reservoirs. The primary impact that would be expected could be a drop in the groundwater levels in these higher elevation water bearing units as the reservoirs drain and new local groundwater levels are established relative to the river elevation.

A number of existing domestic or irrigation wells lie close to the reservoir shorelines (well within the 2.5 miles.) These wells may be influenced by the dropping reservoir water levels when directly or indirectly connected to the reservoir. However, all but three of the shoreline wells tap water-bearing units with elevations below the bottom of the reservoir. The degree of impact will be controlled by the degree of hydraulic connectivity between the reservoirs and the water bearing units below and adjacent to the reservoirs. The degree of connectivity between the reservoirs and water bearing units below and adjacent to the reservoirs is uncertain.

As noted previously, there are existing (and locatable) domestic or irrigation wells that pump from water-bearing units that may be directly connected to the reservoirs. Therefore, changes in reservoirs water levels might directly affect the groundwater level in the wells. Other wells in the vicinity of these three wells access deeper water-bearing units.

In general, domestic or irrigation wells with static water levels that are close to the elevation of the pre-dam river channel will, most likely, not be impacted by the removal of the reservoirs as the river already is a base line for these wells. Similarly, wells with static groundwater levels above the pre-dam river bed elevation, but below current reservoir stages, could experience groundwater level declines down to pre-dam river bed elevations as the river is re-established. The potential impacts at specific wells will depend upon local hydrogeologic conditions at the well site as well as the well construction characteristics. Hydrogeology between well locations conditions can vary widely between sites.

Fish hatchery operations will continue at the Iron Gate Hatchery for eight years following removal of the Iron Gate Dam. After eight years, hatchery production will continue, but may be at an alternate site. Under the KHSA, PacifiCorp is responsible for evaluating hatchery production options that do not rely on the current Iron Gate Hatchery water supply. Such options could include use of groundwater, surface water, or water reuse technologies. PacifiCorp is also responsible for proposing and implementing a post-Iron Gate Dam Hatchery Mitigation Plan (Hatchery Plan) to provide continued hatchery production for eight years after the removal of Iron Gate Dam; and this Hatchery Plan would be developed with information from PacifiCorp's evaluation. However, PacifiCorp is not required to propose a Hatchery Plan until six months following an affirmative Secretarial Determination. The Lead Agencies do not currently know what PacifiCorp will propose in the Hatchery Plan and are unlikely to know unless there is an affirmative Secretarial Determination. An impact analysis of a hatchery production option that does not rely on the current Iron Gate water supply would be purely speculative at this point. Therefore, the potential environmental effects of implementing

a hatchery production option that does not rely on the current Iron Gate water supply are not analyzed in this EIS/EIR.

There are existing domestic and irrigation groundwater wells that could not be located reliably based on the information in the Oregon WRD or California DWR databases. In addition to the non-locatable wells in the databases, there are likely other existing wells in the vicinity of the reservoirs. The real estate information presented in the Dam Removal Real Estate Evaluation Report prepared by the DOI in 2011 lists 1,467 potentially impacted parcels near the Copco and Iron Gate reservoirs. Of those 1,467 parcels, 12% (176 parcels) are listed as improved and 88% (1,291 parcels) are shown as vacant (DOI 2011b). The extent of improvements on the 12% of parcels is not known. However, it is possible that improvements may have included installation of a groundwater well for domestic supplies. The number of improved parcels near the J.C. Boyle reservoir is not known. Therefore, there could be additional domestic or irrigation wells in water-bearing units that intercept the reservoirs. **A decline in groundwater levels at nearby wells would be a significant impact, but implementation of mitigation measure GW-1 would reduce this impact to less than significant.**

*The Proposed Action could cause a reduction in groundwater discharge to the Klamath River.* Removing the dam and eliminating the reservoir could result in less percolation of surface water to the underlying groundwater aquifer due to removal of the water body. However, as discussed in Section 3.7.3 Affected Environment, the reservoirs generally lie within rock valleys where this recharge is expected to be low. Gannett et. al. 2010 concluded that the Klamath River reaches in the project area are gaining reaches (i.e., groundwater discharges to the stream). This assessment, and characteristics of the rock surrounding the reservoirs, suggest that any surface water that may have infiltrated to groundwater systems under the reservoir would likely discharge back to the river just downstream of the impoundment.

The Proposed Action would result in the same relative volume of water flowing through the project area in the Klamath River. The timing of river's hydrograph would be modified to improve fish habitat. Under current conditions, water is retained in the reservoirs to maximize hydropower production by filling and keeping the reservoirs as full as possible; however, the stored volume in the reservoirs does not vary substantially from one time period to another to act as a buffer to flows going down the river. Under the Proposed Action, the water in the river would remain in the river through the project area. **The Proposed Action's impacts on groundwater recharge and the resulting groundwater/surface water interaction would be less than significant.**

*The Proposed Action will require the relocation of the City of Yreka water supply pipeline.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and will have to be relocated prior to the decommissioning of the dam to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline would be suspended from a pipe bridge across the river near its current location. The water supply utilized by the City will not

change, and none of the construction activities are anticipated to interact with or impact existing groundwater supplies or require groundwater supplies to complete the construction. **The relocation of the Yreka water supply pipeline would result in no change in existing conditions of groundwater supplies.**

*Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs will be removed following drawdown.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities will be removed. The removal of the recreational facilities would not impact groundwater or groundwater recharge. **The removal of the recreational facilities would result in no change in existing conditions of groundwater resources.**

### **Keno Transfer**

*Implementation of the Keno Transfer could cause adverse effects to local groundwater.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. There will be no changes in facility operations. This transfer would not result in the generation of impacts to groundwater compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, the implementation of the Keno Transfer would result in no change from existing conditions.**

### **East and West Side Facilities**

*Decommissioning the East and West Side Facilities could have adverse effects to groundwater resources.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. Groundwater recharge in the area is not expected to change. **The decommissioning of the East and West Side facilities would result in no change in existing conditions of groundwater resources.**

### **KBRA**

The KBRA, which is a component of the Proposed Action, encompasses several programs that could affect groundwater, including:

- Water Diversion Limitations
- On-Project Plan
- Water Use Retirement Program
- Interim Flow and Lake Level Program
- Emergency Response Plan

Water Diversion Limitations and the On-Project Plan

*The Water Diversion Limitations program could reduce irrigation water in the driest years.* The Water Diversion Limitations program (KBRA Section 15.1) would reduce the availability of surface water for irrigation on Reclamation's Klamath Project to 100,000 acre feet less than the demand in the driest years to protect mainstem flows. These limitations are intended to increase water availability for fisheries purposes. Reducing surface water diversions to Reclamation's Klamath Project irrigators could result in increased reliance on groundwater substitution during the driest years. Groundwater pumping could occur with emergency wells located on Reclamation's Klamath Project. These wells can only be pumped under a drought declaration. Irrigators typically utilize gravity delivered surface water when available. An increased reliance on groundwater could affect groundwater levels in the pumped aquifer and reduce groundwater inflow into the Klamath River and its tributaries. Groundwater substitution could also affect wells that tap into the same water-bearing units (Gannett et. al. 2010). Therefore, the KBRA includes provisions that would require monitoring of pumping at existing wells, the monitoring of groundwater levels in the pumped aquifer, and the monitoring of springs affected by drops in groundwater levels. Additionally the KBRA prohibits groundwater use within Reclamation's Klamath Project boundaries that results in a reduction in flow of a spring by more than six percent to avoid impacts on groundwater discharge into the Klamath River and its tributaries that would reduce the availability of thermal refugia for fish in these water bodies. The KBRA identifies springs to be monitored and protected as those along Upper Klamath Lake, the Wood River subbasin, Spring Creek on the Williamson River, the Klamath River downstream to Copco 1 Dam, Shovel Creek, and Spencer Creek. Appendix E-2 of the KBRA includes a work plan for investigation and monitoring of the groundwater resources of the Upper Klamath Basin.

With implementation of the KBRA, groundwater investigation and monitoring would occur and the results would be incorporated into the On-Project Plan (KBRA Section 15.2). In support of this groundwater investigation and monitoring effort, the USGS is developing a groundwater model planned for completion in 2011 that will be utilized to assess the effects of groundwater use in the basin and identify any adverse changes in groundwater levels (Gannett 2011). The On-Project Plan would include a plan for the use of groundwater, actions by managers to remedy any adverse impacts identified by groundwater investigations or monitoring, and includes a prohibition on adverse impacts on groundwater sources. A fund for remedying adverse impacts due to groundwater use is identified in KBRA Appendix C-2. Implementation of the On-Project Plan and Water Diversion Limitations program has the potential to generate localized short-term adverse effects on groundwater through the increased use of groundwater to replace surface water deliveries. These effects would be reduced through the implementation of groundwater monitoring and pumping restrictions triggered by any observed adverse effects on groundwater levels. The geographic separation between actions proposed under this program and the hydroelectric facility removal actions analyzed above reduce any potential for groundwater improvements generated by this program to contribute to groundwater effects generated by facility removal. **In the long-term implementation of the On-Project Plan (KBRA Section 15.2) and the Water Diversion Plan (KBRA**

**Section 15.2.4) would be expected to benefit groundwater resources by protecting them from overuse (through provisions prohibiting adverse impacts to groundwater, where none currently exist). Implementation of the On-Project Plan and Water Diversion Plan will require future environmental compliance as appropriate**

Water Use Retirement Program (WURP)

*Upland vegetation management under the WURP would increase inflow to Upper Klamath Lake.* The WURP is intended to permanently increase the flow of water into Upper Klamath Lake by 30,000 acre-feet per year to support restoration of fish populations (KBRA Section 16.2.2). Actions to increase inflow would include upland vegetation management of high water-use plants (i.e., juniper removal) to increase groundwater recharge. The geographic separation between actions proposed under this program and the hydroelectric facility removal actions analyzed above reduce any potential for groundwater improvements generated by this program to contribute to groundwater effects generated by facility removal. **Implementation of the WURP would benefit groundwater resources by increasing groundwater recharge through upland vegetation management. Implementation of the WURP will require future environmental compliance as appropriate.**

Interim Flow and Lake Level Program

*The purchase and lease of water under the Interim Flow and Lake Level Program would increase water for fisheries.* The Interim Flow and Lake Level Program (KBRA Section 20.4) would be an interim program of water purchase and lease to reduce surface water diversions and further the goals of the fisheries programs during the interim period prior to full implementation of the On-Project Allocation and WURP. Water purchase and lease agreements with a term greater than the interim period defined in KBRA Section 20.4.2 would be subject to a consistency requirement with the On-Project Plan. Reduced surface water diversions would not be expected to directly result in increased groundwater use given provisions developed to prevent adverse impacts to groundwater in the KBRA (Section 15.2.4). The geographic separation between actions proposed under this program and the hydroelectric facility removal actions analyzed above eliminate any potential for negative groundwater effects generated by this program contributing to groundwater effects generated by facility removal. **Implementation of the Interim Flow and Lake Level Program would result in less than significant impacts on groundwater resources in the short term, and would be expected to benefit groundwater resources in the long-term. Implementation of the Interim Flow and Lake Level program will require future environmental compliance as appropriate.**

Emergency Response Plan

*Implementation of an Emergency Response Plan could result in changes to groundwater following the failure of a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.* The purpose of the plan is to prepare water managers for an emergency affecting the storage and delivery of water needed for KBRA implementation. The components of the Emergency Response Plan are described in Section 2.4.3.9 and

include potential emergency response measures and processes to implement emergency responses. Implementation of an Emergency Response Plan could potentially reduce emergency groundwater use following a facility or dike failure that limited surface water deliveries by shortening the duration of any surface water delivery interruption. The intent of this plan is to allow for continued storage and delivery of water according to KBRA commitments and would not affect the probability of facility or dike failure. Additionally, given the geographic separation between actions proposed under this program and the hydroelectric facility removal actions analyzed above, the Emergency Response Plan would not be expected to contribute to any changes in groundwater generated by the hydroelectric facility removal action. **Therefore, it is anticipated that implementation of the Emergency Response Plan would result in no change to existing conditions in groundwater resources. However, implementation of the Emergency Response Plan would likely help to reduce groundwater use due to a facility or dike failure which would be a beneficial effect to groundwater resources. Implementing the Emergency Response Plan will likely require the analysis of changes to flood risks in future environmental compliance investigations as appropriate.**

#### **Alternative 3: Partial Facilities Removal of Four Dams Alternative**

The groundwater impacts of the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **Keno Transfer**

The groundwater impacts of the Keno Facility Transfer under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **East and West Side Facility Decommissioning**

The groundwater impacts of the East and West Side Facility Decommissioning under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **KBRA**

The groundwater impacts of the KBRA under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **Alternative 4: Fish Passage at Four Dams**

*Under the Fish Passage at Four Dams Alternative, surface water elevations in the reservoirs would not change and there would be no changes to the relative elevation of the groundwater table.* Under the Fish Passage at Four Dams Alternative, the J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams and Reservoirs would remain in place and water levels in the reservoirs would be similar to historical levels. Therefore, the Fish Passage at Four Dams Alternative would not change the elevation of surface water in the reservoirs outside of historical ranges. Therefore, no changes to the relative elevation of the groundwater table in the vicinity of the reservoirs would be expected. **There would be no groundwater impacts under the Fish Passage at Four Dams Alternative.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

Groundwater impacts associated with the removal of Copco 1 and Iron Gate would be the same as under the Proposed Action. Groundwater impacts at Copco 2 and J.C. Boyle would be the same as those described for the No Action/No Project Alternative.

#### **3.7.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequences Summary**

*Mitigation Measure GW-1* – This mitigation measure provides for the deepening (or replacement) of an existing affected domestic or irrigation groundwater well so the groundwater production rate from the well is returned to conditions prior to implementation of the Proposed Action or its alternatives. This mitigation measure is intended to mitigate for potential impacts from the Proposed Project or its alternatives. Therefore, a preconstruction well survey will be conducted prior to implementation of the Proposed Project or its alternatives. This survey will measure water levels and pumping rates in existing domestic and irrigation wells. This information will form the basis of review for potential claimed damages following construction activities. Well owners not participating in this preconstruction survey will be required to provide adequate documentation showing a decrease in production from the well before and after construction conditions. The review of pre-construction data will be considered with respect to preceding hydrologic conditions (i.e., climatic cycles, wet year vs. dry year). This mitigation measure would also provide an interim supply of potable water for health and safety prior to the completion of the modifications to the affected well.

##### **Effectiveness of Mitigation in Reducing Consequences**

Implementation of mitigation measure GW-1 would ensure that affected groundwater wells are able to provide water supply benefits similar to those prior to implementation of the Proposed Action or its alternatives.

##### **Agency Responsible for Mitigation Implementation**

The Dam Removal Entity would be responsible for implementing mitigation measure GW-1.

##### **Remaining Significant Impacts**

Following implementation of mitigation measure GW-1, no significant adverse impacts associated with groundwater would be anticipated. If the amount of groundwater discharging to the Klamath River was reduced so adverse impacts on fish habitat or habitat for other aquatic species resulted, such impacts would be considered significant. The potential for such impacts and mitigation for them have been addressed in other relevant chapters of this EIS/EIR.

##### **Mitigation Measures Associated with Other Resource Areas**

*Mitigation measure REC-1* would develop new recreational facilities and access point along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel

once the reservoir is removed. Water supplies for these facilities would most likely be supplied through wells located on the new recreational sites. These wells would be replacing existing wells and water consumption is unlikely to increase as a result of replacing recreational facilities. **Therefore, impacts to groundwater as a result of implementing mitigation measure REC-1 would be less than significant.**

No other mitigation measures associated with other resource areas as described in this EIS/EIR would affect groundwater resources.

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## **3.8 Water Supply/Water Rights**

This section describes the impacts on surface water supply availability and water rights compliance that would be associated with implementation of the Proposed Action and alternatives.

### **3.8.1 Area of Analysis**

The area of analysis includes the Klamath Basin in south central Oregon and northwestern California. This discussion divides the Klamath Basin into Upper and Lower Basins based upon hydrologic sub-basins. The Upper Klamath Basin covers 5.6 million acres, and contains the reaches of the Klamath River upstream of Iron Gate Dam. Along this portion of the Klamath River, six dams exist, of which four are being considered for removal under the Klamath Hydroelectric Settlement Agreement (KHSA). The Upper Klamath Basin also contains Reclamation's Klamath Project, which diverts irrigation water from the Klamath River for two National Wildlife Refuges (NWRs) and agricultural use. The Upper Klamath Basin is the area that would be most directly affected by implementation of the Proposed Action. The Lower Klamath Basin covers approximately 4.5 million acres and includes seven hydrologic sub-basins. The lower reaches of the Klamath River are included from downstream of Iron Gate Dam to the river's mouth on the California coastline. Downstream of Iron Gate Dam, the Klamath River has no dams on its mainstem. The sections below are generally organized from upstream to downstream.

### **3.8.2 Regulatory Framework**

This section describes the regulatory framework regarding water rights and supply at the federal and state levels. Section 3.2, Water Quality, discusses the regulations protecting water quality.

#### ***3.8.2.1 Federal Water Law***

##### **The Reserved Rights Doctrine**

The Reserved Rights Doctrine was first articulated in the 1908 Supreme Court decision in *Winters v. United States*. The doctrine provides that when lands are set aside as Indian or other federal reservations, sufficient water to fulfill the purposes of the reservation is reserved as well. Federal reserved water rights arise expressly or by implication from federal treaties, statutes, and executive orders, and vest no later than the date the reservation was established. Unlike state appropriative rights, federal reserved water rights are for present and future uses and may be exercised at any time and are not lost through non-use. While federal reserved water rights may be quantified and administered by states in the context of comprehensive state water adjudication, they are otherwise governed by federal, not state, law.

### **3.8.2.2 State Water Law**

States administer water resources within their boundaries in accordance with one of two state water law doctrines, or a combination of the two. Under the doctrine of prior appropriation, water rights are based on beneficial use, with the first person putting water to use accruing the best right to receive water in times of shortage, regardless of the proximity of the place of use to the source of water. Appropriative rights must be used to be retained. Under the riparian doctrine, rights are based on location rather than use, with landowners bordering waterways possessing corresponding rights to use the flow, and with any water shortages shared accordingly among riparian landowners. Riparian rights may be used at any time, and are not lost through non-use.

A number of states, including Oregon, recognize certain riparian rights, but require all water users, including riparian landowners, to obtain water use permits from the state. In California, riparian landowners may use natural flows for beneficial purposes on riparian lands without a permit, but appropriative rights may only be acquired by permit.

#### **Oregon**

Oregon enacted a comprehensive water use code in 1909, establishing a process by which all new water uses must be applied for and permitted. If appropriation of water was initiated prior to enactment of the 1909 water code and not forfeited or abandoned since then, the current property owner may have a vested water right. Such vested and Federal Reserved water right claims are determined in Oregon in a two-step administrative and judicial process known as a general stream adjudication. The Oregon Water Resources Department (OWRD) initiated an adjudication of all pre-1909 and federal reserved water right claims for the use of surface water in the Klamath Basin in 1975. The Klamath Basin Adjudication, which is ongoing, is the first adjudication in the State to include federal water right claims, including claims for and by the Klamath Tribes, for National Wildlife Refuges, for Reclamation's Klamath Project, for a National Park, for public water reserves, for the wild and scenic portion of the Klamath River in Oregon, for three other wild and scenic river segments in the Upper Klamath Basin, and for a National Forest.

Oregon's water laws are codified in Oregon Revised Statutes, Chapters 536 through 541.

#### **California**

California enacted a water use law in 1914, establishing a system of permitting and licensing of all new appropriative uses of water. Riparian rights continue to have higher priority in California, with riparian landowners retaining a right to use natural flows for beneficial purposes on riparian lands at any time without obtaining a permit from the State Water Resources Control Board (SWRCB). An adjudication may be initiated to determine relative rights to use water from a specific source, but California has not initiated a comprehensive Klamath Basin Adjudication which includes all federal reserved water rights. New permits are not accepted if the SWRCB determines the stream is already fully appropriated. The mainstem of the Klamath River, from 100 yards

downstream of Iron Gate Dam to the Pacific Ocean is declared fully appropriated during the entire calendar year by the SWRCB (2010).

California's water law is contained in the California Code of Regulations, Title 23.

### **Klamath Basin Adjudication**

If an appropriation of water was initiated prior to the enactment of the 1909 water code and has not been forfeited or abandoned since then, a water user may have a “vested” water right. Federal reserved water rights vest no later than the date of the reservation, and as early as “time immemorial,” regardless of whether they have been used. A claim to a vested water right is determined and made a matter of record through an adjudication proceeding. The OWRD is responsible for gathering information about the use of water and presenting to the circuit court OWRD's findings of fact and order of determination, which states who has the right to use water, the amount and location of water use, period of use, and priority date. If nobody files an exception to OWRD's findings, then they are final. If any exceptions are filed, the circuit court hears the matter de novo (again) or delegates it for rehearing. A water right certificate is issued for each decreed right (State of Oregon 2009).

The Klamath Basin Adjudication is the adjudication process for pre-1909, federal reserved, and “*Walton*” (non-Indian successor to Indian allottees) water right claims for the use of surface water within the Upper Klamath Basin in Oregon. The Klamath Basin proceeding began in 1975. Claims of water use have been gathered and contests to the claims have been filed on all of those claims. Administrative law judges have been holding hearings and issuing proposed orders determining the claims and contests. The OWRD will review those proposed orders, and any proposed settlements of contests, and submit its Findings and Order of Determination to the Circuit Court in likely 2012 or 2013 (the last proposed orders are due to be issued in April 2012). Water right claims have been filed by private water users the Klamath Tribes, Klamath allottees, and the United States (for Indian and other federal reservations of land and the Reclamation's Klamath Project). Once OWRD's findings are submitted to court there will be an opportunity for parties to file exceptions to those findings. The Klamath Circuit Court will resolve the exceptions and issue a decree. As of July 2010, 97 percent of contests and 92 percent of the claims in the Upper Klamath Basin have reached a proposed resolution, either by issuance of an administrative law judge's proposed order or by a proposed settlement of contests (State of Oregon 2010a).

### ***3.8.2.3 Interstate Water Allocation***

#### **Klamath Basin Compact**

Allocations of water among states are generally made by compact – a negotiated interstate agreement made with the consent of Congress – or by federal judicial proceeding. No federal court proceeding has allocated the waters of the Klamath River between Oregon and California. However, in 1957, the two States ratified and Congress consented to the Klamath Basin Compact, to “facilitate and promote the orderly, integrated and comprehensive development, use, conservation and control” of water resources in the Klamath Basin. Subject to all vested rights, the Compact provides for

equitable distribution of water among the two states and the federal government, and for preferential rights to the use of water after the effective date of the compact for domestic and irrigation purposes in the Upper Klamath Basin. The Compact recognizes, and protects from any adverse impact, the rights, privileges, and immunities of tribes, as well as the rights, powers and jurisdiction of the United States.

### **3.8.3 Existing Conditions/Affected Environment**

The following section describes the environment and environmental setting for water supply availability and water rights compliance that could be affected by implementing the KHSA (including the Keno Transfer and decommissioning of PacifiCorp's East Side/West Side Facilities) and Klamath Basin Restoration Agreement (KBRA). The Klamath Basin water supply is described, including the relationship to Reclamation's Klamath Project and PacifiCorp's Klamath Hydroelectric Project.

The Klamath Basin is divided into two areas, the Upper and Lower Klamath Basins, as described in Section 3.8.1. The Upper Klamath Basin includes six hydrologic sub-basins: Sprague, Williamson, Upper Klamath Lake, Lost, Butte, and Upper Klamath East. The Lower Klamath Basin includes seven hydrologic sub-basins: Upper Klamath West, Shasta, Scott, Salmon, Lower Klamath, Trinity, and South Fork Trinity. Figure 3.8-1 shows the subset of Klamath River hydrologic sub-basins within the affected environment.

Average annual precipitation in Klamath Falls, Oregon is 13.3 inches, occurring primarily as rain during the fall and winter seasons. Precipitation amounts in the (Lower) Klamath Basin in northwest California can be more than seven times that amount. Surface water runoff is closely related to annual precipitation patterns and has historically defined distinct dry and wet cycles. Recent trends include dry periods from 1915 to 1940 and 1975 to 1994 and wet periods from 1885 to 1915 and 1940 to 1975 (Department of the Interior [DOI] 2011). Klamath River runoff patterns have been measured by United States Geological Survey gages dating back as far as 1905 and reflect these climatic cycles. These gages display a decreasing trend in runoff that follows a general decreasing trend in precipitation amounts.

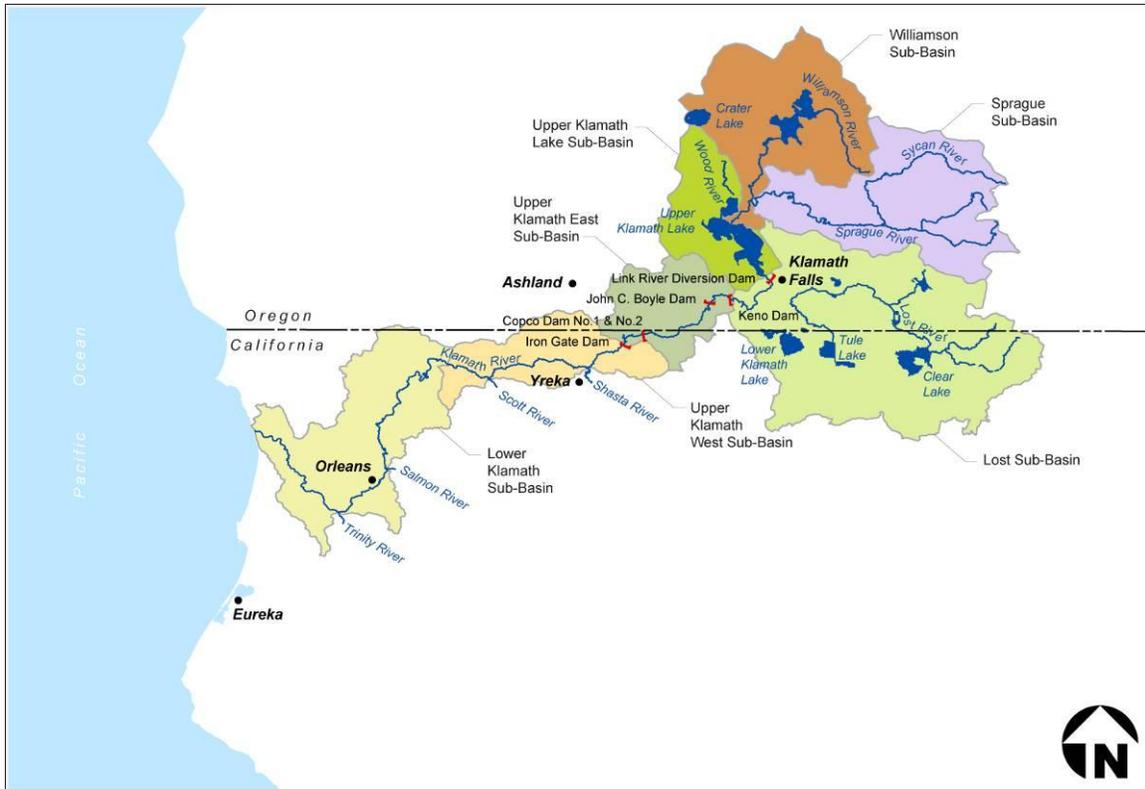


Figure 3.8-1. Area of Analysis

### 3.8.3.1 Upper Klamath Basin

Of the Upper Klamath Basin's six hydrologic sub-basins, the Sprague, Williamson, and Wood Rivers provide the majority of the flow volume to the Klamath River via Upper Klamath Lake. Upper Klamath Lake is a controlled, natural lake that serves as a large, shallow storage basin. Several measures have increased storage in the lake during recent years. In 2007, two miles of levees were breached, restoring approximately 3,500 acres of wetlands in the Williamson River Delta area. Another 1,400 acres were flooded in 2008, which provided 28,800 acre-feet of additional storage in Upper Klamath Lake. Table 3.8-1 shows data for the six hydrologic sub-basins in the Upper Klamath Basin.

The Upper Klamath Basin has multiple entities that rely heavily on the availability of water supply. The Klamath Tribes, upper Klamath irrigators, Reclamation's Klamath Project, Klamath Hydroelectric Project, and six NWRs are all included in the Upper Klamath Basin.

**Table 3.8-1. Upper Klamath Basin Hydrologic Sub-Basins**

Sub-Basin	Size (acres)	Irrigated Acres	Water Supply Source
Williamson River	928,000	65,100	90% diverted from streams, 10% groundwater
Sprague River	1,020,000	61,600	65% diverted from streams, 35% groundwater
Upper Klamath Lake	465,300	52,300	Diverted from streams or from Upper Klamath Lake
Lost River (Three sub-basins)			
<i>Upper Lost River Sub-basin</i>	<i>1,200,000</i>	<i>84,500</i>	50% of water coming from Reclamation's Klamath Project
<i>Middle Lost River Sub-basin</i>	<i>454,500</i>	<i>117,000</i>	70% of agricultural land is irrigated with Reclamation-supplied water; the rest is obtained from groundwater, individual surface water rights, or special Reclamation contracts.
<i>Tule Lake Sub-basin</i>	<i>296,600</i>	<i>64,800</i>	Groundwater provides 40–50% of water for irrigated pastures; most tailwater is reused from Reclamation
Butte Valley	388,100	52,300	Butte Valley sub-basin is an internal drainage basin with an artificial outlet. Groundwater flows from west to east out of the sub-basin toward Lower Klamath Lake. Irrigation water is from groundwater sources and diverted from surface water.
Upper Klamath River East	419,400	4,000	All irrigation water is diverted from the river or tributary streams; water withdrawals are insignificant along this stretch of the river.

Source: Natural Resource Conservation Service (United States Department of Agriculture 2004)

### **The Klamath Tribes**

The Klamath Tribes consist of the Klamath and Modoc Tribes and the Yahooskin Band of the Snake Indians. In an 1864 Treaty with the United States, the Tribes ceded over 20 million acres of land in southern Oregon and Northern California to the United States, reserving for themselves an area extending northeast from Upper Klamath Lake, and containing over 2 million acres. Within the boundaries of the Klamath Reservation, the Treaty provided that the Tribes would retain exclusive fishing and gathering rights. Pursuant to the General Allotment Act of 1887, tribal lands within the Reservation were allotted to individual tribal members, and over the next decade, many of the allotted lands passed into non-Indian ownership. By the early 20th century, the Reservation had been reduced to approximately half its original size. In 1954, Congress terminated federal recognition of the Klamath Tribes and condemned the Tribes' remaining lands. However, the Tribes' fishing and gathering rights, as recognized in the 1864 Treaty, survived termination. The Klamath Termination Act expressly preserved the Tribes' water rights, fishing rights, and other treaty privileges, and the federal courts have since confirmed the existence, scope and priority of the Klamath Tribes' water rights in the Upper Klamath Basin. In a series of decisions in *United States v. Adair*, the courts held that the Tribes have a water right sufficient to support their treaty fishing, hunting and gathering rights,

with a priority date of "time immemorial" - thus senior to all other users in the basin. The courts also recognized a tribal water right for agrarian purposes, with a reservation date (1864) priority. Individual tribal members who received allotments pursuant to the General Allotment Act have a right to use a proportionate share of the tribal water for agrarian purposes, as do their non-Indian successors in interest under certain circumstances. The Klamath Tribes, the United States on behalf of the Tribes, individual Klamath Indian allottees, and non-Indian successors to Indian allottees have numerous claims in Oregon's Klamath Basin Adjudication.

#### **Upper Klamath Landowners**

Individual landowners within the Upper Klamath Basin have water rights for a variety of purposes, including but not limited to irrigation, domestic, livestock, instream use and wildlife purposes. All water right users in the Klamath Basin are subject to the senior federal reserved Tribal instream flow rights that may reduce the available water to junior water rights users. Private irrigators in the upper Klamath Basin have filed claims in the adjudication proceedings and some have organized themselves into an association to help support its members through the legal process of protecting their water rights. The Upper Klamath Water Users Association was created by a group of off-Project water users and is a non-profit organization protecting the interest of its members within the Klamath and Lost River Drainages. They are considered off-Project water users because they are outside of the Reclamation's Klamath Project.

#### **Klamath Basin National Wildlife Refuge System**

Between 1908 and 1958, six NWRs were established in the Upper Klamath Basin: Klamath Marsh (formerly Klamath Forest) (1958), Upper Klamath (1928), Bear Valley (1978), Lower Klamath (1908), Tule Lake (1928), and Clear Lake (1911). Klamath Marsh NWR is along the Williamson River, and the Upper Klamath NWR is on the northwest and southeast sides of Upper Klamath Lake. The other four are south of Klamath Falls in Oregon and California and are adjacent to, or within, the boundaries of Reclamation's Klamath Project.

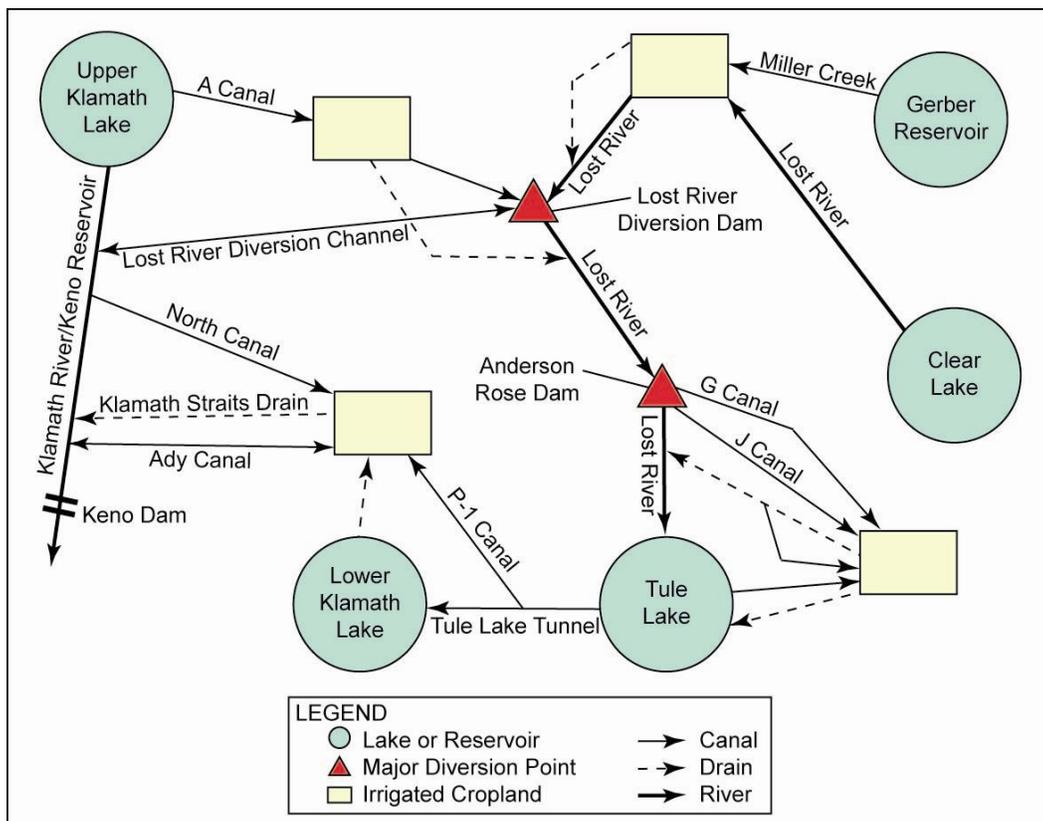
The United States Fish and Wildlife Service (USFWS) manages the NWRs. These areas provide suitable habitat and resources for migratory birds and other fish and wildlife species. The USFWS has claimed vested water rights under the Reclamation's Klamath Project for two of the refuges, the Lower Klamath and Tule Lake NWRs, as well as federal reserved water rights for the two refuges. Water rights for these four refuges are being quantified in the Klamath Basin Adjudication.

#### **Reclamation's Klamath Project**

Reclamation's Klamath Project facilities provide irrigation water to approximately 1,400 farms covering about 235,000 acres (Congressional Research Service 2005) and to the Lower Klamath and Tule Lake NWRs. There are more than 250 contracts associated with Reclamation's Klamath Project; these contracts are with various irrigation districts and other water users (Reclamation 2000). In most cases, the contracts have no end date, and they specify acres to be covered rather than an amount of water to be provided

(Reclamation 2000). Water users formed the Klamath Water Users Association in 1905 to help protect the “on-Project” water interests inside the Reclamation’s Klamath Project.

The Upper Klamath Lake is one of the main sources of water for Reclamation’s Klamath Project. The project’s infrastructure and operation turned the Lost River hydrologic basin, once largely a closed basin, into a tributary to the Klamath River by returning flows through the Lost River Diversion Channel and Tule Lake to Lower Klamath Lake. The Lost River is another main source of water for Reclamation’s Klamath Project, as is the Klamath River from Keno Impoundment. Figure 3.8-2 shows a schematic of Reclamation’s Klamath Project.



**Figure 3.8-2. Schematic of Reclamation’s Klamath Project**

Beginning in January, Reclamation forecasts the available water supplies and establishes a management plan for its Klamath Project for the coming year. Reclamation forecasts the condition of its Klamath Project systems supply based upon Natural Resource Conservation Service forecasts, watershed conditions, and projected water use for both irrigation and wildlife use. The annual operations plan delineates water availability and has been provided to the water users' community since 1995 (Reclamation 2000).

In 1905, Reclamation filed a formal application with the State of Oregon to secure a water supply for the lands within the Project area (Reclamation 2000).

### **Klamath River Dams**

Multiple dams are associated with the Klamath Hydroelectric Project, which is in both Klamath County, Oregon and Siskiyou County, California and is owned and operated by PacifiCorp. Eight developments are part of the Klamath Hydroelectric Project, of which seven are on the mainstem of the Klamath River. Reclamation owns the Link River Dam, which forms Upper Klamath Lake. The East and West Side powerhouses, downstream of Link River Dam, indicate the upstream boundary of the Klamath Hydroelectric Project and the Iron Gate Development is the downstream boundary.

Flows through the Hydroelectric Reach (from Keno Dam downstream to Iron Gate Dam) are related to Upper Klamath Lake elevations, flows diverted to and returned from Reclamation's Klamath Project, relatively small storage capacities of the Klamath Hydroelectric Project developments, and the releases out of Iron Gate Dam (Federal Energy Regulatory Commission [FERC] 2007). Upper Klamath Lake holds 83 percent of the total storage capacity of the reservoirs on the Klamath River (FERC 2007) and approximately 98 percent of active storage (Greimann 2011). Associated reservoirs for J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams contain 14 percent of the total storage capacity and 2 percent of the active storage on the river. However, these dams were not designed for water supply storage purposes and are most often operated as run-of-the-river facilities.

A query on California's Electronic Water Rights Information Management System provided three water right listings upstream of Iron Gate Development (and within the State of California) that listed the Klamath River as the water source. These are held by PacifiCorp for irrigation and stock watering for a total of 5,475 acre-feet during April 1 through October 31. Their locations are approximately four miles upstream of the Copco 1 Reservoir. Three additional PacifiCorp water rights list Copco 1 Reservoir as the water source. Each is for 3,200 cfs and they are associated with power generation and impoundment of water for Copco 1 and 2 Powerhouses. PacifiCorp filed Statements of Diversion and Use for pre-1914 claims with the California SWRCB to use water at Iron Gate Dam for hydropower activities as part of their licensing application. The pre-1914 claims are for 1,800 cfs for power generation, 50 cfs for fish propagation facilities, 3,300 cfs to refill regulatory storage space in Iron Gate Reservoir, and 48 cfs for fish culture.

PacifiCorp has two Oregon water right permits, one associated with the J.C. Boyle Dam hydroelectric generation and the other for irrigation purposes on less than an acre. The irrigation water is drawn from the Link River. (Source: State of Oregon Water Resource Department Water Rights Information System (State of Oregon 2010b))

### **Municipal Water Rights**

#### **City of Yreka**

The City of Yreka receives its water supply from Fall Creek, a tributary to the Klamath River in the Upper Klamath Basin that is approximately 23 miles northeast of the city. A California State Water Rights Permit 15379 allocates the City of Yreka up to 15 cfs or 9.7 million gallons per day (mgd) from this source, although the current demand is less than the permitted allotted amount (City of Yreka 2010). The City of Yreka's diversion was completed in 1969 and the public water systems facilities at Fall Creek include three impoundments; an intake structure with fish screens, a pump, and pre-treatment facility; a cathodic protection field at the Fall Creek Campground and Day Use Boat Ramp; and a 24-inch pipeline that crosses on the eastern upstream end of Iron Gate Reservoir. Water diverted from Fall Creek for the City of Yreka is mainly returned through subsurface drains, infiltration, and irrigation runoff to a tributary of the Shasta River (City of Yreka 2010). It should also be noted that the California Department of Fish and Game (CDFG) possesses a 10 cfs water right (SWRCB License 11681) for fish propagation at Fall Creek Hatchery between March 15 and December 15 each year, not to exceed 5,465 acre-feet per year. Shasta River flows into the Klamath River downstream of Iron Gate Dam.

#### **3.8.3.2 Lower Klamath Basin**

As described above, the Lower Klamath Basin includes seven sub-watersheds downstream of Iron Gate Dam. The area of analysis does not include the Shasta, Scott, Salmon, and Trinity Rivers (see Figure 3.8-1). Generally, the flow rate in the Klamath River increases substantially further downstream within the Lower Klamath Basin, as described in Section 3.6.3.3. The months of July through October generally have much lower flow volumes than the spring runoff months. The long-term average annual flow rate at Iron Gate Dam is just more than 2,000 cfs and approximately 17,600 cfs at the mouth of the Klamath River. Historic stream flows for the Klamath River are discussed in Section 3.6.3.3.

### **Klamath River Water Rights**

Downstream of Iron Gate Dam, the mainstem of the Klamath River flows freely 190 miles through Siskiyou, Del Norte, and Humboldt Counties to the Pacific Ocean. A query on California's Electronic Water Rights Information Management System provided 32 water right listings with the Klamath River as the water source. Appendix L contains the query results and has a map that displays the locations.

Sixteen Statement of Diversion and Use water rights types were filed between 1967 and 2010; 6 of the 16 are currently inactive. Ten appropriative water rights are a state filing; these were all filed in 1956 by the SWRCB. There are four appropriative water rights with a licensed status: one with PacifiCorp in 1957, one with Klamath River Country Estates Owners Association Inc. in 1960, and two with individuals in 1964 and 1966.

The Klamath Community Services District holds one appropriative permitted water right from 1968, and there is one Small Domestic Registration water right from 2006. There are also multiple claims on a number of the creeks, unnamed springs, and groundwater sources scattered within the Lower Klamath Basin.

It is expected that each of these water rights listings will have associated intake facilities to draw water from the Klamath River however; the specific type, location, and layout of each of these intake facilities is unknown at this time.

### **Shasta Valley Irrigators**

Shasta Valley Irrigators (Siskiyou County) claim that an application was submitted in 1956 on their behalf to the State of California to use 60,000 acre-feet from the Klamath River with a point of diversion at Iron Gate Dam. Application A016958 was submitted in 1956 on behalf of the SWRCB, but does not specifically name the Shasta Valley Irrigators as recipients of the water. As of December 2010, no diversion infrastructure exists or is planned for construction involving this water right application.

### **Indian Tribes**

#### Quartz Valley Indian Reservation

The members of the Quartz Valley Indian Community are of upper Klamath (Karuk) and Shasta Indian ancestry. The 174-acre Quartz Valley Indian Reservation is in Siskiyou County near the community of Fort Jones within the Klamath watershed and area of study. Any fishing and concomitant water rights to which the Quartz Valley Community may be entitled have not yet been determined.

#### Karuk Tribe

Congress never formally ratified the treaty negotiated between the United States and the Karuk Tribe in 1851, and no statute or executive order otherwise set aside reservation lands for the Tribe. However, the United States has more recently taken lands into trust for the benefit of the Karuk Tribe, including over 810 acres in Siskiyou County and approximately 40 acres in Humboldt County. Most of the Tribe's aboriginal lands along the Klamath River, above the Klamath Trinity Confluence, now form part of the Klamath National Forest. Any fishing and concomitant water rights to which the Karuk Tribe may be entitled have not yet been determined.

#### Hoop Valley and Yurok Tribes

The Klamath River Reservation, consisting of a strip of land beginning at the Pacific Ocean and extending one mile in width on each side of the Klamath River for a distance of approximately 20 miles, was established by Executive Order in 1855. The Reservation was established on Yurok ancestral lands. In 1876, a second executive order established the Hoopa Valley Indian Reservation, a 12 mile square area southeast of the Klamath River Reservation, beginning at the confluence of the Klamath and Trinity Rivers, and bisected by the Trinity River. A third executive order in 1891 created an extended Hoopa Valley Reservation, which encompassed the original Hoopa Reservation, the Klamath River Reservation, and a strip down the Klamath River from the Klamath-Trinity confluence connecting the two original reservations. In 1988, Congress passed the

Hoopa-Yurok Settlement Act, 25 U.S.C. 1300i et seq, which partitioned the extended reservation between the Hoopa Valley and Yurok Tribes, with the Yurok Reservation comprising the original Klamath River Reservation and the connecting strip, and the Hoopa Reservation comprising the original 12 mile square area. The federal courts have confirmed that the United States reserved fishing rights for the Hoopa Valley and Yurok Tribes when it set aside reservations along the Klamath and Trinity Rivers. DOI has found that the original orders setting aside the Hoopa Valley and Yurok Reservations also reserved rights for instream flows sufficient to sustain fish within the reservation. Although the State of California has not commenced an adjudication to determine the quantity of water to which the Tribes have a right to support their reserved fishing rights, the recognition of such rights is consistent with the federal precedent set in *United States v. Adair*.

#### Resighini Rancheria

The 239-acre Resighini Rancheria is located near the mouth and on the south bank of the Klamath River, and is surrounded by the Yurok Reservation. The Rancheria Reservation was purchased by the Bureau of Indian Affairs in 1938 under the authority of the Indian Reorganization Act, and proclaimed an Indian reservation by Secretarial Order in 1939. Any fishing and concomitant water rights associated with the Resighini Rancheria have not yet been determined.

### **3.8.4 Environmental Consequences**

The analysis of water rights focuses on changes to water supply and compliance with existing water rights laws. This analysis discusses the changes to river flows and water diversions throughout the affected environment in the Klamath Basin and whether the changes could affect existing water rights or water supplies.

#### **3.8.4.1 Environmental Effects Determination Methods**

The impact assessment is based on flow rates and water supply delivery data from the hydrologic modeling completed by the Lead Agencies, along with the methods and assumptions that were utilized in the model. The Lead Agencies applied a one-dimensional HEC-RAS model using historic flow data as input to the model. The modeling provided results for the No Action/No Project Alternative and the Proposed Action. The model's average daily instream flow data helps to describe how the flows would change under different alternatives. The Lead Agencies used this data to assess whether changes to instream flows as a result of the project would be adequate to meet water right requirements. The Lead Agencies also compared water supply diversions to baseline conditions and water rights to determine impact significance. The Hydrology, Hydraulics, and Sediment Transport Studies include more information on the modeling methods and assumptions (DOI 2011).

Specific analysis of changes in river flows and the resulting effect on fisheries are described in Section 3.3, Aquatic Resources. The assessment of the alternatives' effects on Safe Drinking Water Act requirements is presented in Section 3.2, Water Quality. The assessment of the alternatives' effects on Fire Suppression is presented in Section 3.18, Public Health and Safety, Utilities and public services, Solid waste, Power.

#### **3.8.4.2 Significance Criteria**

For the purposes of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR), impacts would be significant if they would result in the following:

- Causing injury to existing water rights or adjudication claims.
- Decreasing water supplies beyond what is needed for public health and safety (i.e., needs for drinking water and fire suppression) for the current population.

#### **3.8.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

The J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams would not be removed under the No Action/No Project Alternative (with a Negative Determination) and operations similar to current operations would be in effect. The Klamath Hydroelectric Project and Reclamation's Klamath Project would be operated as they were before the Secretarial Determination process began, including operation requirements under the 2010 National Oceanic and Atmospheric Administration (NOAA) Fisheries Service Biological Opinion and 2008 USFWS Biological Opinion on Reclamation's Klamath Project. PacifiCorp would resume the FERC relicensing process and operational measures could change.

*Under the No Action/No Project Alternative, continued operation of the Four Facilities could affect water supply operations.* Under the No Action/No Project Alternative, water supplies would be similar to existing conditions depending on the water year type. However, the current demand for water exceeds the supply. As a result, low water years can be devastating to the Indian Tribes and other communities dependent on water to support fish for subsistence, religious, sport and commercial harvest, and to agriculture communities dependent on irrigation water for their livelihood. The No Action/No Project Alternative does not include any action to change water supplies from existing conditions. **Therefore, the No Action/No Project Alternative would have no effect on water rights or water supplies because the risk of decreasing water supplies beyond what is needed for the current population's public health and safety would not change from the existing conditions.**

*Under the No Action/No Project Alternative, ongoing restoration actions would continue to be implemented and could affect water supply availability.* These actions include the Agency Lake and Barnes Ranches Project, and ongoing fisheries restoration actions.

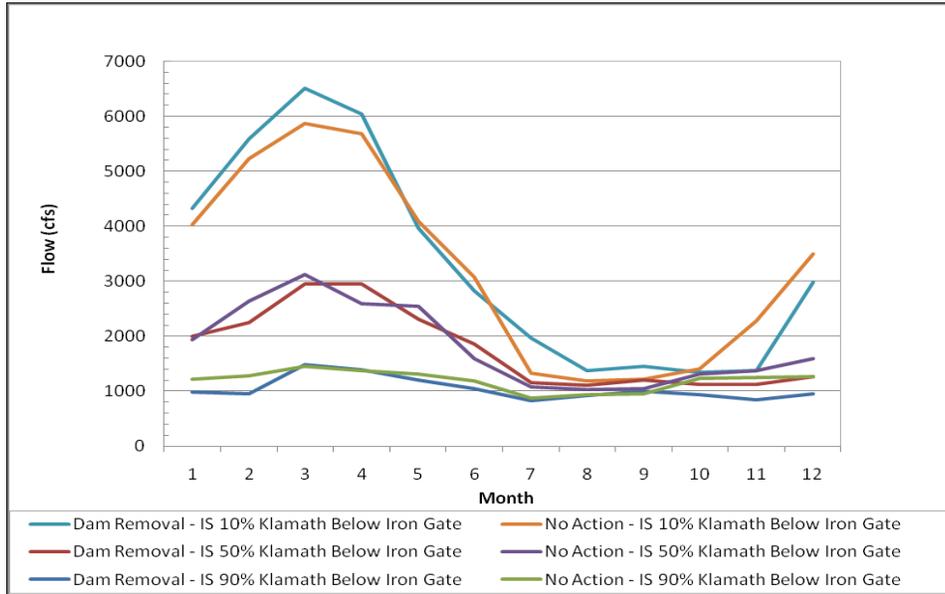
Reclamation purchased the Agency Lake and Barnes Ranches adjacent to Agency Lake in 1998 and is currently using portions of the ranches as pumped storage. These ranches have been transferred to the USFWS and are now part of the Upper Klamath NWR. USFWS is studying the possibility of breaching the dikes which would convert the 63,770 acre-feet of storage from pumped storage to passive storage in Upper Klamath Lake. The Agency Lake/Barnes Ranches Project would go through separate National Environmental Policy Act evaluations as plans are developed for future restoration activities. **Future changes would not substantively change the quantity of storage or water supply yield associated with that storage and therefore, there would be no change from existing conditions.**

**Alternative 2: Full Facilities Removal of Four Dams (the Proposed Action)**

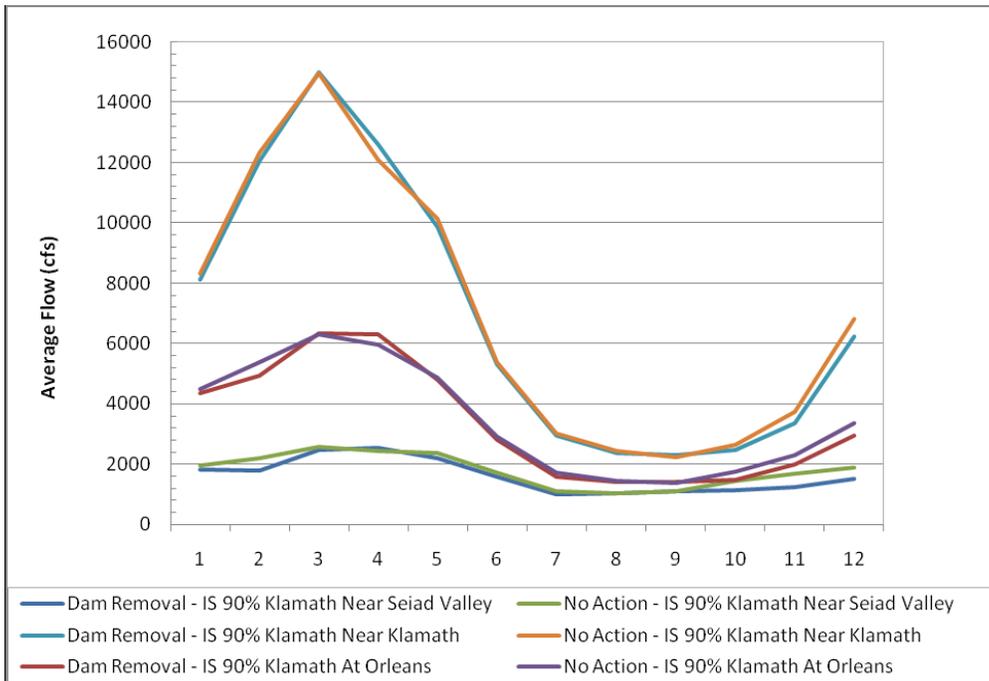
*Relocation of the Yreka water supply pipeline after drawdown of the Iron Gate Reservoir and could affect water supply.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and would have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline would either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Bridge just downstream of Iron Gate Dam. The water supply for Yreka, on Fall Creek, would be unaffected by the relocation work. The pipeline would be disconnected for a short amount of time, as dictated by the available storage supply for the city, to prevent interruption of service to the residents of Yreka. **The relocation of the Yreka Pipeline would result in no change from existing conditions.**

*Removal of recreational facilities currently located on the banks of the existing reservoirs could affect water supply or water rights.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities would be removed. **The removal of the recreational facilities would result in no change from existing conditions.**

*Dam removal could change surface water flows available for diversion downstream of Iron Gate Dam.* Modeling efforts rely on historical flow data to create a set of flows under future operational prescriptions. The Lead Agencies compared the modeled flow rate at Iron Gate Dam under the Proposed Action to that of the No Action/No Project Alternative. Figure 3.8-3 shows the exceedance flow results for the No Action/No Project Alternative and the Proposed Action. The results showed either a slightly higher or slightly lower flow rate on the Klamath River downstream of Iron Gate Dam when compared to the No Action/No Project Alternative. Flows under the Proposed Action could change both because of the dam removal activities and the KBRA diversion and instream flow requirements, and these effects are combined in these figures. Figure 3.8-4 shows that these differences would diminish farther downstream from Iron Gate Dam. The modeling results show that at Seiad Valley, approximately 62 miles downstream from the Iron Gate Dam, the flow rates would be nearly identical.



**Figure 3.8-3. Flows for different year types under the Proposed Action and No Action Alternatives just downstream from Iron Gate Dam (DOI 2011)**



**Figure 3.8-4. 90% Exceedance Flows Near Seiad Valley, Orleans, and Klamath for Dam Removal and No Action Alternatives (DOI 2011)**

Because the flow rates at Seiad Valley would be nearly identical between the Proposed Action and the No Action/No Project Alternative, the Proposed Action is not likely to affect water supply downstream of Seiad Valley. As shown in Appendix L, approximately 8 of the 32 California water rights are downstream of Seiad Valley. **Under the Proposed Action, impacts on water supply downstream of Seiad Valley would be less than significant.**

*Dam removal could be affected by the changes in water supply compared to the No Action/No Project Alternative.* Flow rates just downstream of Iron Gate Dam are the lowest within this reach and provide a conservative estimate on available water supply when comparing to the downstream diversion amounts. There are 24 water right holders along this reach including one small domestic registration and 7 appropriative water rights; 4 are state filings with the SWRCB (reserve water for future use and development), 2 are listed with PacifiCorp and associated with facilities at Iron Gate Dam including operation of the fish hatchery, and 2 are for irrigation and fire protection purposes. As stated in Section 2.4.3.1, an alternate water source would need to be found for operation of the fish hatchery until the restoration and return of native fish at self sustaining population levels is achieved. The remaining 16 water rights are associated with riparian water rights (Statement of Diversion and Use permits) of which 6 are inactive. The monthly diversion flow rate associated with all of the active and inactive water rights, aside from the four reserved state filings and the PacifiCorp power diversion water right,<sup>1</sup> is approximately 64 cfs (based on water right information in Appendix L). During peak summer months, usage typically doubles. Since usage generally doubles between Iron Gate Dam and Seiad Valley during July and August, the peak short term diversion flow rate that would be diverted is 128 cfs if all users doubled their water diversion rate during the same period. This flow rate represents the peak flow diverted, and would likely be lower during wetter water years. The Proposed Action would change the flows in the river, but the flows would still be substantially greater than the peak diversion. The most conservative comparison is just downstream of Iron Gate Dam, where the flows would be the lowest in the potentially affected reach. Comparing the peak potential diversion with low flow conditions, the diversions would be approximately 16 percent of the Klamath River flows during a dry year<sup>2</sup>. A 90 percent exceedance flow of 824 cfs was used to represent a dry year. The flow rate of 824 cfs was once the seasonal low during the month of July, when irrigation and livestock demands are the greatest. (These low flows were used to develop a conservative impact evaluation, but they are less than what is currently acceptable under the NOAA Fisheries Service biological opinion.)

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<sup>1</sup> The four state filings with the SWRCB were not included because the water right is associated with a storage amount to preserve water for future use with no indication of the period of time during which the flow volume will be drawn. The PacifiCorp water right is associated with power generation at Iron Gate Dam and does not result in reduction of flows. For the diversion amount given in cubic feet per year (ID: WR-6), a diversion period of six months was assumed.

<sup>2</sup> The increase during July and August is an average based on reported values on Statement Diversion and Use forms available on California Electronic Water Rights Information Management System for the Klamath River.

Because the amount of flow diverted for water right users between Iron Gate Dam and Seiad Valley would be less than 20 percent of the flow in the Klamath River in the upstream portions of this reach during dry year, low flow conditions, water right users are not likely to experience decreased supplies because of the changes in flows. **Under the Proposed Action, impacts on downstream Klamath River water right users would be less than significant.**

*Release of stored sediment during drawdown of reservoirs could change Klamath River geomorphology and affect water intake pumps downstream of Iron Gate Dam.* Reservoir drawdown would release the sediment behind PacifiCorp dams downstream. Reservoir drawdown activities would begin on November 1, 2019 at Copco 1, on January 1, 2020 at J.C. Boyle and Iron Gate Dams, and on June 1, 2020 at Copco 2 Dam. During this period, individual downstream intake facilities could be inundated with sediment deposits, causing operational problems. Reclamation conducted modeling of the reservoir drawdown and erosion of reservoir sediment. The released sediment would likely exceed the carrying capacity of the river during some water year types, and would result in sedimentation and particle settling in slow-moving downstream areas. The fine fraction of the released sediment (silts, clays, and organics) would not be expected to deposit in substantial amounts in the river channel. The majority of this material would be transported to the ocean and would not interact substantially with the river bed. The amount of fine deposition would also decrease with distance from the dam. If drawdown occurred in a dry year, a substantial deposition of sands would be expected in the reach from Iron Gate Dam to as much as eight miles downstream of the dam, around Cottonwood Creek. There are 14 water rights registered on this reach; five are listed as inactive, two are a state filing with the SWRCB, and two are associated with PacifiCorp's Iron Gate Dam facility and fish hatchery. The remaining water rights are associated with domestic, irrigation, and/or fire protection use. The specific layout of these intake facilities is unknown, and they have potential to be affected by sediment deposits. **Under the Proposed Action, impacts to water intake pumps downstream of Iron Gate Dam would be significant. Implementation of mitigation measure WRWS-1 would reduce this impact to a less than significant level.**

*Activities associated with Interim Measures (IMs) could result in changes to PacifiCorp's water rights.* Prior to construction, "Interim Measures" as described in the KHSA (KHSA Section 1.2.4) would be implemented and would control operations of the hydroelectric facilities. IM 16 would eliminate three screened diversions from Shovel and Negro Creeks (the Lower Shovel Creek Diversion [7.5 cfs], Upper Shovel Creek Diversion [2.5 cfs], and Negro Creek Diversion [5 cfs]) and would seek to modify PacifiCorp's water rights to move the points of diversion to the mainstem Klamath River. The intent of this measure is to provide additional water for suitable habitat for aquatic species in Shovel and Negro creeks, while not diminishing PacifiCorp's water rights. While this measure would require a change to PacifiCorp's water rights, it would not affect the exercise of the water right (i.e., the quantity of water diversions) or flow in the Klamath River. **Therefore, the impact on water supply from implementation of the Interim Measures would be less than significant.**

### **Keno Transfer**

*Implementation of the Keno Transfer could cause changes to operations affecting water levels upstream of Keno Dam, which could cause changes to water supply or water rights.* The Keno Transfer would be a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on water supply/water rights compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

### **East and West Side Facilities**

*Decommissioning the East and West Side Facilities could cause adverse impacts to water supply and water rights.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. Water users currently reliant on a diversion from the West Canal would have their water supply connection extended to either Link River or Upper Klamath Lake. **Therefore, implementation of the East and West Side Facility Decommissioning action would result in no change from existing conditions.**

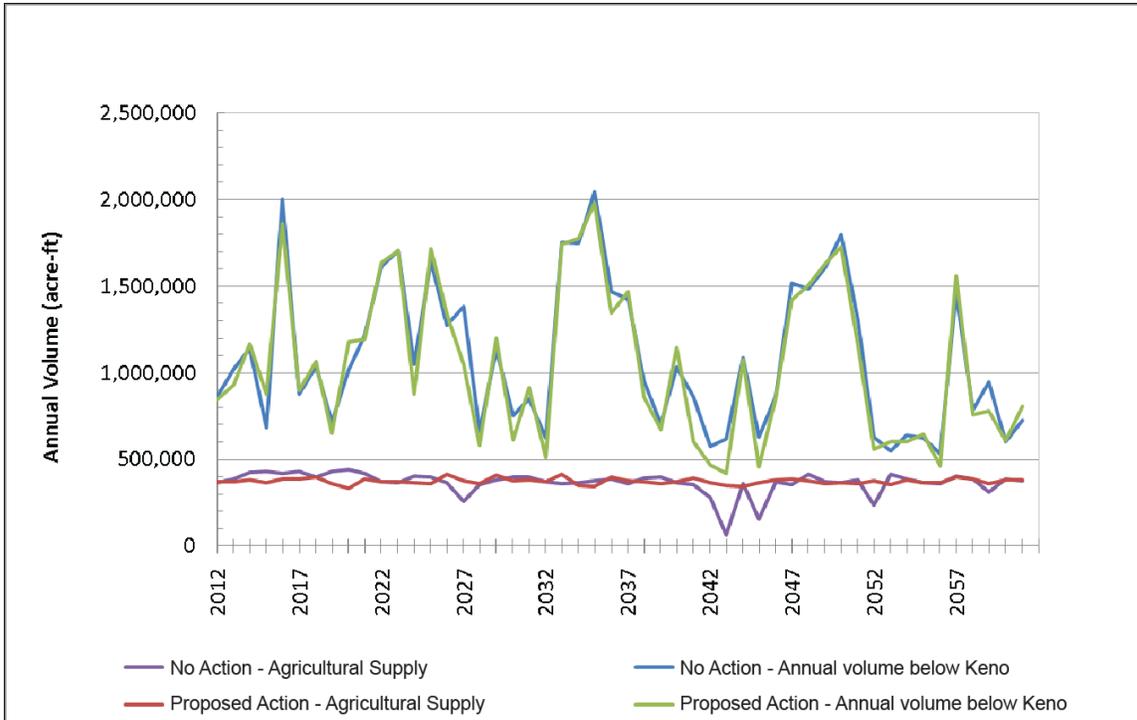
### **KBRA**

The KBRA, which is a component of the Proposed Action, encompasses several programs that could affect water rights and water supply, including:

- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration
- Water Diversion Limitations
- On-Project Plan
- Future Storage Opportunities
- Water Use Retirement Program
- Off-Project Water Settlement
- Off-Project Water Reliance Program
- Emergency Response Plan
- Climate Change Assessment and Adaptive Management
- Interim Flow and Lake Level Program
- Drought Plan

One of the goals of the KBRA includes improving water supply reliability by increasing storage capabilities and management plans, improving availability. Figure 3.8-5 presents Klamath Project Simulation Model results predicting the annual flow at Keno Dam and annual agricultural supply. The agricultural supply represents supply to Reclamation's Klamath Project and includes Tule Lake NWR and Lower Klamath NWRs (two NWRs in the area that are the most directly affected by the KBRA). The flows for the No Action/No Project Alternative are governed by operating requirements under the 2010

NOAA Fisheries Service Biological Opinion and 2008 USFWS Biological Opinion on Reclamation’s Klamath Project, while flows for the Proposed Action would change because of the dam removal activities and would be governed by KBRA diversion and instream flow requirements (as well as future biological opinions). Annual flows downstream of Keno Dam would be generally similar between the No Action/No Project Alternative and Proposed Action except for a few dry years when flow would continue to be supplied to Reclamation’s Klamath Project<sup>3</sup>.



**Figure 3.8-5. Annual flows under the No Action/No Project Alternative and Proposed Action (DOI 2011)**

**Fisheries Reintroduction and Management Plan**

*Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan would require water rights to divert water for the fish handling facilities.* Fish handling facilities to collect fish downstream of Keno Dam and at Link River Dam would require water sources. The facilities would not consumptively use the water; the water would pass through the facilities for release back into the system. The geographic separation between this project and the hydroelectric facility removal actions analyzed above eliminate any potential for negative water supply effects generated by this program from contributing to water supply effects generated by facility removal.

<sup>3</sup> Minimum flows may change in the future. Hydrologic modeling assumed that the Drought Plan would include a minimum flow of 800 cfs (DOI 2011). The final Drought Plan or future ESA actions could change the minimum flows; however, these assumptions reflect the best available information at the time of the modeling.

**Because the fish handling facility would not increase consumptive use on the Klamath River system, the impacts of the trap and haul operations on water supply/water rights would be less than significant.**

#### **Wood River Wetland Restoration**

*Implementation of the Wood River Wetland Restoration Project would result in changes to storage opportunities at Agency Lake, which could affect water supply.* A study of Wood River Wetland area management options would investigate providing additional storage for a total of 16,000 acre-feet of storage capacity at or adjacent to Agency Lake. This additional storage would improve water supply reliability and assist with alleviating short-term impacts related to water supply delivery during Water Diversion Limitations (another KBRA program) helping to offset a portion of the deficiencies. The geographic separation between this project and the hydroelectric facility removal actions analyzed above eliminate any potential for negative water supply effects generated by this program from contributing to water supply effects generated by facility removal. **Implementation of the Wood River Wetland Restoration Project would be a less than significant impact to water supply. Implementation of the Wood River Wetland Restoration will require future environmental compliance as appropriate.**

#### **Water Diversion Limitations**

*Implementation of Water Diversion Limitations to Reclamation's Klamath Project could result in changes to water diversions, which may affect water rights and water supply.* Water Diversion Limitations provide specific allocation of water for refuges and limitations on specific diversions for the Reclamation's Klamath Project intended to increase water availability for fisheries purposes. Water Diversion Limitations would be implemented during dry years to increase flows for fisheries by reducing Reclamation's Klamath Project diversion upstream of approximately 100,000 acre-feet. Water diversions could increase by 10,000 acre-feet for irrigation in some years if: 1) dam removal is implemented, 2) 10,000 acre-feet of new storage is created, or 3) Klamath Basin Coordinating Council concurs. Implementation of the diversion limitations would include assurances of increased reliability of diversions. The On-Project Plan, described in more detail below, provides the framework for management of Water Diversion Limitations implementation. While reducing diversions during the driest years would affect water supply for irrigation, it would not affect what is needed for public health and safety. Water may not be available to fulfill some water rights or adjudication claims during dry years; however the On-Project Plan, Drought Plan, and Future Storage Opportunities to be implemented as part of the KBRA would help to offset a portion of these deficiencies. These plans would provide mechanisms for irrigators to plan for water deliveries based on the type of water year. It is likely that health and safety issues related to water supply would be a priority whereas, water for irrigation would likely be less of a priority. The geographic separation between the Water Diversion Limitations and the hydroelectric facility removal actions analyzed above reduce the potential for negative water supply effects generated by this program from contributing to water supply effects generated by facility removal. **Implementation of Water Diversion Limitations is anticipated to have less than significant impact on water supply to Reclamation's Klamath Project. Implementation of the Water Diversion Limitations will require future environmental compliance as appropriate.**

### **On-Project Plan**

*Implementation of the On-Project Plan to allow for full implementation of Water Diversion Limitations to Reclamation's Klamath Project would result in changes to water diversions for irrigation in dry years, which could affect water rights or adjudicated rights.* The purpose of the On-Project Plan is to provide additional water supply or reduce the demand for Reclamation's Klamath Project to make up the differences between anticipated use and actual diversion. These actions include: land fallowing and shifting to dryland crop alternatives, efficiency and conservation measures (i.e. drip irrigation), development of groundwater sources, or creation of additional storage. A specific objective is included in the plan that groundwater pumping would not reduce flow greater than 6 percent to springs upstream of Copco Dam; which includes the Klamath, Wood and Williamson Rivers. The voluntary water management plan would partially offset the expected supply reductions. The improvements in water supply generated by the On-Project Plan and Water Diversion Limitations would not be expected to contribute to effects of hydroelectric facility removal analyzed above.

**Implementation of the On-Project Plan is anticipated to benefit water rights and supply. Implementation of the On-Project Plan will require future environmental compliance as appropriate.**

### **Future Storage Opportunities**

*The study of additional off-stream storage opportunities in the Upper Klamath Basin to identify new storage opportunities could affect water supply.* Reclamation plans to identify and study additional off-stream storage opportunities. KBRA parties would support ongoing investigations and acquisition of additional storage. The addition of 10,000 acre-feet of storage is a milestone in implementation of the KBRA. Off-stream storage is likely to improve water supply reliability and assist with alleviating short-term impacts related water supply delivery during Water Diversion Limitations (another KBRA program) helping to offset a portion of the deficiencies. Additionally the development of future storage opportunities would not be expected to contribute to any changes in water supply generated by the hydroelectric facility removal action.

**Implementation of Future Storage Opportunities would result in no change from existing conditions for water supply. Implementation of the Future Storage Opportunities will require future environmental compliance investigations as appropriate.**

### **Water Use Retirement Program (WURP)**

*Implementation of the WURP increases instream flow to Upper Klamath Lake which could affect water rights and water supply upstream of Upper Klamath Lake.* The WURP is a voluntary program for the purpose of supporting fish populations restoration by permanently increasing inflow to Upper Klamath Lake by 30,000 acre-feet per year. A variety of management measures and irrigation water use changes would help to accomplish an inflow increase and are described in Section 2.4.3.9. Some measures include implementing water efficiency projects, increasing natural storage through wetland or improved riparian area performance, and purchase and retirement of water rights from willing sellers. Increases to inflow rates from these measures are for instream flows and are not meant for diversion and use and there would be no additional increases

available for downstream diversions. The geographic separation between the actions proposed under this program and the hydroelectric facility removal actions analyzed above eliminate the potential for negative water supply effects generated by this program from contributing to water supply effects generated by facility removal. **Implementation of the WURP is anticipated to have a less than significant impact to water rights because rights would be voluntarily retired. Implementation of the WURP is expected to have no effect to water supply because there would be no changes to diversions. Implementing the WURP will likely require future environmental compliance investigations as appropriate.**

#### **Off-Project Water Settlement (OPWAS)**

*Implementation of OPWAS negotiations could affect water rights and adjudicated rights upstream of Upper Klamath Lake.* The intent of OPWAS is to negotiate a settlement of long-standing water disputes between the Upper Klamath Water Users Association, Klamath Tribes, and the Bureau of Indian Affairs. OPWAS includes terms that: 1) resolve the Off-Project Irrigators' contests to claims in Tribal Cases; 2) in the event that not all such contests are resolved, provide reciprocal assurances for maintenance of instream flows and reliable irrigation water deliveries consistent with applicable law; and 3) in all cases provide for a WURP. The effects of these settlement actions could provide an amicable and quicker solution for those who are affected by the ongoing Klamath Basin Adjudication. The negotiated settlements would resolve certain contests to significant major water right claims in the Upper Klamath Basin. The improvements in water supply generated by the settlement of water disputes would not be expected to contribute to effects of hydroelectric facility removal analyzed above. **Implementation of OPWAS would be a beneficial effect to resolve water rights and adjudicated rights and a less than significant impact to unresolved cases due to reciprocal assurances. Implementation of OPWAS will require future environmental compliance as appropriate.**

#### **Off-Project Water Reliance Program**

*Implementation of Off-Project Water Reliance Program could change water deliveries for irrigation upstream of Upper Klamath Lake to Off-Project water users affecting water supplies.* The Off-Project Water Reliance Program would not be implemented until full implementation of the WURP and 30,000 acre-feet of additional flow is added to Upper Klamath Lake and Water Diversion Limitations are fully implemented. The agreement establishes a program consistent with the WURP to avoid or mitigate the immediate effects of unexpected circumstances affecting water availability for irrigation in the Off-Project area. Activities under the Off-Project Water Reliance Program may include: funding water leasing to increase water supply availability for irrigation in the Upper Klamath Basin or mitigating the economic impacts of lost agricultural production by Off-Project irrigators. The geographic separation between the actions proposed under this program and the hydroelectric facility removal actions analyzed above eliminate any potential for negative water supply effects generated by this program contributing to water supply effects generated by facility removal. **Implementation of the Off-Project Water Reliance Program to provide additional water availability and help minimize reductions in water supply in the Off-Project Area would help to maintain or**

**improve water supply conditions but may not fully remedy negative water supply effects. This would be a less than significant impact. Implementation of the Off-Project Water Reliance Program will require future environmental compliance as appropriate.**

#### **Emergency Response Plan**

*Implementation of an Emergency Response Plan could result in a change to water supply deliveries in the event of failure to a facility in Reclamation's Klamath Project or dike on Upper Klamath Lake or Lake Ewauna.* The purpose of the plan is to prepare water managers for an emergency affecting the storage and delivery of water needed for KBRA implementation. The components of the Emergency Response Plan are described in Section 2.4.3.9 and includes providing a supply and response in case of a failure of a Klamath Reclamation Project facility, such as a pump or dike. Response actions such as groundwater substitution or groundwater sharing, similar to the ongoing drought plan, and affects of these actions could improve short-term water supply reliability and could have short-term groundwater elevation effects. The improvements in water supply generated by development of off-stream storage would not be expected to contribute to effects of hydroelectric facility removal analyzed above. **Implementation of an Emergency Response Plan would be a beneficial effect to water supply deliveries during emergency periods because management actions would help to continue supply as well as improve water supply reliability. Implementation of the Emergency Response Plan will require future environmental compliance as appropriate.**

#### **Climate Change Assessment and Adaptive Management**

*Implementation of Climate Change Assessment and Adaptive Management could result in changes to water deliveries depending on climatic changes.* One of the main purposes of Climate Change Assessment and Adaptive Management is to respond to and protect basin interests from the adverse affects of climate change. Water deliveries could be affected during periods of water shortages or surplus conditions. Klamath Basin Parties including technical experts would be involved in development of the assessment and adaptive management strategies. Assessments and development of adaptive management strategies would be implemented continuously to respond to predicted climate changes. Climate change assessments would be conducted to identify indications of effects of climate change, such as a wider range of wet and dry years. Management of water resources would include actions such as improving storage capabilities during the wet years and conservation during dry years. The improvements in water supply generated by development of off-stream storage would not be expected to contribute to effects of hydroelectric facility removal analyzed above. **While water supply could be adversely impacted by climate change, implementation of Climate Change Assessment and Adaptive Management would be a beneficial effect to water supply because it will help to reduce the effects of climate change. Implementation of Climate Change Assessment and Adaptive Management will require future environmental compliance as appropriate.**

### **Interim Flow and Lake Level Program**

*Implementation of Interim Flow and Lake Program during the interim period could change water deliveries affecting water supply.* The goal of the Interim Flow and Lake Level Program is to “further the goals of the Fisheries Program” during the interim period. This would be accomplished with, among other actions, an interim program of water purchases and leases during the interim period prior to full implementation of the On-Project Plan and WURP. Leases and purchases of water under this interim program shall be from willing sellers and counted towards instream water supply. Additionally the geographic separation between the actions proposed under this program and the hydroelectric facility removal actions analyzed above eliminate any potential for negative water supply effects generated by this program contributing to water supply effects generated by facility removal. **Therefore, implementation of the Interim Flow and Lake Level Program would cause a less than significant impact to water rights and water supply. Implementation of the Interim Flow and Lake Level Program will require future environmental compliance as appropriate.**

### **Drought Plan**

*Implementation of Drought Plan water and resource management actions could result in changes to water supply deliveries for Klamath Basin interests during drought years.* The purpose of the plan is to take management actions so that no Klamath Basin interest shall bear an unreasonable portion of burdens imposed or the risk of loss or injury as a result of drought or extreme drought. Response actions could include releasing stored water, paid forbearance agreements, conservation, groundwater substitution, or groundwater sharing. The effects of these actions could improve short-term water supply reliability and could have potential short-term groundwater elevation effects. Because users would have a choice between irrigating and being compensated for not irrigating, the current priority system in place within the Klamath Project might not be necessary during most year types. The improvements in water supply generated by development of off-stream storage would not be expected to contribute to effects of hydroelectric facility removal analyzed above. **Implementation of a Drought Plan would be a beneficial effect to water supply deliveries during drought periods because management actions would help to offset shortfalls in supply as well as improve water supply reliability. Implementation of the Drought Plan will require future environmental compliance as appropriate.**

### **Alternative 3: Partial Facilities Removal of Four Dams**

Under the Partial Facilities Removal of Four Dams Alternative the impacts would be the same as those described for the Proposed Action. **Impacts associated with relocation of the Yreka water supply pipeline and removal of recreation facilities at reservoirs would have no effect to water supply or water rights. Flow changes downstream of Iron Gate Dam and implementation of IMs would have a less than significant impact to water supply and water rights. Sediment release during reservoir drawdown has the potential to significantly affect water intake pumps by sediment deposits. Mitigation measure WRWS-1 would reduce this impact to less than significant.**

**Keno Transfer**

The effects of the Keno Transfer would be the same as those described for the Proposed Action.

**East and West Side Facilities**

The effects of the decommissioning of the East and West Side Facilities would be the same as those described for the Proposed Action.

**KBRA**

The KBRA would also be implemented under the Partial Facilities Removal Alternative. Impacts on water supply and water rights would be the same as described for the Proposed Action.

**Alternative 4: Fish Passage at Four Dams**

Under the Fish Passage at Four Dams Alternative, the drawdown and sediment impacts described under the Proposed Action would not occur. Flow rates downstream of Iron Gate Dam and water supply operations would be similar to those under the No Action/No Project Alternative to provide adequate flows for fish. **Under the Fish Passage at Four Dams Alternative, there would be no impact on water rights and water supply.**

**Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could require water rights to divert water for the fish handling facilities.* Fish handling facilities to collect fish downstream of Keno Dam and at Link River Dam would require water sources. The facilities would not consumptively use the water; the water would pass through the facilities for release back into the system. **Because the fish handling facility would not increase consumptive use on the Klamath River system, the impacts of the trap and haul measures in the Fish Passage at Four Dams Alternative on water supply/water rights would be less than significant.**

**Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

Under this alternative, only Iron Gate and Copco 1 Dams would be removed and fish passage would be installed at Copco 2 and J.C. Boyle Dams. The impact of sediments deposited downstream would be smaller, because sediment would be retained behind J.C. Boyle and Copco 2 Dams. After the drawdown period, flow rates downstream of Iron Gate Dam would be between the No Action/No Project Alternative and the Proposed Action.

**Impacts associated with relocation of the Yreka water supply pipeline and removal of recreation facilities at reservoirs would have no effect to water supply or water rights. Flow changes downstream of Iron Gate Dam would have a less than significant impact to water supply and water rights. Sediment release during reservoir drawdown has the potential to significantly affect water intake pumps by sediment deposits. Mitigation measure WRWS-1 would reduce this impact to less than significant.**

### **Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could require water rights to divert water for fish handling facilities.* The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. **Because the fish handling facility would not increase consumptive use on the Klamath River system, the impacts of trap and haul measures in the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative on water supply/water rights would be less than significant.**

### **3.8.4.4 Mitigation Measures**

#### **Mitigation Measure by Consequences Summary**

*Mitigation Measure WRWS-1* - Assess each pump location at legitimate points of diversion. Following dam removal, investigate intake and pump sites at the request of the water user. If effects on water supply intakes occur as a result of dam removal, the Dam Removal Entity (DRE) will complete modifications to intake points as necessary to reduce effects to a less-than-significant level.

#### **Effectiveness of Mitigation in Reducing Consequences**

Implementation of WRWS-1 will ensure that intake points of diversion affected by sediment deposition downstream of dam removal activities are dealt with individually and on an as-needed basis.

#### **Agency Responsible for Mitigation Implementation**

The DRE will coordinate with affected water users to determine appropriate solutions on a site-by-site basis.

#### **Remaining Significant Impacts**

No remaining significant adverse impacts on water rights and water supply are anticipated.

#### **Mitigation Measures Associated with Other Resource Areas**

*Mitigation REC-1* would create a plan to develop new recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoirs are removed. Water supplies for the campgrounds would most likely be supplied through wells placed on the new sites as appropriate. **There would be no impact to water rights or supplies from the implementation of REC-1.**

### 3.8.5 References

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## 3.9 Air Quality

This section discusses potential air quality impacts from the Proposed Action and alternatives. This discussion describes the affected environment/environmental setting, analysis methods, significance criteria, and impacts for each of the alternatives. Appendix M provides a summary of the existing emission sources and monitoring data, detailed emission calculation methodologies, and detailed emission inventories.

### 3.9.1 Area of Analysis

The area of analysis includes multiple counties in northern California and southern Oregon. Direct air quality impacts from the Proposed Action and alternatives would be limited to Siskiyou County, California and Klamath County, Oregon for dam removal activities, while additional impacts could occur in Jackson County, Oregon and Shasta County, California from haul truck or construction worker travel. The quantitative analysis for the alternatives was limited to these four counties.

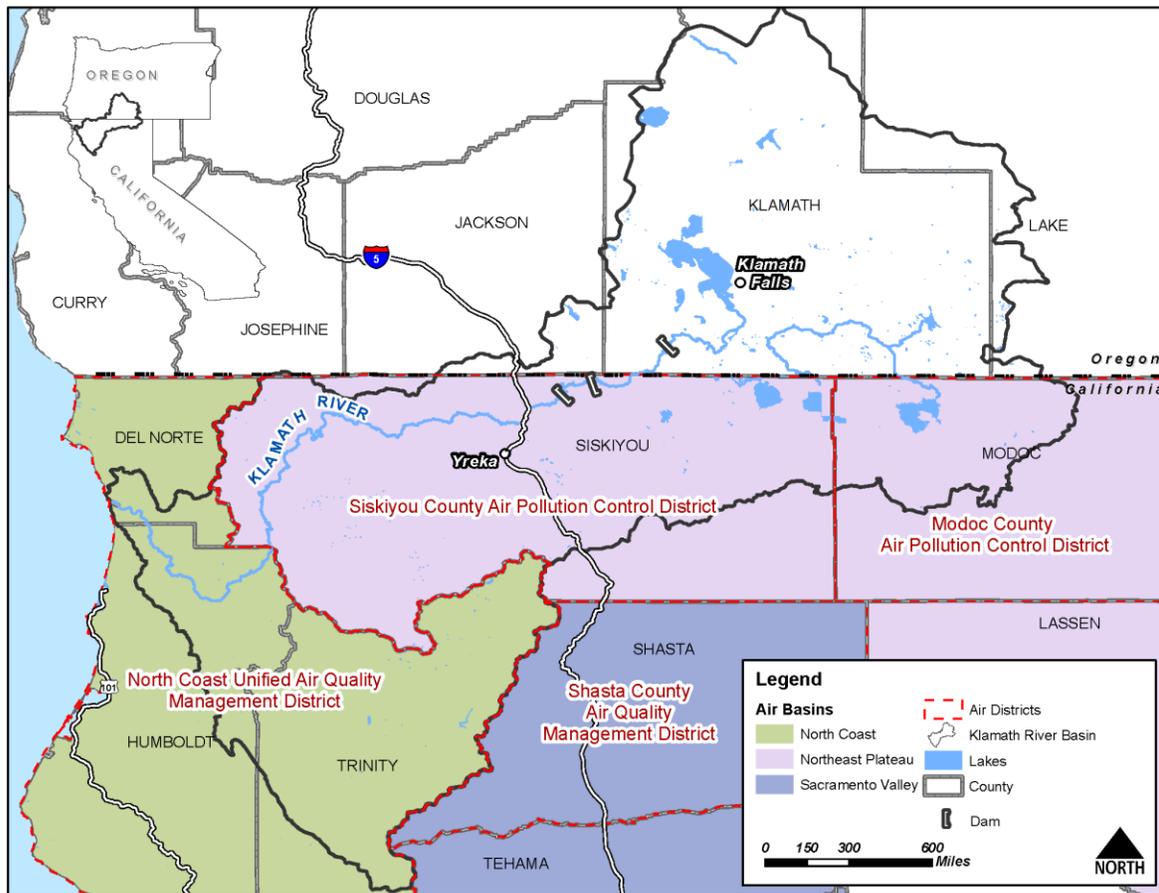
The area of analysis includes the Curry County in Oregon and Del Norte, Humboldt, Modoc and Trinity counties in California for a qualitative analysis of the impacts that would be caused by implementation of programmatic elements of the alternatives.

California is divided into fifteen different air basins based on common geographic and political boundaries. The North Coast, Northeast Plateau, and Sacramento Valley Air Basins cover the portion of the Klamath Basin within California. The geographic scope of the analysis also includes the jurisdictions of the North Coast Unified Air Quality Management District, the Siskiyou County Air Pollution Control District, the Modoc County Air Pollution Control District, and the Shasta County Air Quality Management District. Figure 3.9-1 identifies the air quality area of analysis.

### 3.9.2 Regulatory Framework

The Klamath Falls, Oregon Nonattainment Area is designated as a nonattainment area for fine particulate matter <2.5 microns (PM<sub>2.5</sub>), while the Klamath Falls Urban Growth Boundary (UGB) is designated as a maintenance area for carbon monoxide (CO) and inhalable particulate matter <10 microns (PM<sub>10</sub>). Additionally, the Medford-Ashland Air Quality Maintenance Area (AQMA) is designated as a maintenance area for PM<sub>10</sub> and CO. As a result, the following de minimis thresholds for general conformity apply to these two urban areas:

- PM<sub>2.5</sub> (nonattainment): 100 tons per year
- Sulfur dioxide (SO<sub>2</sub>) (as PM<sub>2.5</sub> precursor): 100 tons per year
- Nitrogen oxides (NO<sub>x</sub>) (as PM<sub>2.5</sub> precursor): 100 tons per year
- CO (maintenance): 100 tons per year
- PM<sub>10</sub> (maintenance): 100 tons per year



Source: California Air Resource Board (CARB) 2010a.

**Figure 3.9-1. Area of Analysis for both KHSA and KBRA**

Air quality management and protection responsibilities are regulated by federal, state, tribal, and local levels of government, which are listed below.

### **3.9.2.1 Federal Authorities and Regulations**

- Clean Air Act (40 CFR 50-88)
- General Conformity (40 CFR 93, Subpart B)

### **3.9.2.2 State Authorities and Regulations**

- California Clean Air Act (H&S Code, §39000 et seq.)
- Oregon Administrative Rules (Chapter 340, Divisions 200-268)
- Oregon Revised Statutes (Chapter 468A)
- Medford Maintenance Plan for CO (Oregon Department of Environmental Quality [ODEQ] 2001)

- Klamath Falls PM<sub>10</sub> Maintenance Plan (ODEQ 2002)
- Medford-Ashland AQMA PM<sub>10</sub> State Implementation Plan (ODEQ 2004)

### **3.9.2.3 Local Authorities and Regulations**

- Siskiyou County Air Pollution Control District
- Modoc County Air Pollution Control District
- Shasta County Air Quality Management District
- North Coast Unified Air Quality Management District (Del Norte, Humboldt, and Trinity Counties)
- Klamath County Clean Air Ordinance (Ordinance No. 63.05)

### **3.9.2.4 Tribal Air Quality Management**

- Karuk Tribe *Eco-Cultural Resources Management Plan* (2010)
- Yurok Tribe Air Quality Ordinance

## **3.9.3 Existing Conditions/Affected Environment**

Siskiyou County, California is dominated by volcanic peaks (e.g., Mount Shasta) and forested mountains. The county is sparsely populated. Agricultural activities (including rangeland) are primarily in areas that are not wooded. The climate generally features hot summer days with cool nights and mild winters in the low valleys. The mountainous areas have cool summers and severe winters. Various recreational activities and hunting also occur in Siskiyou County.

Klamath County is generally characterized by high desert prairie with a variety of mountain ranges and isolated peaks. As with Siskiyou County, the area is largely rural and agricultural, while recreation and hunting activities dominate.

### **3.9.3.1 Existing Air Quality Conditions**

The air quality conditions for the area are typically the result of existing emission sources in the area and meteorological conditions that affect the dispersion of the emissions once they enter the atmosphere.

### **Attainment Designations**

Regions are designated as nonattainment, maintenance, or attainment areas with respect to the various National and California ambient air quality standards, based on their compliance with the standards. A nonattainment area is defined as a region that does not meet the federal or state ambient air quality standards. Maintenance areas are those areas that previously did not meet the air quality standards (i.e., nonattainment), but are now consistently meeting the requirements. If an area consistently meets the air quality standards, then it is designated as an attainment area. The affected counties in California are all currently designated as a federal attainment area for all pollutants. The Klamath Falls UGB in Oregon is designated as a maintenance area for CO and PM<sub>10</sub>; the Medford-Ashland AQMA is designated as a maintenance area for CO and PM<sub>10</sub>; and the Klamath

Falls Nonattainment Area is designated as a nonattainment area for PM<sub>2.5</sub>. Table 3.9-1 presents the attainment designations for each of the federal criteria air pollutants.

**Table 3.9-1. Federal Attainment Status of the Study Area**

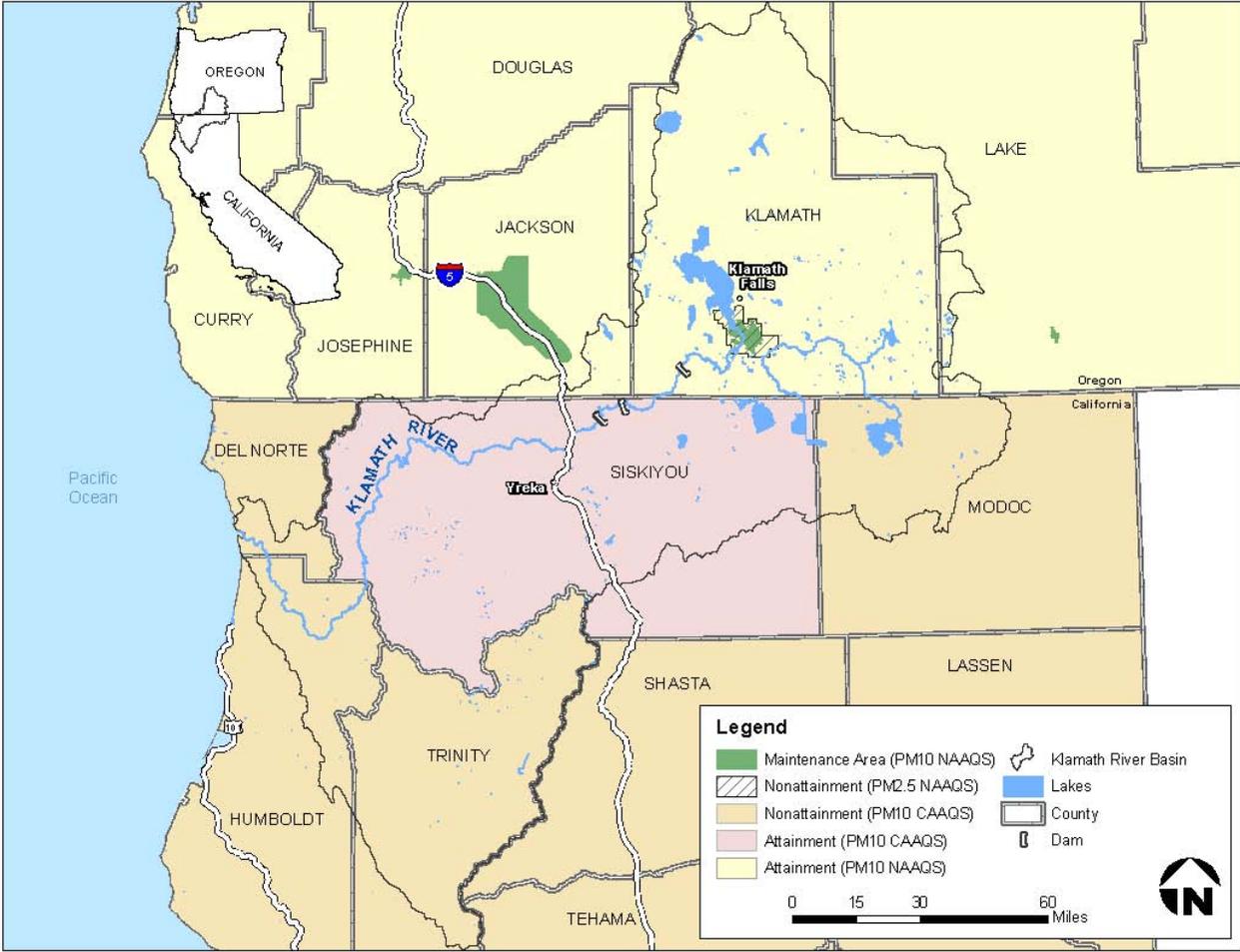
Pollutant	Federal Status
Ozone (O <sub>3</sub> )	Attainment
Inhalable particulate matter (PM <sub>10</sub> )	Maintenance (Klamath Falls UGB and Medford-Ashland AQMA) Attainment (all other areas)
Fine particulate matter (PM <sub>2.5</sub> )	Nonattainment (Klamath Falls Nonattainment Area) Attainment (all other areas)
Carbon monoxide (CO)	Maintenance (Klamath Falls UGB and Medford-Ashland AQMA) Attainment (all other areas)
Nitrogen dioxide (NO <sub>2</sub> )	Attainment
Sulfur dioxide (SO <sub>2</sub> )	Attainment

Source: United States Environmental Protection Agency (USEPA) 2010a; OAR 340-204.

AQMA: Air Quality Maintenance Area

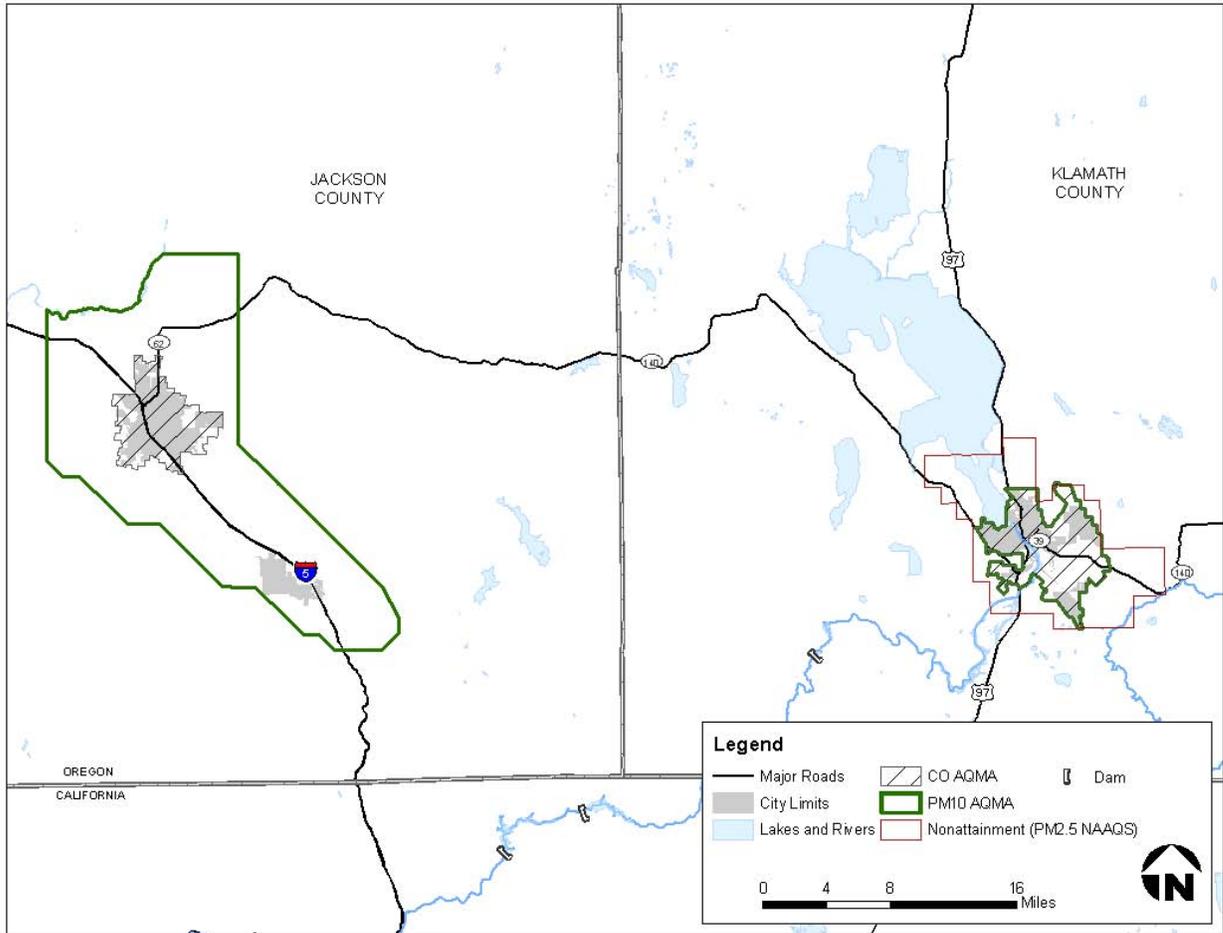
UGB: urban growth boundary

The J.C. Boyle Dam is in Klamath County and not in the Klamath Falls UGB or the Klamath Falls PM<sub>2.5</sub> Nonattainment Area; therefore, the dam is in an area that is designated an attainment area for all pollutants. The Medford-Ashland AQMA is currently a maintenance area for the PM<sub>10</sub> and CO National Ambient Air Quality Standards (NAAQS). Although this area is outside of the Klamath Basin, trucks and/or construction workers could travel through this region. Figure 3.9-2 shows the location of particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) nonattainment and maintenance areas for the NAAQS in relation to the Klamath Basin. Figure 3.9-3 shows the Klamath Falls UGB, the Klamath Falls Nonattainment Area, and the Medford-Ashland AQMA.



Source: California Air Resources Board (CARB) 2010a; United States Environmental Protection Agency (USEPA) 2010b.

**Figure 3.9-2. Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>) NAAQS and CAAQS Designations**



Source: Oregon Department of Environmental Quality 2008

**Figure 3.9-3. Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>) and Carbon Monoxide (CO) NAAQS Designations in Oregon**

Siskiyou County is currently a nonattainment-transitional area<sup>1</sup> for the California ozone (O<sub>3</sub>) standard, whereas Shasta County is a nonattainment area for the state O<sub>3</sub> California Ambient Air Quality Standard (CAAQS). All other California counties within the Klamath Basin are in attainment of the O<sub>3</sub> CAAQS. Siskiyou County is in attainment of the California PM<sub>10</sub> standards, but the other California counties in the Klamath Basin are in nonattainment of the PM<sub>10</sub> CAAQS. All California counties in the project area are in attainment of the PM<sub>2.5</sub>, CO, nitrogen dioxide (NO<sub>2</sub>), and SO<sub>2</sub> CAAQS. Table 3.9-2 lists the attainment status for each pollutant with regard to CAAQS. Figure 3.9-2 identifies the attainment status for the PM<sub>10</sub> CAAQS and Figure 3.9-4 identifies the attainment status for the O<sub>3</sub> CAAQS.

<sup>1</sup> An area classified “nonattainment-transitional” for O<sub>3</sub> has had three or fewer exceedances at each site during the last year. This classification means that the area is close to attaining the standard for the given pollutant.

**Table 3.9-2. California Air Quality Attainment Status for the Study Area**

Pollutant	California Status
Ozone (O <sub>3</sub> )	Nonattainment-Transitional (Siskiyou County) Nonattainment (Shasta County) Attainment (Del Norte, Humboldt, Modoc, and Trinity Counties)
Inhalable particulate matter (PM <sub>10</sub> )	Attainment (Siskiyou County) Nonattainment (Del Norte, Humboldt, Trinity, Shasta, and Modoc Counties)
Fine particulate matter (PM <sub>2.5</sub> )	Attainment/Unclassified (All counties)
Carbon monoxide (CO)	Attainment/Unclassified (All counties)
Nitrogen dioxide (NO <sub>2</sub> )	Attainment (All counties)
Sulfur dioxide (SO <sub>2</sub> )	Attainment (All counties)

Source: CARB 2010b.



Source: CARB 2010a; United States Environmental Protection Agency (USEPA) 2010b.

**Figure 3.9-4. Ozone (O<sub>3</sub>) NAAQS and CAAQS Designations**

### 3.9.4 Environmental Consequences

#### 3.9.4.1 Environmental Effects Determination Methods

This analysis uses estimates of emissions that would occur from the removal of the dams or the installation of fish passage structures. These estimates came from a variety of emissions models and spreadsheet calculations:

- CARB Urban Emissions (URBEMIS) model, Version 9.2.4 (fugitive dust calculations from construction equipment, cut/fill activities, and building demolition)
- CARB EMFAC2007 model (on-road vehicle emissions factor model for California)
- United States Environmental Protection Agency (USEPA) MOBILE6.2<sup>2</sup> (on-road vehicle emissions factor model for Oregon)
- CARB OFFROAD2007 (off-road vehicle emissions factor model for California)
- USEPA NONROAD2008a (off-road vehicle emissions factor model for Oregon)
- Midwest Research Institute (1996), *Improvement of Specific Emission Factors* (paved road dust emissions)
- *Compilation of Air Pollutant Emission Factors (AP-42)* (USEPA 2006)

Appendix M provides detailed information on the emission calculations.

#### 3.9.4.2 Significance Criteria

For the purposes of this analysis, an air quality impact would be significant if one or more of the following criteria are met:

- The effects would cause an air quality standard to be violated
- Activities or emissions would result in a cumulatively considerable net increase of:
  - O<sub>3</sub> in Siskiyou County or Shasta County, California (O<sub>3</sub> nonattainment-transitional and nonattainment areas, respectively)
  - PM<sub>10</sub> in Del Norte, Humboldt, Trinity, Shasta, and Modoc Counties (PM<sub>10</sub> nonattainment areas)
- Cause release of emissions that exceed 250 pounds per day for NO<sub>x</sub>, volatile organic compounds (VOC), PM<sub>10</sub>, PM<sub>2.5</sub>, or sulfur oxides (SO<sub>x</sub>); or 2,500 pounds per day for CO (Siskiyou County Air Pollution Control District Rule 6.1)
- Expose sensitive receptors to substantial pollutant concentrations (defined by pollutant thresholds)
- Activities or emissions would be inconsistent with Oregon's Regional Haze Plan (ODEQ 2009)

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<sup>2</sup> Although the USEPA recently developed the Motor Vehicle Emission Simulator (MOVES) to replace MOBILE6.2, MOVES has only been approved for use in SIPs and Transportation Conformity (75 FR 9411). Because it has not yet been approved for project-level analyses, MOBILE6.2 was used to estimate emissions from on-road vehicles in Oregon.

- Activities or emissions would be inconsistent with California’s Regional Haze Plan (CARB 2009)

The Proposed Action would also occur within close proximity (within 100 kilometers<sup>3</sup>) of several mandatory federal Class I areas, which are areas in which visibility was declared by Congress to be an important value (Clean Air Act, Section 169A). The following Class I areas could be affected by the Proposed Action or its alternatives.

- Crater Lake National Park (Oregon)
- Gearhart Mountain Wilderness (Oregon)
- Lava Beds National Monument (California)
- Marble Mountain Wilderness (California)
- Mountain Lakes Wilderness (Oregon)

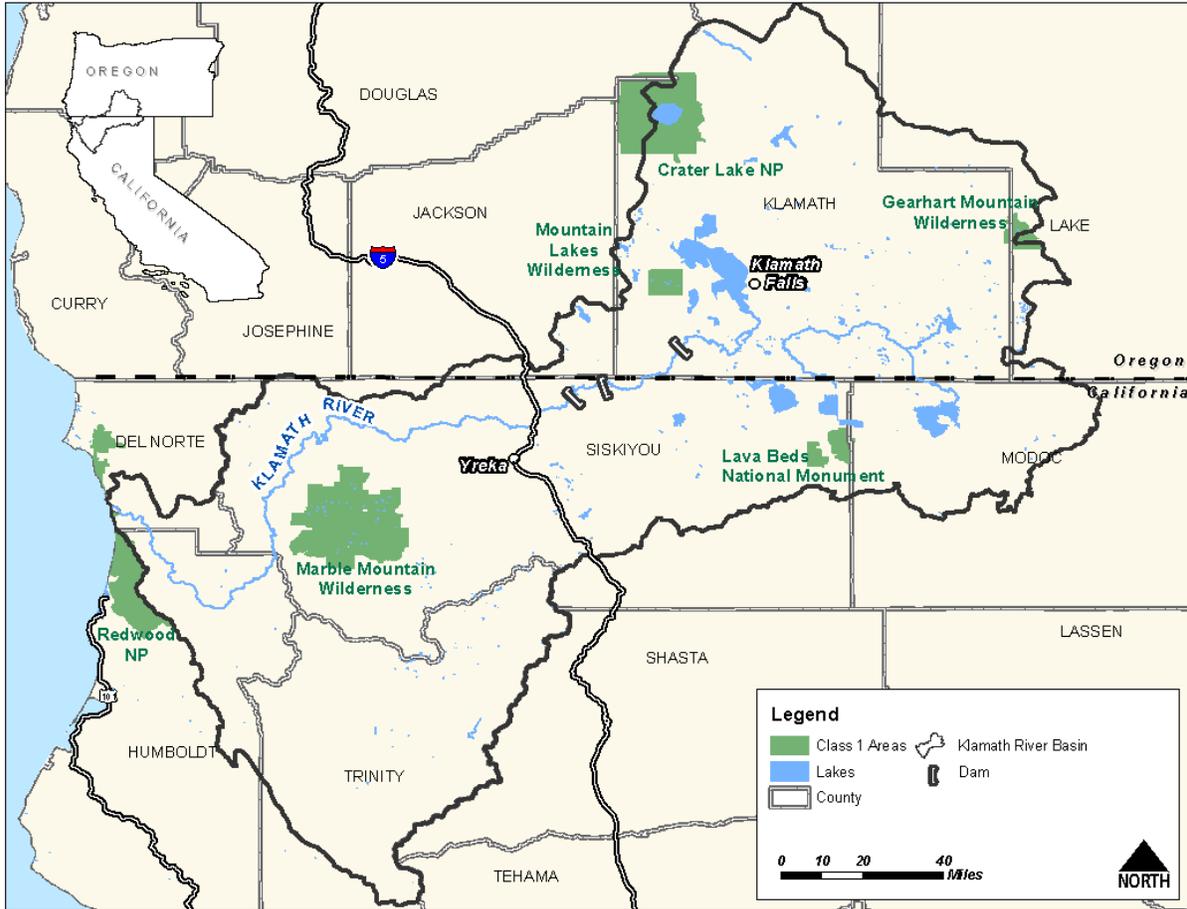
Oregon’s *Regional Haze Plan* (ODEQ 2009) indicates that the current rules addressing construction-related activities in Oregon are sufficient to prevent visibility impairment in Oregon Class I areas. Several rules that address construction activities include Oregon Administrative Rule (OAR) 340-208-0110, which sets opacity limits for visible emissions from any air contaminant source and OAR 340-208-0210, which addresses fugitive emissions from a variety of sources.

California’s *Regional Haze Plan* (CARB 2009) indicates that CARB’s In-Use Off-Road Diesel Vehicle Regulation (adopted on July 26, 2007) will reduce particulate matter and NOx emissions by 74 percent and 32 percent, respectively, from current levels. CARB expects this measure to be sufficient to mitigate visibility impacts from construction activities.

Figure 3.9-5 shows the Federal Class I areas that are within the Klamath Basin.

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<sup>3</sup> The 100-kilometer distance is based on a memorandum from the USEPA (1979) to Regional Administrators that indicated that “[v]ery large sources...may be expected to affect ‘air quality related values’ at distances greater than 100 kilometers.” Although the distance is related to the Prevention of Significant Deterioration permitting program, the distance is being used as a proxy for activities associated with the Proposed Action.



Source: National Park Service 2010.

Figure 3.9-5. Federal Class I Areas

### 3.9.4.3 Effects Determinations

No operational sources are part of the Proposed Action; therefore, this analysis considers only construction-related air quality impacts. Appendix M describes the methods by which construction impacts were estimated.

#### **Alternative 1: No Action/No Project Alternative**

*Vehicle exhaust from continued maintenance and operation of the Four Facilities could cause emissions of air pollutants.* Under the No Action/No Project Alternative, none of the activities under the KHSA would be completed. Operational emissions that would occur from employees commuting to the Four Facilities, vendor trips, or other emission sources would continue to occur under the No Action/No Project Alternative. **These emissions are expected to be minimal and were not quantified for this analysis.**

*Activities associated with Interim Measures (IMs) could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.* Several IMs would be implemented under the No Action/No Project Alternative. Several of these measures could result in increased criteria pollutant emissions:

- IM 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement
- IM 8: J.C. Boyle Bypass Barrier Removal

IM 7 would require PacifiCorp to place suitable gravels in the J.C. Boyle Bypass and Peaking reaches using a passive approach before high flow periods or to provide for other habitat enhancement. The No Action/No Project Alternative includes only one year of this measure. Criteria pollutant emissions could occur from trucks hauling gravel to the J.C. Boyle Bypass and Peaking reaches; however, the number of trucks required to deliver gravel is expected to be minor.

IM 8 requires the removal of the sidecast rock barrier located approximately 3 miles upstream of the J.C. Boyle Powerhouse in the J.C. Boyle Bypass Reach. Potential air quality emissions are expected to be less than those quantified for the removal of Copco 1 from blasting activities.

Based on the limited amount of construction equipment expected to be used simultaneously, peak daily emissions are not expected to exceed the significance criteria described previously. **The impact on air quality from implementation of the IMs would be less than significant.**

#### **Ongoing Restoration Activities**

*Construction activities from several ongoing restoration actions could cause emissions of air pollutants.* Under the No Action/No Project Alternative, several projects would be assumed to proceed over time. These resource management actions could receive additional funding and could be expanded or accelerated through the KBRA; however, they were started or under consideration before the KBRA was developed and would move forward even without the KBRA. The Fish Habit Restoration activities could result in criteria pollutant emissions. **This project would involve some limited construction activities that could result in short-term temporary air emissions in the upper basin. The effects of these activities would be fully analyzed in separate National Environmental Policy Act evaluations for each project as they are designed.**

#### **Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

*Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.* Emission sources include exhaust emissions from off-road construction equipment, on-road trucks, construction worker employee commuting vehicles; and fugitive dust emissions from unpaved roads and general earth moving activities. General earth moving activities that could generate fugitive dust include the operation of construction equipment on the site and removal of excavated

materials (cut/fill activities). The Iron Gate Fish Hatchery would be operated for eight years after the dam removal, but the hatchery would not be rebuilt or relocated. While additional water may be routed to the hatchery to support its operation, an increase in emissions would not occur. Operational emissions were therefore not estimated for the hatchery.

Table 3.9-3 summarizes predicted uncontrolled peak daily and annual emission rates for VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> for the Proposed Action. This analysis uses the conservative assumption that the peak day of construction could occur at the same time for each dam; therefore, the peak daily emissions are additive. The analysis assumes that dust control measures like watering and erosion control fabrics would be required by the United States Department of the Interior (DOI). In addition, the calculations assume that all haul roads would be covered in gravel with minimal silt content. As a result, these measures are included as part of the project and are not considered to be mitigation measures.

Cofferdams would be constructed at the Four Facilities during deconstruction activities. Concrete rubble, rock, and earthen materials that would come from the dam removal activities would be used as possible to construct the cofferdams. Since the cofferdams would be constructed from materials salvaged from the dam demolition activities, emissions associated with construction would already be included in the emissions inventory. Additional emissions could occur when the cofferdams are later demolished, but this activity would not cause any changes to the significance determinations.

As Table 3.9-3 shows, total emissions of NO<sub>x</sub> and PM<sub>10</sub> exceed the significance criteria for the four sites. The greatest source of NO<sub>x</sub> emissions from each of the dams would be off-road construction equipment, followed by on-road trucks, and then employee commuting vehicles. The major sources of PM<sub>10</sub> emissions would be fugitive dust from unpaved roads and then cut/fill activities. Any adverse impacts would be temporary.

**Table 3.9-3. Uncontrolled Emissions Inventories for the Proposed Action**

Location	Peak Daily Emissions (pounds per day) <sup>1</sup>					
	VOC	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub> <sup>2</sup>
Iron Gate	67	272	<b>348</b>	2	210	50
Copco 1	27	176	129	1	174	165
Copco 2	22	83	113	1	17	6
J.C. Boyle	15	54	60	5	103	27
Grand Total	131	584	<b>650</b>	9	<b>503</b>	248
California Total <sup>3</sup>	116	531	<b>590</b>	4	<b>401</b>	221
Oregon Total	15	54	60	5	103	27
Significance Criterion <sup>4</sup>	250	2,500	250	250	250	250
	Annual Emissions (tons per year) – 2020					
Iron Gate	3	11	14	<1	10	2
Copco 1	1	7	5	<1	8	7
Copco 2	1	3	5	<1	<1	<1
J.C. Boyle	1	3	5	<1	3	1
Total (2020)	6	24	28	1	20	11
California Total <sup>3</sup>	5	21	23	<1	18	10
Oregon Total	1	3	5	<1	3	1
De Minimis Threshold <sup>5</sup>	n/a	100	100	100	100	100

Notes:

<sup>1</sup> Values shown in **bold** are significant.

<sup>2</sup> Where emission factors were only provided for PM<sub>10</sub>, appropriate PM size profiles were used to estimate PM<sub>2.5</sub> emissions. Appendix M includes detailed calculation tables.

<sup>3</sup> California total includes emissions for activities at Iron Gate, Copco 1, and Copco 2 Dams.

<sup>4</sup> Based on Siskiyou County Air Pollution Control District Rule 6.1 permitting thresholds.

<sup>5</sup> General conformity de minimis thresholds from 40 CFR 93.153.

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SO<sub>2</sub> = sulfur dioxide

PM<sub>10</sub> = inhalable particulate matter

PM<sub>2.5</sub> = fine particulate matter

Demolition of Copco 1 dam could generate concrete dust, which has a high pH. Dust control measures as described in mitigation measure AQ-4 would be used to control concrete dust to the maximum extent feasible. Management of the high pH content is discussed further in Section 3.5, Terrestrial Resources. **The impact on air quality from emissions of NOx and PM<sub>10</sub> from the demolition of the Four Facilities would be a significant impact. Implementation of mitigation measures AQ-1 through AQ-4 would reduce emissions of NOx to a less than significant level; however, emissions of PM<sub>10</sub> would remain significant and unavoidable.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust that could*

*exceed Siskiyou County's thresholds of significance.* On- and off-road construction equipment would be used to complete the relocation and construction of the Yreka water supply pipeline. These construction activities would occur before demolition activities at Iron Gate and would not overlap with other construction or demolition activities. Typical equipment that would be expected to be used to complete construction of the pipeline would include excavators, graders, loaders, and scrapers. Based on the limited amount of construction equipment expected to be used simultaneously, peak daily emissions are not expected to exceed the significance criteria described previously. **The impact on air quality from the construction of the Yreka water supply pipeline would be less than significant.**

*Activities associated with several IMs could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.* Prior to construction, IMs as described in the KHSA (KHSA Section 1.2.4) would be implemented and would control operations of the hydroelectric facilities. Several of the IMs in the Proposed Action could result in increased criteria pollutant emissions:

- IM 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement
- IM 16: Water Diversions

IM 7 would require PacifiCorp to place suitable gravels in the J.C. Boyle bypass and peaking reach using a passive approach before high flow periods or to provide for other habitat enhancement. The Proposed Action includes seven years of implementing this measure. Criteria pollutant emissions could occur from trucks hauling gravel to the J.C. Boyle bypass and peaking reach; however, the number of trucks required to deliver gravel is expected to be minor.

IM 16 would eliminate three screened diversions from Shovel and Negro Creeks and would also require the installation of screened irrigation pump intakes, as necessary, in the Klamath River. Limited construction equipment and haul trucks would be required to remove the screened diversions or to construct new diversions.

Based on the limited amount of construction equipment expected to be used simultaneously, peak daily emissions are not expected to exceed the significance criteria described previously. **The impact on air quality from implementation of the IMs would be less than significant.**

*Restoration actions could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust from the use of helicopters, trucks, and barges.* Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed sediment. Upper areas would be reseeded from a barge until the reservoir levels become too low to operate and access the barge. Aerial application would be necessary for precision applications of material near sensitive areas and the newly established river

channel. Aerial hydroseeding is scheduled to begin on March 15, 2020 and last for 10 days at Iron Gate and 20 days at Copco. Trucks would also be used as necessary to provide seeding. Additional fall seeding may be necessary to supplement areas where spring hydroseeding was unsuccessful. These revegetation actions would be happening simultaneously to the demolition of the Four Facilities; therefore, emissions would contribute to those already occurring for the Proposed Action. **Helicopters, trucks, and barges from restoration actions would cause a temporary significant air quality impact and would increase the significant air quality impacts generated by dam deconstruction in and around the dam sites. Available mitigation measures would not reduce emissions to less than significant levels; therefore, emissions would remain significant and unavoidable.**

*Relocation and demolition of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust.* The demolition of the Four Facilities would change recreational opportunities from lake-based recreation to river-based recreation. This change would require several recreation facilities to be relocated or demolished. On- and off-road construction equipment would be used to complete these activities, which would occur after the dam demolition actions. Furthermore, although there are multiple recreation facilities being demolished or relocated, the facilities would likely not be removed simultaneously. Based on the limited size of each recreation facility, typical equipment to be used during construction activities would include dozers, scrapers, loaders, and graders. The amount of equipment expected to be used simultaneously is expected to be minimal; therefore, peak daily emissions are not expected to exceed the significance criteria described previously. **The impact on air quality from the relocation and demolition of the various recreation facilities would be less than significant.**

*Vehicle exhaust and fugitive dust emissions from dam removal activities could exceed the de minimis thresholds in 40 CFR 93.153 that would require the development of a general conformity determination.* Emissions from trucks and employee commuting could occur within the Klamath Falls UGB, the Klamath Falls Nonattainment Area (PM<sub>2.5</sub>), or the Medford-Ashland AQMA; therefore, emissions that would occur within these areas are subject to the requirements of general conformity. If the total of direct and indirect emissions are below the general conformity de minimis thresholds in 40 CFR 93.153, then no further action is needed and a general conformity determination is not required.

While only emissions that would occur within the designated nonattainment or maintenance areas would be subject to general conformity, it is not possible to separate those emissions from the project total. As a result, total emissions from haul trucks and employee commuting was compared to the general conformity de minimis thresholds as a conservative analysis. Emissions from trucks and employee commuting are less than the general conformity de minimis thresholds identified in Section 3.9.2.1 (see Table 3.9-3) and therefore a conformity determination is not necessary for any of the maintenance or nonattainment areas. **As a result, a general conformity determination is not required.**

*Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas.* Demolition activities would be conducted in compliance with Oregon and California regulations related to fugitive dust emissions. In addition, any fugitive dust emissions would be short-term and temporary and would not have long-term effects related to visibility. **Impacts related to visibility would be less than significant.**

#### **Keno Transfer**

*Implementation of the Keno Transfer could have adverse effects on air quality.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on air quality compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance with agreements and historic practice (KHSA Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

#### **East and West Side Facility Decommissioning**

*Decommissioning the East and West Side Facilities could cause adverse air quality effects.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA would redirect water flows currently diverted at Link River Dam into the two canals, back into the Link River. These construction activities would be conducted in the years prior to 2020 and would not overlap with other construction or demolition activities. Peak daily emissions would likely be minimal and are not expected to exceed the significance criteria. **The impact on air quality from the East and West Side Facilities decommissioning action would be less than significant.**

#### **KBRA**

The KBRA has several programs that could cause temporary increases in air quality pollutant emissions, primarily from construction activities. The following KBRA programs could cause air quality impacts from the use of heavy equipment:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration Project
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction

*Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.* Potential construction activities include channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. Several of these activities would require construction equipment with the potential to emit air quality pollutants. While the exact geographic location and timing of these programs is not known, it is assumed that some could occur at the same

time and in the same area as the hydroelectric facility removal actions analyzed above and could contribute to the severity of the facility removal air quality effects. **Due to the potentially large amount of construction activities that would occur for the various KBRA programs, it is anticipated that the effects from air quality could be significant. Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce the severity of these effects to a less than significant level; however, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap-and-haul activities.* Potential operational emissions could occur from haul trucks moving fish around Keno Impoundment and Link River. Upstream-migrating fish would be collected downstream from Keno Dam and relocated to Upper Klamath Lake or its tributaries. Downstream-migrating fish would be collected at Link River Dam (and the East Side and West Side canals) and relocated downstream from Keno Dam. Seasonal trap and haul operations would occur during periods of poor water quality in Keno Impoundment. Hauling activities would occur after the peak emission-generating period of facility removal because fish cannot access Keno Dam until after removal of the Four Facilities; however, some construction activities associated with completing removal activities and reservoir restoration may occur at the same time as hauling operations. Construction emissions related to dam removal and hauling operations, taken together, could increase the severity of the air quality effects, but the combined emissions would likely still be less than the peak emissions during dam deconstruction. **Although the exact extent and timing of these hauling activities is not known, it is assumed that air quality impacts would be significant because of the long haul distance that is expected. Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce the severity of these effects to a less than significant level; however, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

### **Alternative 3: Partial Facilities Removal of Four Dams Alternative**

Under the Partial Facilities Removal Alternative, some of the structures associated with the dams would remain in place. As a result, the area in which removal activities could occur is smaller than under the Proposed Action.

*Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.* As it would be for the Proposed Action, the major source of NO<sub>x</sub> emissions associated with the Partial Facilities Removal Alternative would be off-road construction equipment and other sources of exhaust emissions. The major source of PM<sub>10</sub> and PM<sub>2.5</sub> emissions would be fugitive dust that is generated from

movement on unpaved roads and surfaces. Secondary formation of PM<sub>2.5</sub> could also occur from NO<sub>x</sub> and SO<sub>x</sub> emissions; however, these pollutants are not emitted in sufficient quantities to affect the Klamath Falls Nonattainment Area.

The Iron Gate Fish Hatchery would be operated for eight years after the dam removal, but the hatchery would not be rebuilt or relocated. While additional water may be routed to the hatchery to support its operation, an increase in emissions would not occur. Operational emissions were therefore not estimated for the hatchery.

Table 3.9-4 is a summary of predicted uncontrolled peak daily and annual emission rates for VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> for the Partial Facilities Removal Alternative. As Table 3.9-4 shows, total emissions of NO<sub>x</sub> and PM<sub>10</sub> would exceed the significance criteria for the four sites.

Demolition of Copco 1 dam could generate concrete dust, which has a high pH. Dust control measures as described in mitigation measure AQ-4 would be used to control concrete dust to the maximum extent feasible. Management of the high pH content is discussed further in Section 3.5, Terrestrial Resources. **The impact on air quality from emissions of NO<sub>x</sub> and PM<sub>10</sub> the Four Facilities would be a significant impact. Implementation of mitigation measures AQ-1 through AQ-4 would reduce emissions of NO<sub>x</sub> to a less than significant level; however, emissions of PM<sub>10</sub> would remain significant and unavoidable.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short-term and temporary increases in vehicle exhaust and fugitive dust emissions that could exceed Siskiyou County's thresholds of significance.* Air quality impacts associated with the water supply pipeline construction would be the same as those discussed for the Proposed Action. **The impact on air quality from the construction of the Yreka water supply pipeline would be less than significant.**

*Activities associated with several IMs could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.* Air quality impacts associated with implementation of IMs would be the same as those discussed for the Proposed Action. **The impact on air quality from implementation of the IMs would be less than significant.**

*Restoration actions could result in short-term and temporary increases in vehicle exhaust and fugitive dust emissions from the use of helicopters, trucks, and barges.* Air quality impacts associated with the restoration actions would be the same as those discussed for the Proposed Action. **Helicopters, trucks, and barges from restoration actions would cause a temporary significant air quality impact and would increase the significant air quality impacts generated by dam deconstruction in and around the dam sites. Available mitigation measures would not reduce emissions to less than significant levels; therefore, emissions would remain significant and unavoidable.**

**Table 3.9-4. Uncontrolled Emissions Inventories for the Partial Facilities Removal Alternative**

Location	Peak Daily Emissions (pounds per day) <sup>1</sup>					
	VOC	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub> <sup>2</sup>
Iron Gate	66	270	<b>344</b>	2	208	49
Copco 1	27	173	124	1	171	165
Copco 2	21	80	103	1	12	5
J.C. Boyle	14	48	53	5	94	25
Grand Total	128	570	<b>625</b>	9	<b>484</b>	244
California Total <sup>3</sup>	115	522	<b>571</b>	4	<b>390</b>	219
Oregon Total	14	48	53	5	94	25
Significance Criterion <sup>4</sup>	250	2,500	250	250	250	250
	Annual Emissions (tons per year) – 2020					
Iron Gate	3	11	14	<1	10	2
Copco 1	1	7	5	<1	7	7
Copco 2	1	3	4	<1	<1	<1
J.C. Boyle	1	2	3	<1	2	1
Total (2020)	6	23	26	<1	20	11
California Total	5	21	23	<1	17	10
Oregon Total	1	2	3	<1	2	1
De Minimis Threshold <sup>5</sup>	n/a	100	100	100	100	100

Notes:

<sup>1</sup> Values shown in **bold** are significant.

<sup>2</sup> Where emission factors were only provided for PM<sub>10</sub>, appropriate PM size profiles were used to estimate PM<sub>2.5</sub> emissions. Appendix M includes detailed calculation tables.

<sup>3</sup> California total includes emissions for activities at Iron Gate, Copco 1, and Copco 2 Dams.

<sup>4</sup> Based on Siskiyou County Air Pollution Control District Rule 6.1 permitting thresholds.

<sup>5</sup> General conformity de minimis thresholds from 40 CFR 93.153.

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SO<sub>2</sub> = sulfur dioxide

PM<sub>10</sub> = inhalable particulate matter

PM<sub>2.5</sub> = fine particulate matter

*Relocation and demolition of various recreation facilities could result in short-term and temporary increases in vehicle exhaust and fugitive dust emissions. Air quality impacts associated with the recreation facilities would be the same as those discussed for the Proposed Action. **The impact on air quality from the relocation and demolition of the various recreation facilities would be less than significant.***

*Vehicle exhaust and fugitive dust emissions from dam removal activities could exceed the de minimis thresholds in 40 CFR 93.153 that would require the development of a general conformity determination.* Emissions from trucks and employee commuting could occur within the Klamath Falls UGB, the Klamath Falls Nonattainment Area (PM<sub>2.5</sub>), or the Medford-Ashland AQMA; therefore, emissions that would occur within these areas are subject to the requirements of general conformity. If the total of direct and indirect emissions are below the general conformity de minimis thresholds in 40 CFR 93.153, then no further action is needed and a general conformity determination is not required.

While only emissions that would occur within the designated nonattainment or maintenance areas would be subject to general conformity, it is not possible to separate those emissions from the project total. As a result, total emissions from haul trucks and employee commuting was compared to the general conformity de minimis thresholds as a conservative analysis. Emissions from trucks and employee commuting are less than the general conformity de minimis thresholds identified in Section 3.9.2.1 (see Table 3.9-4) and therefore a conformity determination is not necessary for any of the maintenance or nonattainment areas. **As a result, a general conformity determination is not required.**

*Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas.* Demolition activities would be conducted in compliance with Oregon and California regulations related to fugitive dust emissions. In addition, any fugitive dust emissions would be short-term and temporary and would not have long-term effects related to visibility. **Impacts related to visibility would be less than significant.**

#### **Keno Transfer**

The effects of the Keno Transfer would be the same as those for the Proposed Action.

#### **East and West Side Facility Decommissioning**

The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action.

#### **KBRA**

The effects of implementing the KBRA would be the same as those described in the Proposed Action.

#### **Alternative 4: Fish Passage at Four Dams Alternative**

The Fish Passage at Four Dams Alternative would not include removal of dams, but would instead include construction of fish passages. Under this alternative, fugitive dust emissions would be caused by movement of construction equipment on the soil and internal haul roads, but not by cut/fill activities, which would not occur.

*Vehicle exhaust and fugitive dust emissions from construction of fish passage could increase emissions of VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.* Table 3.9-5 is a summary of predicted uncontrolled peak daily and annual emission rates for VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> for the Fish Passage at Four Dams Alternative. As Table 3.9-5 shows, maximum daily emissions for all pollutants would not exceed the thresholds of significance. **The**

**impact on air quality from emissions of VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> at the Four Facilities would be a less than significant impact.**

**Table 3.9-5. Uncontrolled Emissions Inventories for the Fish Passage at Four Dams Alternative**

Location	Peak Daily Emissions (pounds per day)					
	VOC	CO	NO <sub>x</sub>	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub> <sup>1</sup>
Iron Gate	11	63	59	<1	8	3
Copco 1	10	58	45	<1	5	2
Copco 2	10	58	50	<1	5	2
J.C. Boyle	9	16	50	4	11	6
Maximum <sup>2</sup>	11	63	59	4	11	6
Significance Criterion <sup>3</sup>	250	2,500	250	250	250	250
	Annual Emissions (tons per year)					
Iron Gate (2023)	2	10	5	<1	2	1
Copco 1 (2025)	1	7	3	<1	2	<1
Copco 2 (2024)	1	4	1	<1	1	<1
J.C. Boyle (2022)	<1	<1	2	<1	1	<1
Total (2022-2025)	4	22	11	<1	6	1
Maximum	2	10	5	<1	2	1
De Minimis Threshold <sup>4</sup>	n/a	100	100	100	100	100

Notes:

- <sup>1</sup> Where emission factors were only provided for PM<sub>10</sub>, appropriate PM size profiles were used to estimate PM<sub>2.5</sub> emissions. Appendix M includes detailed calculation tables.
- <sup>2</sup> Since demolition activities for each dam site occurs during different years and do not overlap, the maximum daily emissions from each dam site are used to evaluate significance.
- <sup>3</sup> Based on Siskiyou County Air Pollution Control District Rule 6.1 permitting thresholds.
- <sup>4</sup> General conformity de minimis thresholds from 40 CFR 93.153.

Key:

- VOC = volatile organic compounds
- CO = carbon monoxide
- NO<sub>x</sub> = nitrogen oxides
- SO<sub>2</sub> = sulfur dioxide
- PM<sub>10</sub> = inhalable particulate matter
- PM<sub>2.5</sub> = fine particulate matter

*Vehicle exhaust and fugitive dust emissions from dam removal activities could exceed the de minimis thresholds in 40 CFR 93.153 that would require the development of a general conformity determination. Emissions from trucks and employee commuting could occur within the Klamath Falls UGB, the Klamath Falls Nonattainment Area (PM<sub>2.5</sub>), or the Medford-Ashland AQMA; therefore, emissions that would occur within these areas are subject to the requirements of general conformity. If the total of direct and indirect emissions are below the general conformity de minimis thresholds in 40 CFR 93.153, then no further action is needed and a general conformity determination is not required.*

While only emissions that would occur within the designated nonattainment or maintenance areas would be subject to general conformity, it is not possible to separate

those emissions from the project total. As a result, total emissions from haul trucks and employee commuting was compared to the general conformity de minimis thresholds as a conservative analysis. Emissions from trucks and employee commuting are less than the general conformity de minimis thresholds identified in Section 3.9.2.1 (see Table 3.9-5) and therefore a conformity determination is not necessary for any of the maintenance or nonattainment areas. **As a result, a general conformity determination is not required.**

*Fugitive dust emissions from construction activities could impair visibility in Federal Class I areas.* Construction activities would be conducted in compliance with Oregon and California regulations related to fugitive dust emissions. In addition, any fugitive dust emissions would be short-term and temporary and would not have long-term effects related to visibility. **Impacts related to visibility would be less than significant.**

#### **Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.* Potential operational emissions could occur from haul trucks moving fish around Keno Impoundment and Link River. Upstream-migrating fish would be collected downstream from Keno Dam and relocated upstream from Link River Dam. Downstream-migrating fish would be collected at Link River Dam (and the East Side and West Side canals) and relocated downstream from Keno Dam. Seasonal trap and haul operations would occur during periods of poor water quality in Keno Impoundment. **Although the exact extent and timing of these hauling activities is not known, it is assumed that air quality impacts from the trap and haul measures would be significant because of the long haul distance that is expected. Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce the severity of these effects to a less than significant level.**

#### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative**

The Fish Passage at Two Dams Alternative would include removal of Copco 1 and Iron Gate Dams, but would leave Copco 2 and J.C. Boyle Dams in place with newly constructed fish passages. This alternative would essentially be a combination of the Proposed Action (Full Facilities Removal) and the Fish Passage at Four Dams Alternative, with similar emissions sources.

*Vehicle exhaust and fugitive dust emissions could increase emissions of VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.* Table 3.9-6 is a summary of predicted uncontrolled peak daily and annual emission rates for VOC, NO<sub>x</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> for the Fish Passage at Four Dams Alternative. The Iron Gate Fish Hatchery would be operated for eight years after the dam removal, but the hatchery would not be rebuilt or relocated. While additional water may be routed to the hatchery to support its operation, an increase in emissions would not occur. Operational emissions were therefore not estimated for the hatchery. As Table 3.9-6 shows, total emissions of NO<sub>x</sub> and PM<sub>10</sub> would exceed the significance criterion for the four sites.

**Table 3.9-6. Uncontrolled Emissions Inventories for the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative**

Location	Peak Daily Emissions (pounds per day) <sup>1</sup>					
	VOC	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub> <sup>2</sup>
Iron Gate	67	282	<b>345</b>	2	209	49
Copco 1	28	179	129	1	173	165
Copco 2	12	61	82	<1	6	4
J.C. Boyle	10	32	63	4	11	7
Grand Total	117	552	<b>620</b>	7	<b>399</b>	225
California Total <sup>3</sup>	107	521	<b>557</b>	3	<b>388</b>	218
Oregon Total	10	32	63	4	11	7
Significance Criterion <sup>4</sup>	250	2,500	250	250	250	250
<b>Annual Emissions (tons per year) – 2020</b>						
Iron Gate	3	12	14	<1	10	2
Copco 1	1	7	5	<1	8	7
Copco 2	<1	1	1	<1	<1	<1
J.C. Boyle	<1	1	2	<1	<1	<1
Total (2020)	4	20	22	<1	18	10
California Total	4	19	20	<1	17	10
Oregon Total	<1	1	2	<1	<1	<1
De Minimis Threshold <sup>5</sup>	n/a	100	100	100	100	100

Notes:

<sup>1</sup> Values shown in **bold** are significant.

<sup>2</sup> Where emission factors were only provided for PM<sub>10</sub>, appropriate PM size profiles were used to estimate PM<sub>2.5</sub> emissions. Appendix M includes detailed calculation tables.

<sup>3</sup> California total includes emissions for activities at Iron Gate, Copco 1, and Copco 2 Dams.

<sup>4</sup> Based on Siskiyou County Air Pollution Control District Rule 6.1 permitting thresholds.

<sup>5</sup> General conformity de minimis thresholds from 40 CFR 93.153.

Key:

- VOC = volatile organic compounds
- CO = carbon monoxide
- NOx = nitrogen oxides
- SO<sub>2</sub> = sulfur dioxide
- PM<sub>10</sub> = inhalable particulate matter
- PM<sub>2.5</sub> = fine particulate matter

Demolition of Copco 1 Dam could generate concrete dust, which has a high pH. Dust control measures as described in mitigation measure AQ-4 would be used to control concrete dust to the maximum extent feasible. Management of the high pH content is discussed further in Section 3.5, Terrestrial Resources. **The impact on air quality from emissions of NOx and PM<sub>10</sub> from construction work at the Four Facilities would be a significant impact. Implementation of mitigation measures AQ-1 through AQ-4 would reduce emissions to a less than significant level.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short-term and temporary*

*increases in vehicle exhaust and fugitive dust emissions.* Air quality impacts associated with the Yreka water supply pipeline would be the same as those described for the Proposed Action. **The impact on air quality from the construction of the Yreka water supply pipeline would be less than significant.**

*Restoration actions could result in short-term and temporary increases in vehicle exhaust and fugitive dust emissions from the use of helicopters, trucks, and barges.* Air quality impacts related to restoration activities would be similar to those described for the Proposed Action but would only occur near the Iron Gate and Copco 1 Dam sites.

**Helicopters, trucks, and barges from restoration actions would cause a temporary significant air quality impact and would increase the significant air quality impacts generated by dam deconstruction in and around the dam sites. Available mitigation measures, including AQ-1 through AQ-3, are not expected to reduce emissions to less than significant levels; therefore, emissions would remain significant and unavoidable.**

*Relocation and demolition of various recreation facilities could result in short-term and temporary increases in vehicle exhaust and fugitive dust emissions.* Recreation facilities near J.C. Boyle Reservoir would stay intact, and the Copco 2 area does not have any developed recreation facilities. Recreation facilities at Iron Gate and Copco 1 would be removed. As with the Proposed Action, the amount of equipment expected to be used simultaneously is expected to be minimal; therefore, peak daily emissions are not expected to exceed the significance criteria described previously. **The impact on air quality from the relocation and demolition of the various recreation facilities would be less than significant.**

*Vehicle exhaust and fugitive dust emissions from dam removal activities could exceed the de minimis thresholds in 40 CFR 93.153 that would require the development of a general conformity determination.* Emissions from trucks and employee commuting could occur within the Klamath Falls UGB, the Klamath Falls Nonattainment Area (PM<sub>2.5</sub>), or the Medford-Ashland AQMA; therefore, emissions that would occur within these areas are subject to the requirements of general conformity. If the total of direct and indirect emissions are below the general conformity de minimis thresholds in 40 CFR 93.153, then no further action is needed and a general conformity determination is not required.

While only emissions that would occur within the designated nonattainment or maintenance areas would be subject to general conformity, it is not possible to separate those emissions from the project total. As a result, total emissions from haul trucks and employee commuting was compared to the general conformity de minimis thresholds as a conservative analysis. Emissions from trucks and employee commuting are less than the general conformity de minimis thresholds identified in Section 3.9.2.1 (see Table 3.9-6) and therefore a conformity determination is not necessary for any of the maintenance or nonattainment areas. **As a result, a general conformity determination is not required.**

*Fugitive dust emissions from construction and demolition activities could impair visibility in Federal Class I areas.* Construction and demolition activities would be conducted in

compliance with Oregon and California regulations related to fugitive dust emissions. In addition, any fugitive dust emissions would be short-term and temporary and would not have long-term effects related to visibility. **Impacts related to visibility would be less than significant.**

***Trap and Haul – Programmatic Measure***

*Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.* The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. **Although the exact extent and timing of these hauling activities is not known, it is assumed that air quality impacts from the trap and haul measures would be significant because of the long haul distance that is expected. Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce the severity of these effects to a less than significant level.**

**3.9.4.4 Mitigation Measures**

**Mitigation Measure by Consequence Summary**

AQ-1 – Any off-road construction equipment (e.g., loaders, excavators, etc.) must be equipped with engines that meet the model year (MY) 2015 emission standards for off-road compression-ignition (diesel) engines (13 CCR 2420-2425.1). Older model year engines may also be used if they are retrofit with control devices to reduce emissions to the applicable emission standards.

AQ-2 – Any on-road construction equipment (e.g., pick-up trucks at the construction sites) must be equipped with engines that meet the MY 2000 or on-road emission standards.

AQ-3 – Any trucks used to transport materials to or from the construction sites must be equipped with engines that meet the MY 2010 or later emission standards for on-road heavy-duty engines and vehicles (13 CCR 1956.8). Older model engines may also be used if they are retrofit with control devices to reduce emissions to the applicable emission standards.

AQ-4 – Dust control measures will be incorporated to the maximum extent feasible during blasting operations at Copco 1 Dam. The following control measures will be used during blasting activities:

- Conduct blasting on calm days to the extent feasible. Wind direction with respect to nearby residences must be considered.
- Design blast stemming to minimize dust and to control fly rock.
- Install wind fence for control of windblown dust

**Effectiveness of Mitigation in Reducing Consequence**

Implementation of the various engine control measures (AQ-1, AQ-2, AQ-3, and AQ-4) would substantially reduce NOx and PM<sub>10</sub> emissions; however, the extent of the reduction would vary based on the size (horsepower), age, and type of equipment<sup>4</sup>. Controlling emissions from equipment operating on the construction site, including both off-road construction equipment (AQ-1) and on-road pick-up trucks (AQ-2), would reduce NOx and PM<sub>10</sub> emissions by over 80 percent each. Controlling emissions from on-road heavy-duty diesel trucks could also reduce NOx emissions by approximately 20 percent or more. The effectiveness of AQ-4 cannot be quantified, but the mitigation would minimize PM<sub>10</sub> and PM<sub>2.5</sub> emissions that would occur during blasting operations at Copco 1. Table 3.9-7 summarizes the expected emissions after mitigation.

**Table 3.9-7. Summary of Mitigated Emissions by Alternative**

Alternative <sup>1</sup>	Peak Daily Emissions (pounds/day)					
	VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>
Full Facilities Removal	66	405	146	3	<b>309</b>	74
Partial Facilities Removal	64	394	137	3	<b>294</b>	60
Fish Passage at Two Dams	54	372	156	3	209	44
Significance Criterion <sup>2</sup>	250	2,500	250	250	250	250

Notes:

<sup>1</sup> Alternative 4 (Fish Passage at Four Dams) not shown in Table because mitigation was not required.

<sup>2</sup> Based on Siskiyou County Air Pollution Control District Rule 6.1 permitting thresholds.

Key:

- VOC = volatile organic compounds
- CO = carbon monoxide
- NOx = nitrogen oxides
- SO<sub>2</sub> = sulfur dioxide
- PM<sub>10</sub> = inhalable particulate matter
- PM<sub>2.5</sub> = fine particulate matter

**Agency Responsible for Mitigation Implementation**

The Dam Removal Entity would be responsible for implementing mitigation measures AQ-1 through AQ-3.

**Remaining Significant Impacts**

Following implementation of the mitigation measures specified for a given alternative, PM<sub>10</sub> emissions would remain significant and unavoidable for the Proposed Action and the Partial Facilities Removal Alternative.

<sup>4</sup> The vehicular emission factor models used in this analysis, specifically EMFAC2007 for on-road emissions and OFFROAD2007 for off-road emissions in California, assume a specific fleet mix of vehicles. For example, by default, EMFAC2007 contains emission factors and vehicle activity data for model years 1965 through 2040 for each vehicle class. When the model is run for a specific calendar year, then it makes assumptions about the percentage of vehicles for each model year, fuel type, and vehicle class would be operating. As a result, the default model assumptions would contain a mix of vehicles from model year 1965 to 2020 (year of construction).

### **Mitigation Measures Associated with Other Resource Areas**

*Transporting fish and mollusks under Mitigation Measures AR-1, 2, 5-7 could cause temporary increases in criteria pollutants.* These mitigation measures would involve trap and haul of fish and mollusks to protect them from the reservoir drawdown and dam demolition activities. It is anticipated that as many as 150 truck trips would be required to transport juveniles from areas downstream of Iron Gate Dam to the confluence of the Klamath and Trinity Rivers between February and April 2020. The increase in daily truck trips would be minor (approximately 2 trips per day) and would not contribute substantially to the existing emissions. **The air quality impacts associated with these mitigation measures would be less than significant.**

*Construction activities associated with Mitigation Measure TR-1 could cause a temporary increase in vehicle exhaust and fugitive dust emissions.* Relocation of Jenny Creek Bridge and culverts near Iron Gate Reservoir would occur before the other construction phases of dam removal. On- and off-road construction equipment would be used to complete the necessary construction, but would be minor compared to the dam demolition emissions. **Air quality impacts associated with Mitigation Measure TR-1 would be less than significant.**

*Several other mitigation measures may require construction, including Mitigation Measure H-2 (move or elevate structures with flood risk), GW-1 (deepen or replace wells), REC-1 (replacement of recreational facilities), and WRWS-1 (modify water intakes).* These measures could produce temporary impacts on air quality during construction activities within localized areas. These activities would take place before or after the primary construction and deconstruction activities associated with the Proposed Action and action alternatives. The same or similar elements as for the Proposed Action and action alternatives would be incorporated into these construction activities to avoid or reduce impacts on air quality. **Mitigation Measures AQ-1 through AQ-3 would be implemented, as necessary, to avoid or reduce impacts as under the Proposed Action. Therefore, impacts on air quality from the implementation of H02, GW-1, REC-1, and WRWS-1 would be less than significant.**

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## **3.10 Greenhouse Gases/Global Climate Change**

This section discusses potential greenhouse gas (GHG) and global climate change impacts from the Proposed Action and alternatives. The analysis related to climate change was organized into two distinct categories: 1) issues related how climate change would affect the Proposed Action, and 2) issues related to the quantification of GHG emissions. This section describes the affected environment/environmental setting, analysis methods, significance criteria, and impacts for each of the alternatives. Appendix N provides detailed GHG emission calculations.

### **3.10.1 Area of Analysis**

The area of analysis is the Klamath Basin, which includes multiple counties in northern California and southern Oregon. A quantitative analysis of GHG emissions associated with implementation of the Klamath Hydroelectric Settlement Agreement (KHSAs) was restricted to Siskiyou and Shasta Counties in California and Klamath and Jackson Counties in Oregon. This area was defined to encompass GHG emissions associated with dam removal activities and construction-related vehicle trips (e.g., trucks and construction worker commuting).

A qualitative analysis of GHG impacts was completed for the aforementioned counties, as well as Del Norte, Humboldt, Modoc, and Trinity Counties in California and Curry County in Oregon. These counties would encompass areas affected hydrologically by implementation of the KHSAs and the Klamath Basin Restoration Agreement (KBRA). In other words, regions that could be affected by the effects of climate change, such as increased temperature, changes in precipitation, and reduced snowpack, were evaluated.

Although project-related emissions are restricted to the area of analysis described above, data on the existing GHG emissions are only available at the state-level for California and Oregon (California Air Resources Board [CARB] 2009; Oregon 2010). The climate change analysis is based on global circulation models that typically do not have resolutions finer than the region or state. As a result, it was necessary to use a larger region than that included the area of analysis to establish existing conditions.

### **3.10.2 Regulatory Framework**

Greenhouse gas and global climate change are governed by several federal and state laws and policies, which are listed below.

#### **3.10.2.1 Federal Authorities and Regulations**

- Department of the Interior Secretarial Order No. 3289
- Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule (75 FR 31514)

### **3.10.2.2 State Authorities and Regulations**

- California Executive Order S-3-05
- California Executive Order S-13-8
- California Executive Order S-14-08
- California Executive Order S-21-9
- California Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32)
- California Renewable Energy Resources Act (Senate Bill 2, First Extraordinary Session [SBX1 2])
- California Environmental Quality Act (CEQA) Guidelines (14 CCR §15064)
- Oregon House Bill 3543

### **3.10.3 Existing Conditions/Affected Environment**

Data generated from global circulation models are used to project changes to climate. Climate change projections are based on varying global circulation models and emissions scenarios documented in reports, as described below. Because each report is based on different models and scenarios, each has varying levels of uncertainty associated with the projected changes. For this analysis, the ranges of projected changes published in each report are presented. In addition, the models used for each report were conducted at different scales (regional, state or local), as indicated in the descriptions below.

- **The United States Global Change Research Program (USGCRP)<sup>1</sup> climate impact analyses (USGCRP 2009):** The foundation for the USGCRP report is a set of 21 Synthesis and Assessment Products, as well as other peer-reviewed scientific assessments, including those of the Intergovernmental Panel on Climate Change (IPCC), the United States Climate Change Science Program, the United States National Assessment of the Consequences of Climate Variability and Change, the Arctic Climate Impact Assessment, the National Research Council's Transportation Research Board report on the Potential Impacts of Climate Change on United States Transportation, and a variety of regional climate impact assessments (USGCRP 2009). The scale of the USGCRP results is for the Northwest.
- **The Oregon Climate Assessment Report by the Oregon Climate Change Research Institute (OCCRI) (OCCRI 2010):** The Oregon Climate Assessment Report draws on research on climate change impacts in the western United States from the Climate Impacts Group at the University of Washington and the California Climate Action Team (OCCRI 2010). The scale for the OCCRI results is for the state of Oregon.

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<sup>1</sup> United States Global Change Research Program is a consortium of 13 federal departments and agencies authorized by Congress in 1989 through the Global Change Research Act (P.L. 101-606). The USGCRP coordinates and integrates federal research on changes in the global environment and their implications for society.

- **The regional climate change effects synthesized by the Federal Highway Administration (FHWA 2010):** The FHWA report is based on the USGCRP report and the supporting database (CMIP3), as well as publicly available publications and literature on model results. In addition, FHWA high-resolution temperature and precipitation projections for the continental United States developed through statistical downscaling of the results of 16 climate models of the CMIP3 database were provided for low and moderately high emission scenarios for three future projections, including near-term, mid-century, and end-of-century. The scale of the FHWA results is for the Northwest.
- **Impacts to the Klamath Basin prepared by the National Center for Conservation Science and Policy; and the Climate Leadership Initiative (Barr et al. 2010):** For the Klamath Basin by the National Center for Conservation Science and Policy and the Climate Leadership Initiative, three global climate models—CSIRO, MIROC, and HADCM—and a vegetation model (MC1) predicted future temperature, precipitation, vegetation, runoff, and wildfire in the Klamath Basin (Barr et al. 2010). The scale of the results for this report is for the Klamath Basin.
- **Hydrologic, hydraulic, and sediment transport studies conducted by The Reclamation Technical Service Center, upon request of the Reclamation Mid-Pacific Regional Office to support the Secretarial Determination on Klamath Dam Removal and Basin Restoration (Bureau of Reclamation [Reclamation] 2010):** For the hydrologic, hydraulic, and sediment transport studies conducted by the Reclamation Technical Service Center, five different future climate scenarios were simulated. The scenarios were chosen to bracket the range of results predicted by global circulation models. Four scenarios correspond to combinations of the 25<sup>th</sup> and 75<sup>th</sup> quantiles of the precipitation and temperature predicted by the global circulation models for the Upper and Lower Klamath Basins. The fifth is the 50<sup>th</sup> quantile of the precipitation and temperature. The precipitation and temperature predicted by the global circulation models were downscaled to the Upper and Lower Klamath Basin. See Section 3.6, Flood Hydrology.

### **Summary**

The projected changes in climate conditions are expected to result in a wide variety of effects in the Pacific Northwest<sup>2</sup> and the Klamath Basin with regard to the Proposed Action and the alternatives. The most relevant consequences related to the Proposed Action include changes to stream flow, temperature, precipitation, groundwater, vegetation changes, and flow. In general, climate model predictions include:

- Increased average ambient air and water temperature
- Increased number of extreme heat days

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<sup>2</sup> The Pacific Northwest is defined by the USGCRP as Washington, Oregon, Idaho, and western Montana. Although the USGCRP "Pacific Northwest" region does not include California, it has the climate most representative of the Klamath Basin. The USGCRP region that contains California is the "Southwest" climate region, which includes California, Nevada, Arizona, Utah, and parts of New Mexico, Colorado, and Texas. The Southwest data represents the desert climates, which is not applicable to the Klamath Basin.

- Changes to annual and seasonal precipitation, including increased frequency and length of drought, less winter snow and more winter rain, and changes in water quality
- Increased heavy precipitation
- Reduced snow pack
- Vegetation changes
- Groundwater hydrology changes
- Changes to annual stream flow

These projected changes are discussed in detail in the following paragraphs. The potential impacts related to the Proposed Action are discussed in Section 3.10.4.3 - Effects Determination.

**Increased Temperature**

Future regional average annual air temperatures in Oregon are projected to increase by 0.2 to 1°F per decade depending on future GHG emissions, as compared to temperatures in the 20<sup>th</sup> century (OCCRI 2010). Projected temperature increases for the Pacific Northwest and the Klamath Basin are presented in Table 3.10-1.

**Table 3.10-1. Projected Changes in Air Temperature under Existing Conditions**

Region	Next Two Decades	Mid-21 <sup>st</sup> Century	End of 21 <sup>st</sup> Century
Pacific Northwest	+3.0 °F	+3.6 to 5.0 °F	+5.1 to 8.3 °F
Klamath Basin	---	+2.1 to 3.6 °F	+4.6 to 7.2 °F

*Source: United States Global Change Research Program 2009, Barr et al. 2010*

Baseline conditions for the Pacific Northwest are based on data from 1961 to 1979 (USGCRP 2009). Baseline conditions for the Klamath Basin are based on data from 1961 to 1990 (Barr et al. 2010).

In addition, the results of the hydraulic, hydrologic and sediment studies conducted to support this document show an average temperature increase of 2.5 to 4.0 °F in the Upper Klamath Basin between 2020 and 2069, as compared to temperatures during the period 1950 –1999 (Reclamation 2010).

Increased temperature may result in a variety of general consequences for the Pacific Northwest and the Klamath Basin:

- Increased evaporation rates (USGCRP 2009).
- Increased incidence of wildfire (OCCRI 2010).
- Increased occurrence of short-term and long-term drought conditions (USGCRP 2009).
- Changing water quality of natural surficial water bodies, including higher water temperatures, decreased and fluctuating dissolved oxygen content (Barr et. al 2010), and increased cycling of detritus.

- Earlier, longer, and more intense algae blooms (Barr et al. 2010).
- Changes to soil moisture (USGCRP 2009), which may lead to soil subsidence under structures.
- Increased energy demand for cooling, refrigeration and water transport (Barr et al. 2010; USGCRP 2009).
- Buckling of pavement or concrete structures (USGCRP 2009).
- Decreased lifecycle of equipment or increased frequency of equipment failure (USGCRP 2009).
- Increased frequency of freeze-thaw cycles in winter months (USGCRP 2009).
- Changes to salmon populations due to increased water temperatures and other water quality changes (USGCRP 2009).
- Drought stresses and higher temperatures that could decrease tree growth and change habitat in most low- and mid-elevation forests (Barr et al. 2010).
- Warmer winters and longer growing seasons that may increase the frequency and intensity of insect attacks, such as those of the mountain pine beetle (Barr et al. 2010).
- Disruption of the coordination between predator-prey or plant-pollinator life cycles that may lead to declining populations of many native species (Barr et al. 2010).
- Increased water temperature (Barr et al. 2010).

As discussed in Section 3.3, Aquatic Resources, high water temperatures are detrimental to anadromous species when eggs or juveniles are present. High water temperatures have also been associated with fish kills in the Klamath River downstream of Iron Gate Dam.

#### **Increased Number of Extreme Heat Days**

By mid-century, heat events are projected to increase in the Pacific Northwest (FHWA 2010). By mid-century, the Pacific Northwest could experience an additional one to three heat waves annually (i.e., three or more days with the daily heat index exceeding 90°F), with other locations experiencing up to one additional heat wave each year under a moderate emission scenario (Salathe et al. 2009).

Increases in the number of extreme heat days may result in declining air quality due to increased ozone concentrations and increased incidence of heat-related illness and death.

#### **Annual Precipitation**

Over the next century, mean precipitation is projected to change gradually from existing precipitation averages. By mid-century (2035-45), the annual precipitation projections in the Klamath Basin exhibit a large range, from an 11 percent reduction to a 24 percent increase overall (Barr et al. 2010). Baseline conditions for the Klamath Basin are based on data from 1961 to 1990 (Barr et al. 2010).

The results of the hydraulic, hydrologic and sediment studies conducted to support this document show a change in total precipitation under the climate change scenarios ranging from five percent less to five percent greater precipitation between 2020 and 2069, as compared to precipitation during the period 1950 – 1999 (Reclamation 2010).

Precipitation changes associated with climate change are complicated by the El Niño Southern Oscillation (ENSO). ENSO produces a cool, dry winter in the Klamath Basin and has cycles of 2–7 years of building and declining precipitation (Independent Science Advisory Board 2007). Climate change could affect the frequency or severity of ENSO events, which would change precipitation patterns in the Klamath Basin (Kiparsky and Gleick 2003). In addition, the Klamath Basin is at the southern edge of a low pressure cell during ENSO events, with the primary effect being a shift of storms southward towards southern California (National Oceanic and Atmospheric Administration Fisheries Service [NOAA Fisheries] 2008). Climate change could move the low pressure area northward, which could change the types of ENSO effects within the basin from producing a drier winter to producing more intense winter storms.

**Changes to Seasonal Precipitation**

While only a slight increase in precipitation (defined as annual total precipitation divided by the number of “wet” days where precipitation exceeds 1 millimeter per day) is projected for the Pacific Northwest (Salathe et al. 2009), changes in seasonal precipitation, including winter rain replacing winter snow, are projected to result in earlier and higher spring stream flows and lower late summer stream flows (USGCRP 2009; Barr et al. 2010). Table 3.10-2 summarizes projected seasonal changes in precipitation for the Pacific Northwest and the Klamath Basin.

**Table 3.10-2. Projected Seasonal Changes in Precipitation**

Region	Season	Next Two Decades	Mid-21 <sup>st</sup> Century	End of 21 <sup>st</sup> Century
Pacific Northwest	Winter	+3 to +5%	+5 to +7%	+8 to +15%
	Spring	+3%	+3 to +5%	+5 to +7%
	Summer	-6%	-8 to -17%	-11 to -22%
	Fall	+3 to +5%	+5%	+7 to +9%
Klamath Basin	Summer	---	-15 to -23%	-3 to -37%
	Winter	---	+1 to +10%	-5 to +27%
	Annual	---	-9 to +2%	-11 to +24%

*Source: United States Global Change Research Program 2009, Barr et al. 2010*

Baseline conditions for the Pacific Northwest are based on data from 1961 to 1979 (USGCRP 2009). Baseline conditions for the Klamath Basin are based on data from 1961 to 1990 (Barr et al. 2010).

Summer months in the Klamath Basin are projected to have precipitation decreases ranging from 15 to 23 percent from historic baseline (1961-1990) (Barr et al. 2010). However, less than 12 percent of the average annual precipitation in the Klamath Basin falls from June-August (Western Regional Climate Center 2010), so the effect on average actual summer precipitation would be small (less than 0.2 inches). In the Upper Klamath Basin, dry-season (April to September) and summer (July to September) stream flow

have already declined 16 percent and 38 percent, respectively, during the period between 1961-2009 (Mayer and Naman 2011).

Changes to seasonal precipitation may result in a variety of general consequences for the Pacific Northwest and Klamath Basin, which are listed below.

- Shifting stream flow patterns, including higher and earlier peak spring flows and lower late summer flows may alter the timing of fish migration (Barr et al. 2010).
- Decreased summer water supply (OCCRI 2010).
- Increased fine sediment in streams may result in negative impacts on the spawning of native fish that build their nests in the areas of clean rocks and gravel (Barr et al. 2010).
- Cessation of flow from springs fed by groundwater may reduce the amount of refuge that these areas provide for fish survival (Barr et al. 2010).
- More variable flow from smaller groundwater springs may occur, with potential disappearance in the driest years (Barr et al. 2010).
- Increased frequency and severity of flooding may occur (USGCRP 2009).
- Increased runoff may lead to surface water quality changes, including increased turbidity, increased organic content, color changes, and alkalinity changes (Barr et al. 2010).

#### **Increase in Heavy Precipitation**

Projections show that by mid-century, heavy precipitation, defined as annual total precipitation divided by the number of “wet” days where precipitation exceeds one millimeter per day, would increase slightly in the Pacific Northwest (FHWA 2010). The fraction of precipitation that falls on days where precipitation exceeds the 95<sup>th</sup> percentile was projected to decrease along the leeward side of the Cascade Mountains (Salathe et al. 2009). The characteristics along the leeward side of the Cascade Mountains are comparable to the Klamath Basin. Diffenbaugh (2005) projected an increase of up to 10 extreme precipitation events per year in the Pacific Northwest (up to a 140 percent increase) under a higher emission scenario with some variation depending on location within the region.

Increases in heavy precipitation may result in a variety of general consequences for the Pacific Northwest:

- Increased fine sediment in streams may result in negative effects on the spawning of native fish that build their nests in the areas of clean rocks and gravel (Barr et al. 2010).
- Increased frequency and severity of flooding may occur (USGCRP 2009).
- Increased runoff may lead to surface water quality changes including increased turbidity, increased organic content, color changes, and alkalinity changes (Barr et al. 2010).

### **Reduced Snowpack**

By the 2040s, April 1<sup>st</sup> snowpack is projected to decline by as much as 40 percent in the Cascade Mountains (Payne et al. 2004) and between 37 percent and 65 percent in the Klamath Basin (Hayhoe et al. 2004). Cascade snowpack is projected to be less than half of what it was in the 20<sup>th</sup> century, with lower elevation snowpack being most vulnerable (OCCRI 2010). Projections show that by mid-century, warm-season runoff will decrease by 30 percent or more on the western slopes of the Cascade Mountains and by 10 percent in the Rocky Mountains (USGCRP 2009). By the end of the century, snowpack is projected to decline by 73 percent to 90 percent (Hayhoe et al. 2004).

Similarly, the results of the hydraulic, hydrologic and sediment studies conducted to support the Secretarial Determination on the Klamath Dam Removal and Basin Restoration show a more rapid snow melt for all climate change simulations.

Reduced snowpack may result in a variety of general consequences for the Pacific Northwest, including increased incidence of short- and long-term drought and limited inundation periods for side channels, which serve as nurseries for young fish and other aquatic animals (Barr et al. 2010). Summer water supply will also decrease as a result of reduced snowpack (OCCRI 2010).

### **Groundwater Hydrology**

Projected increases in temperature and changes to seasonal precipitation will impact groundwater hydrology. Projected changes in groundwater hydrology include alterations of the timing and amount of recharge, increases in evapotranspiration, lowering of heads in boundaries such as streams, lakes, and adjacent aquifers, sea-level rise, and increased pumping demand, which will be exacerbated by population growth (OCCRI 2010). The high Cascade basins that are primarily fed by deep groundwater systems could sustain low flow during summer months (OCCRI 2010). Basins in the east of the Cascades are projected to have low summer flow in a distant future as groundwater recharge declines over time (OCCRI 2010).

Groundwater hydrology changes may result in a variety of general consequences for the Pacific Northwest and Klamath Basin, including the following:

- Decreased stream flows for rivers and streams that are primarily fed by groundwater supplies (Barr et al. 2010).
- Decreased availability of groundwater for agricultural use and water supply (USGCRP 2009).
- Reduced cool water refuge for aquatic animals due to the decline of springs fed by groundwater and the cessation and increased variability of flow to smaller springs (Barr et al. 2010).

### **Vegetation Changes**

Conditions in the Upper Klamath Basin are projected to favor grasslands in areas that are currently suitable for sagebrush and juniper (Barr et al. 2010). In the Lower Klamath Basin, conditions suitable for oaks and madrone may expand while those suitable for

maritime conifer forest could decrease (Barr et al. 2010). The percentage of the Klamath Basin burned by wildfire is expected to increase from current levels by 11 percent to 22 percent per year by the end of the 21<sup>st</sup> century (Barr et al. 2010). In addition, decreased soil moisture and increased evapotranspiration may result in the loss of wetland and riparian habitats (Barr et al. 2010).

Vegetation changes may result in a variety of general consequences for the Pacific Northwest and Klamath Basin, including the following:

- Changes in water quality (e.g., sediment) from burn area runoff (Barr et al. 2010).
- Changes in the tree canopy that affect rainfall interception, evapotranspiration, and infiltration of precipitation, affecting the quantity of runoff (Barr et al. 2010).
- Changes in the shading over surface waters, which may affect surface water temperatures and other water quality characteristics (USGCRP 2009).
- Changes in wood and organic debris recruitment, which may affect water quality and channel morphology and complexity (Barr et al. 2010).
- Reduced ability to respond to flooding due to changes in wetland and riparian zone plant communities and hydraulic roughness (USGCRP 2009).
- Increased stress on species populations due to loss of wetland and riparian habitats (USGCRP 2009).
- Shifting distribution of plant and animal species on land, with some species becoming more or less abundant (OCCRI 2010).
- Rare or endangered species may become less abundant or extinct (OCCRI 2010).
- Insect pests and invasive species may become more abundant (OCCRI 2010).

### **Flow**

Future annual stream flow effects calculations based on projected precipitation amount and timing changes are particularly difficult to predict. Annual stream flows (the volume of flow in a year) were evaluated by comparing future model-estimated flows (based on runoff estimates from the three climate models) against actual stream flow measurements. Annual stream flows at the four stations evaluated (Iron Gate, Sprague River, Shasta River, and Salmon River) were “similar” to past records when comparing the frequency of “particularly” high and low flow events. The three models’ results vary regarding projections of higher or lower annual flows – two models projecting lower flows and one projecting higher annual flows as compared to current flows (Barr et al. 2010).

Similarly, the results of the hydraulic, hydrologic and sediment studies conducted to support this document show that the climate change scenarios are not sufficiently refined to determine effects to peak flows and therefore it is difficult to determine if climate change will have a significant impact on flood risk or geomorphology. However, if the future climate is wetter and with a faster snowmelt runoff during the spring, then peak flows would likely increase as well. However, if the climate is drier, faster snowmelt may result in peak flows that are not substantially higher (Reclamation 2010).

Though the model used to project future flows did not identify a consistent trend, it is known that free-flowing rivers respond better to changes in climate conditions due to the

ability to adjust to and absorb disturbances through flow adjustments that buffer against impacts (Palmer et al. 2008). A natural riverine system is in constant, dynamic equilibrium, absorbing highly variable flow forces by changing channel morphology and dissipating energy via sediment transport and woody debris. A natural river system is capable of using those “tools” to gradually adjust to flow regime changes due to climate-induced precipitation change. Consequently, the more physical changes the river system has been subjected to, such as changes in sediment budgets and flow regimes due to dams or land clearing, the less capable the system is of responding to or absorbing changed flow regime.

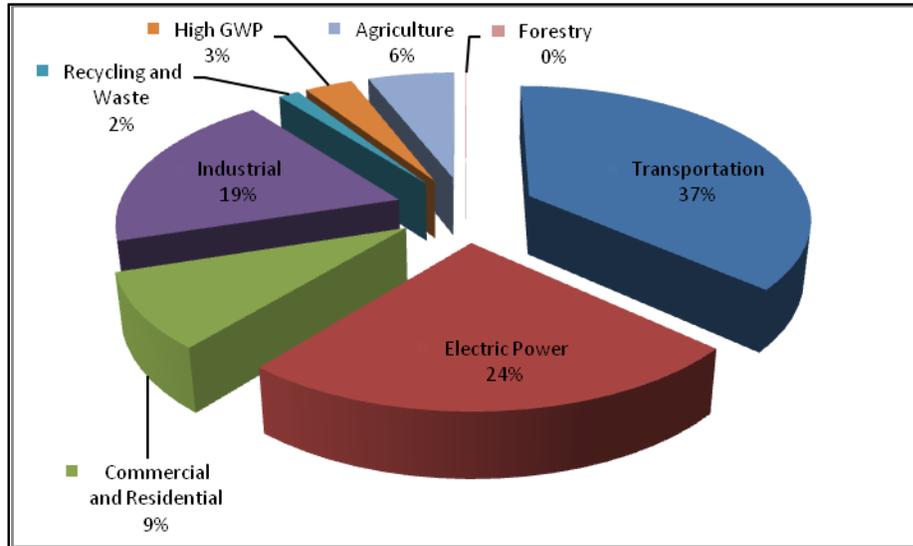
### ***Existing Conditions – Greenhouse Gases***

The GHG analysis completed for the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) evaluated the following three pollutants: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O). The other two pollutants commonly evaluated in various mandatory and voluntary reporting protocols, hydrofluorocarbons and perfluorocarbons, are not expected to be emitted in large quantities and are not discussed further in this section.

Worldwide, California<sup>3</sup> is the twelfth to sixteenth largest emitter of CO<sub>2</sub> (based on data source), and is responsible for approximately two percent of the world’s CO<sub>2</sub> emissions (California Energy Commission [CEC] 2006b). As shown in Figure 3.10-1, transportation is responsible for 37 percent of the State’s GHG emissions, followed by electricity generation (24 percent), the industrial sector (19 percent), commercial and residential (9 percent), agriculture and forestry (6 percent) and other sources (5 percent). Emissions of CO<sub>2</sub> and N<sub>2</sub>O are largely byproducts of fossil fuel combustion. Methane, a highly potent GHG, results largely from off-gassing associated with agricultural practices and landfills. Sinks of CO<sub>2</sub>, which are sources that absorb more CO<sub>2</sub> than release CO<sub>2</sub>, include uptake by vegetation and dissolution into the ocean. California GHG emissions in 2008 (the last year inventoried) totaled approximately 474 million metric tons CO<sub>2</sub> equivalent (MMTCO<sub>2</sub>e) (CARB 2009).

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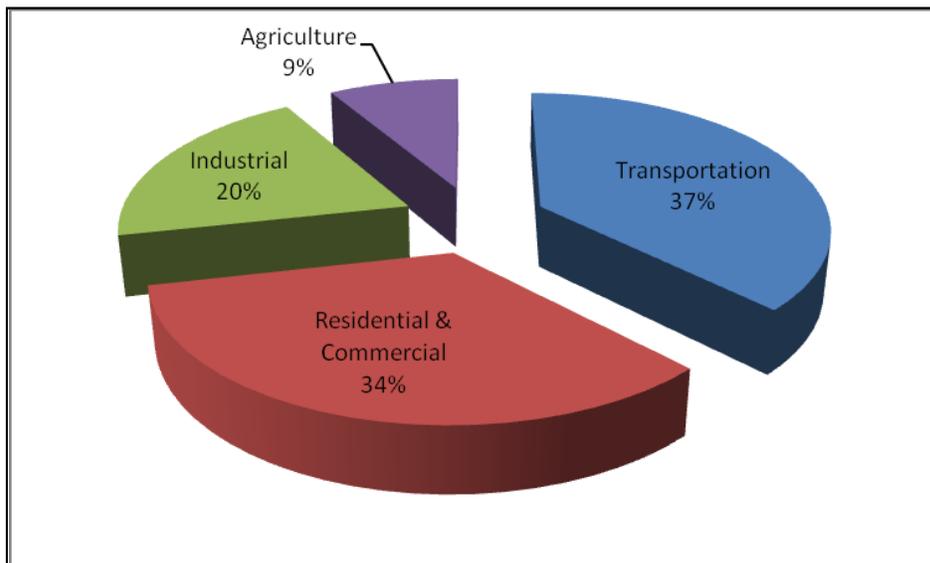
<sup>3</sup> Although the area of analysis for the project is restricted to portions of northern California and southern Oregon, GHG emissions data is not available at this level of detail; therefore, background emissions data (i.e., existing conditions) is presented at the state-level for both California and Oregon.



Source: California Air Resources Board 2009.

**Figure 3.10-1. California GHG Emission Sources (as of 2008)**

As shown in Figure 3.10-2, the distribution of emission sources in Oregon is similar to that in California, with the majority of emissions occurring from the transportation sector (37 percent), followed by the residential and commercial sector (34 percent), then by industrial sources (20 percent), and agriculture (9 percent). Oregon GHG emissions in 2007 (the last year inventoried) totaled approximately 68 MMTCO<sub>2</sub>e (Oregon 2010).



Source: Oregon 2010.

**Figure 3.10-2. Oregon GHG Emission Sources (as of 2007)**

### **3.10.4 Environmental Consequences**

By its very nature, climate change is a cumulative phenomenon, and it is not possible to link a single project to specific climatological changes. The Proposed Action and alternatives would result in temporary GHG emissions from construction-related activities. Total GHG emissions from deconstruction or construction activities at the three dams in California (Iron Gate, Copco 1, and Copco 2 Dams) would make up 0.0007 to 0.002 percent of statewide emissions, depending on the alternative. Emissions associated with activities at J.C. Boyle Dam in Oregon would make up 0.001 to 0.004 percent of statewide emissions, depending on the alternative.

#### **3.10.4.1 Environmental Effects Determination Methods**

The analysis related to climate change was organized into two distinct categories: 1) issues related to how climate change would affect the Proposed Action, and 2) issues related to the quantification of GHG emissions.

The quantification of GHG emissions was performed similarly to the one for the air quality (Section 3.9) analysis with a few exceptions. Project-related emissions were compared to applicable thresholds of significance to evaluate environmental impacts from GHG.

Direct GHG emissions include those associated with on- and off-site construction equipment, construction worker commuting, and haul truck emissions. Indirect GHG emissions include changes that could occur from alterations in land use, agricultural resources, and recreation from implementation of the KHSAs and KBRA. See Section 3.9, Air Quality, for additional detail relevant to the estimation of these emissions. In addition, consideration is provided in this section to the potential emissions associated with other power sources that may be used to replace the hydropower associated with the Four Facilities.

This analysis also evaluates how the GHG emissions resulting from the project might affect global climate change. GHG emissions are quantified or qualitatively described, as discussed above, for the changes associated with each project alternative, including land use changes and changes to recreational use.

#### **Climate Change**

The purpose of this climate change analysis is to determine how projected changes to climate conditions might affect the Proposed Action and alternatives. The Lead Agencies used the results of global climate models from leading institutions around the world, combined with publicly available, peer-reviewed studies, to identify the projected climate change effects and their consequences specific to the Pacific Northwest region and the Klamath Basin.

The main resources for identifying the project effects and general consequences were the USGCRP climate impact analyses (USGCRP 2009), the Oregon Climate Assessment Report by the OCCRI (OCCRI 2010), the regional climate change effects synthesized by the FHWA (FHWA 2010), the climate change impacts analysis prepared specifically for

the Klamath Basin by the National Center for Conservation Science and Policy; and the Climate Leadership Initiative (Barr et al. 2010). The 2009 California Climate Change Strategy also provided guidance for the analysis. For consequences specific to the project alternatives, publications by Palmer et al. (2008), Dinse et al. (2009), and Reclamation (2010) were used to evaluate the effect of dams on a natural system's ability to adjust to and absorb disturbances caused by potential changes in climate conditions.

#### **Greenhouse Gas Emissions Quantification**

Emissions of GHG were quantified using the same emission factor models identified in the air quality section (Section 3.9). Emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O were estimated for on- and off-site combustion sources, including mobile and stationary sources.

Each GHG contributes to climate change differently, as expressed by its global warming potential (GWP). GHG emissions are discussed in terms of carbon dioxide equivalent (CO<sub>2</sub>e) emissions, which express, for a given mixture of GHG, the amount of CO<sub>2</sub> that would have the same GWP over a specific timescale. CO<sub>2</sub>e is determined by multiplying the mass of each GHG by its GWP<sup>4</sup>. This analysis uses the GWP from the IPCC *Second Assessment Report* (IPCC 1996) for a 100-year time period to estimate CO<sub>2</sub>e. Although subsequent assessment reports have been published by the IPCC, the international standard, as reflected in various federal, state, and voluntary reporting programs, is to use GWPs from the *Second Assessment Report*.

GHG emissions were calculated for construction activities related to dam demolition and/or fish passage construction including heavy equipment use, hauling of demolition debris to landfill, as well as worker transportation.

If a United States Environmental Protection Agency (USEPA)-approved emissions factor model (e.g., EMFAC2007, MOBILE6.2, OFFROAD, or NONROAD) does not predict emissions of a particular pollutant, then emission factors were obtained, if possible, from the Federal Mandatory Reporting of Greenhouse Gases Rule (40 CFR Part 98).

The analysis provides a quantitative comparison between removing a renewable source of energy from the hydroelectric dams and estimated emissions that may result from use of an alternative power source, such as fossil fuels, biomass, or other renewable energy sources.

Both Oregon and California have Renewable Portfolio Standard (RPS) goals that seek to increase the amount of renewable energy resources used by certain utilities. The RPS goal for California is to have 33 percent of an electricity seller's load served with renewable power by 2020 (Executive Order S-14-08; and SBX1 2), while Oregon's RPS goal is for 25 percent of a utility's retail sales of electricity to be from renewable energy by 2025 (Senate Bill 838). PacifiCorp is currently on track to meet its Oregon RPS target, but is not expected to meet California's RPS target without the use of tradable renewable

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<sup>4</sup> As an example, CH<sub>4</sub> has a GWP of 21, as specified in the Intergovernmental Panel on Climate Change's *Second Assessment Report* (1996). One metric ton of CH<sub>4</sub> is equal to 21 metric tons of CO<sub>2</sub>e (1 metric ton x 21).

energy credits (PacifiCorp 2011). Since PacifiCorp is on a trajectory to increase its use of renewable energy, any modifications to the Four Facilities, either by demolition or power generation reductions, would decrease the amount of renewable power that PacifiCorp has in its portfolio. Although short-term effects could occur from modifications to the hydroelectric dams, these effects would be offset in the long-term because PacifiCorp would need to continue increasing its renewable energy share to meet the RPS goals in the two states.

#### **3.10.4.2 Significance Criteria**

At the present time, neither of the lead agencies has adopted significance thresholds for the analysis of GHG emissions. However, the CEQA Guidelines instructs:

“A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment:

1. The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting.
2. Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.
3. The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions.” (14 C.C.R. § 15064.4.)

In reference to factor number 1 stated above, the Klamath Facilities Removal Project would produce a temporary increase in direct GHG emissions by virtue of the construction and restoration activities, but once activities are complete, direct project emissions be reduced. With complete facilities removal, there would be no continuing operation or maintenance since the area occupied by the facilities would be returned to natural riverine and riparian setting. The partial facilities removal alternatives would still continue to have operation and maintenance emissions, but to a lesser degree than the No Action/No Project Alternative. Indirect GHG emissions would increase with the project as a result of replacing hydropower produced at the dams with power that is likely to be produced, at least in part, from fossil fuels through other regional sources.

As for factor number 2 (above) from the CEQA guidelines, the nature of the GHG emissions from the Klamath Facilities Removal Project differs from most projects considered highest priority for curbing emissions either on a statewide or regional basis. Typical emission sources considered for quantitative thresholds of significance involve construction and ongoing operational emissions from stationary industrial projects with high rates of combustion emissions (for example, refineries, power plants, other processing that utilizes industrial boilers) or the construction and increased power and transportation needs from newly constructed residential/commercial projects. In these cases ongoing emissions from combustion and transportation are likely to be cumulatively considerable.

For the Proposed Action and alternatives, there are no direct operational GHG emissions. Appreciable direct emissions would occur only for a limited time as a result of construction (dam deconstruction and/or fish passage construction) and restoration. However, the Proposed Action would indirectly produce ongoing GHG emissions through conversion from the electricity produced by the local hydropower facilities to regional power from a mixture of sources likely including GHG-emitting fossil fuels.

Currently, there are no adopted numerical thresholds of significance in California that are specifically applicable to the Klamath Facilities Removal Project. The South Coast Air Quality Management District (SCAQMD) and the Bay Area Air Quality Management District have adopted numerical CEQA thresholds of significance for industrial stationary source GHG emissions; both districts use a threshold of 10,000 MTCO<sub>2</sub>e per year (Bay Area Air Quality Management District 2011; SCAQMD 2008). Only the SCAQMD's threshold addresses construction emissions. SCAQMD amortizes construction emissions over a thirty-year period. The annual quantity is combined with a project's annual operational emissions and compared to the 10,000 MTCO<sub>2</sub>e per year threshold to determine significance.

Regarding the statewide plan for reducing GHG emissions for factor number 3 from the CEQA guidelines, a GHG impact could be considered significant if emissions from either the Proposed Action or the alternatives exceed at least one of the two thresholds utilized in this EIS/EIR for GHG emissions. The first threshold is based on SCAQMD's methodology and as a result, GHG emissions would be significant if they exceed 10,000 MTCO<sub>2</sub>e in a year. SCAQMD developed its threshold to address emissions from stationary source/industrial projects. However, because there are no adopted numerical thresholds for construction emissions, and the SCAQMD threshold incorporates construction emissions to its determination, using the SCAQMD method for the current project is justified.

The second manner in which a GHG impact would be significant is if GHG emissions from either the Proposed Action or the alternatives would substantially obstruct compliance with the GHG emission reductions in AB 32 and Executive Order S-3-05. Compliance with the AB 32 goal of reducing California's GHG emissions by 2020 to 1990 levels requires cutting at least 29 percent of business-as-usual emissions (i.e., emissions projected by CARB for the year 2020 without any emission reduction measures) (CARB 2008). Executive Order S-3-05 further reduces the state's emissions to 80 percent below 1990 levels by 2050. Thus, the calculated emissions from Proposed Action or from any alternative should be compared to emissions that would be produced if implemented in accordance with the assumptions CARB used to calculate its business-as-usual scenario. If emissions from the Proposed Action or alternatives are at least 29 percent below business-as-usual in 2020, impacts could be considered less than significant. For purposes of this EIS/EIR, the calculated GHG emissions from the Proposed Action or alternatives will be compared to existing numerical thresholds of significance for industrial and residential projects (factor 2) and to the statewide plan for reducing emissions outlined in AB 32 and Executive Order S-3-05.

### **3.10.4.3 Effects Determinations**

Emissions of GHG would occur from construction activities associated with either removing dams or constructing fish passage facilities. Direct emissions of GHG would occur from engine exhaust emissions from off-road construction equipment, on-road trucks, and construction worker commuting vehicles. Emissions were estimated using various emission factor models, including CARB's EMFAC2007 and OFFROAD2007 for on- and off-road exhaust emissions and USEPA's MOBILE6.2 and NONROAD2008 for engine exhaust emissions. Fugitive dust emissions were also estimated using CARB's URBEMIS2007 (version 9.2.4) model and additional calculations from AP-42 (USEPA 1995). Detailed calculations from each alternative are provided in Appendix N.

Indirect GHG emission changes could also occur from alterations in land use, agricultural resources (including the creation of new agricultural areas), and recreation from implementation of the KHSR and KBRA. These emission changes could occur from changing open water reservoirs to one of the following categories that could replace the reservoirs:

- Grassland/pasture (including cattle grazing)
- Wetlands (with increased sequestration)<sup>5</sup>
- Re-planting of forests (including riparian vegetation)

Changes in recreational activities, such as decreases in motorized vehicles and increases in non-motorized vehicles, would also occur from the potential removal of the dams. It is expected that the removal of the dams would result in a decrease in motorized recreation activities from the elimination of the open water reservoirs, which would consequently result in a reduction of GHG emissions.

Sediments in reservoirs contain carbon that is formed from the decomposition of accumulated dead plankton and other debris that could be released when a dam is decommissioned. If anoxic digestion causes the carbon to be released in the form of CH<sub>4</sub>, then there could be a net negative impact of the existing reservoirs associated with the dams because of the higher GWP of CH<sub>4</sub> as compared to CO<sub>2</sub> (Pacca 2007).

Except for emissions from power plant operations and maintenance, GHG emissions from hydropower are negligible because no fuels are burned; however, plant matter can decay in the reservoir, causing the buildup and release of CH<sub>4</sub> (USEPA 2007). Analyzing the magnitude of these CH<sub>4</sub> emissions is difficult, but it is important to understand that open water reservoirs associated with hydropower may have a certain level of CH<sub>4</sub> emissions from their operation. The Klamath Hydroelectric Project reservoirs have characteristics that would favor high CH<sub>4</sub> emissions: they receive massive organic/nutrient loads from upstream, have large in-reservoir algal blooms, and have anoxic hypolimnions (See Section 3.2, Water Quality).

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<sup>5</sup> Sequestration is the process of removing carbon from the atmosphere and storing it in carbon sink.

The USEPA has also estimated carbon sequestration rates from a variety of agricultural and forestry practices. Table 3.10-3 summarizes the carbon sequestration rates documented by the USEPA. Insufficient information is available to estimate the exact carbon sequestration that could occur from the conversion of the open water reservoirs to one of these other land uses; however, it is expected that a net reduction in carbon emissions could occur from the land use conversion.

**Table 3.10-3. Representative Carbon Sequestration Rates and Saturation Periods for Key Agricultural and Forestry Practices**

Activity	Representative Carbon Sequestration Rate (metric tons of C per acre per year)	Time Over Which Sequestration May Occur Before Saturating <sup>[1]</sup>
Afforestation <sup>[2]</sup>	0.6 – 2.6 <sup>[3]</sup>	90–120+ years
Reforestation <sup>[4]</sup>	0.3 – 2.1 <sup>[5]</sup>	90–120+ years
Changes in forest management	0.6 – 0.8 <sup>[6]</sup>	If wood products included in accounting, saturation does not necessarily occur if C continuously flows into products
	0.2 <sup>[7]</sup>	
Conservation of riparian buffers	0.1 – 0.3 <sup>[8]</sup>	Not calculated
Conversion from conventional to reduced tillage	0.2 – 0.3 <sup>[9]</sup>	15–20 years
	0.2 <sup>[10]</sup>	25–50 years
Changes in grazing land management	0.02 – 0.5 <sup>[11]</sup>	25–50 years
Biofuel substitutes for fossil fuels	1.3 – 1.5 <sup>[12]</sup>	Saturation does not occur if fossil fuel emissions are continuously offset

Source: United States Environmental Protection Agency 2010a.

Notes:

- <sup>1</sup> Values refer to the level of time during which sequestration could be occurring. After the stated period, then there would cease to be a positive effect from the carbon sink.
- <sup>2</sup> Values are for average management of forest after being established on previous croplands or pasture.
- <sup>3</sup> Value calculated over 120-year period. Low value is for spruce-fir forest type in lake states; high value is for Douglas Fir on Pacific Coast. Soil carbon accumulation is included in estimate.
- <sup>4</sup> Values are for average management of forest established after clear-cut harvest.
- <sup>5</sup> Values calculated over 120-year period. Low value is for Douglas Fir in Rocky Mountains; high value is for Douglas Fir in Pacific Coast. No accumulation in soil carbon is assumed.
- <sup>6</sup> Select examples, calculated over 100 years. Low value represents change from 25-year to 50-year rotation for loblolly pines in Southeast; high value is change in management regime for Douglas Fir in Pacific Northwest. Carbon in wood products included.
- <sup>7</sup> Forest management here encompasses regeneration, fertilization, choice of species, and reduced forest degradation. Average estimate here is not specified to US, but averaged over developed countries.
- <sup>8</sup> Assumed that carbon sequestration rates are the same as average rates for lands under United States Department of Agriculture Conservation Reserve Program.
- <sup>9</sup> Estimates include only conversion from conventional to no-till for all cropping systems except for wheat-fallow systems, which may not produce net carbon gains. Estimates of changes in other GHG not included.
- <sup>10</sup> Assumed that average carbon sequestration rates are the same for conversion from conventional till to no-till, mulch till, or ridge till. Estimates of changes in other GHG not included.
- <sup>11</sup> See Improve/Intensity Management section in Table 16.1 of Follett et al. (2001). Low end is improvement of rangeland management; high end is changes in grazing management on pasture, where soil organic carbon is enhanced through manure additions. Estimates of flux changes in other GHG not included.
- <sup>12</sup> Assumes growth of short-rotation woody crops and herbaceous energy crops, and that burning this biomass offsets 65 to 75 percent of fossil fuel in CO<sub>2</sub> estimates. Estimates of changes in other GHG not included.

Key:

C = carbon

If the land behind the removed dams is converted to agricultural use such as cattle grazing, certain agricultural practices could result in an increase in GHG emissions. For example, grasslands and pastures could serve as carbon sinks, but cattle grazing could actually counteract some of these sinks. Section 4.9 of the Federal Energy Regulatory Commission (FERC) EIS discusses this issue further. Emissions from the digestion of cattle feed and manure management would result in net GHG emissions. Additional information on the number of head of cattle and the total size of the land conversion would be necessary to estimate whether there would be a net benefit or adverse impact from possible cattle grazing.

### **Alternative 1: No Action/No Project Alternative**

#### **Effects of Climate Change on the No Action/No Project Alternative**

The No Action/No Project Alternatives would likely require greater management actions, policies, and mitigation measures to protect the surrounding ecosystems and communities as compared to actions that include dam removal because the Klamath Basin is more likely to experience a greater magnitude of consequences from the projected changes in climate conditions than if the dams were removed. The situation might require costly future projects to prevent or respond to the consequences of climate change. For example, disturbances caused by drought, changes to vegetation, changes to water quality characteristics, and changes to fish and shellfish populations and patterns might not be able to be adjusted to or absorbed as easily with the dams in place as without them. The baseline temperatures on the mainstem of the Klamath River are stressful for fish, and fish rely on small areas of refugia (typically near tributary inflow). Increased ambient temperatures could increase water temperatures. Therefore climate change is likely to reduce or possibly eliminate these refugia, making the temperature in the mainstem of the river unsuitable for fish rearing and movement during critical times of the year. Increased energy expenditure for rescuing fish or removing them to controlled (hatchery-type) situations may then be necessary for maintaining viable fish populations in the Klamath Basin.

Also, free-flowing rivers, in general, respond better to changes in climate conditions due to the ability to adjust to and absorb disturbances through flow adjustments that buffer against impacts (Palmer et al. 2008). A natural riverine system is in constant, dynamic equilibrium, absorbing highly variable flow forces by changing channel morphology and dissipating energy via sediment transport and woody debris. A natural river system is capable of using those “tools” to gradually adjust to flow regime changes due to climate-induced precipitation change. Consequently, the more physical changes the river system has been subjected to, such as changes in sediment budgets and flow regimes due to dams or land clearing in the basin or riparian zones, the less capable the system is of responding to or absorbing changed flow regime.

As described in Section 3.2, Water Quality, climate change would cause general increases in water temperature that could decrease the 100 percent saturation level for dissolved oxygen. This decrease in dissolved oxygen concentration at saturation would act in opposition to successful total maximum daily load implementation. Climate

change would increase the possibility of continued exceedance of the minimum dissolved oxygen objectives in the region.

As described in Section 3.3, Aquatic Resources, the temperature in the Klamath River Estuary and Pacific Ocean would remain similar to the existing conditions and climate change would continue to play a role in future temperatures. Warmer water temperatures associated with climate change would increase the frequency and duration of stressful water temperatures for cold-water species, including all anadromous fish and salmonids in the basin. For warm-water species, little effect would likely result from this level of warming.

### **Effects of the No Action/No Project Alternative on Climate Change**

*Vehicle exhaust from operation and maintenance of the Four Facilities and continued water impoundment in the reservoirs could result in GHG emissions.* Under the No Action/No Project Alternative, none of the activities under the KHSA would be completed. Since the removal of the dams or the construction of fish passages would not occur, there would be no emissions associated with construction; however, ongoing CH<sub>4</sub> emissions from anaerobic decay in the impoundment would still occur under the No Action/No Project Alternative. Continual emissions would also occur from equipment use and worker commute for operation and maintenance of facilities.

The Karuk Tribe (2006) estimated the total amount of CH<sub>4</sub> released from Keno, J.C. Boyle, Copco, and Iron Gate Reservoirs, calculated by multiplying the reservoirs' area by areal emissions rates from reservoirs around the world with similar characteristics (poor water quality). The resulting estimate ranged from approximately 8,000 to 29,000 MTCO<sub>2</sub>e per year<sup>6</sup>. Without Keno Impoundment, CH<sub>4</sub> emissions would be approximately 4,000 to 14,000 MTCO<sub>2</sub>e per year for Iron Gate, Copco, and J.C. Boyle Reservoirs. Under the No Action/No Project Alternative, releases of CH<sub>4</sub> from the reservoirs would continue at the same levels. See Appendix N for detailed calculations.

**There would be no change from existing conditions from GHG emissions from vehicle emissions or continued impoundment of water relative to existing conditions.**

*Activities associated with several interim measures (IMs) could result in short-term and temporary increases in GHG emissions from vehicle exhaust.* Several IMs would be implemented under the No Action/No Project Alternative. Several of these measures could result in increased GHG emissions:

- IM 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement
- IM 8: J.C. Boyle Bypass Barrier Removal

IM 7 would require PacifiCorp to place suitable gravels in the J.C. Boyle Bypass and Peaking reaches using a passive approach before high flow periods or to provide for other

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<sup>6</sup> The emission estimation ranges provided in this section are based on a GWP of 21 for CH<sub>4</sub>; the original Karuk Tribe calculation assumed a GWP of 23, but the calculation was changed to be consistent with the rest of the report.

habitat enhancement. The No Action/No Project Alternative includes only one year of this measure. GHG emissions could occur from trucks hauling gravel to the J.C. Boyle Bypass and Peaking reaches; however, the number of trucks required to deliver gravel is expected to be minor.

IM 8 requires the removal of the sidecast rock barrier located approximately 3 miles upstream of the J.C. Boyle Powerhouse in the J.C. Boyle Bypass Reach. Potential GHG emissions are expected to be less than those quantified for the removal of Copco 1 from demolition activities.

Based on the limited amount of construction equipment expected to be used simultaneously, it is likely that emissions from implementation of the IMs would not exceed the significance criteria. **The impact on GHG emissions and climate change from implementing the IMs would be less than significant.**

*Reducing a renewable source of power could result in GHG impacts from possible non-renewable alternate sources of power.* Under the No Action/No Project Alternative, the Four Facilities would continue to operate under annual licenses. Continued operation would not change existing GHG emissions from the Four Facilities. While the No Action/No Project Alternative assumes annual renewal of licenses, relicensing of the Four Facilities could result in the need for replacement power and subsequent changes in GHG emissions from any changes in renewable sources of power. If relicensing occurred, the amount of electricity produced could reduce as a result of redirecting a certain quantity of river flow from power generation to bypass or fish passage. For example, the FERC EIS (2007) determined that power generation under the Staff Alternative with Mandatory Conditions would produce 141,859 less megawatt-hours per year than PacifiCorp's proposal. If relicensing were to require the annual average electricity output to be reduced, then the reduction in power would need to be replaced with another source. As explained below under Alternative 2, the production of replacement electric generation would, in the near term, result in increased GHG emissions. Such other sources may result in increased GHG emissions (i.e., coal-fired power plant(s)). **Under the No Action/No Project Alternative that assumes annual licensing, there would be no change from existing conditions from GHG emissions relative to existing conditions.**

*Vehicle exhaust from several ongoing restoration actions could increase GHG emissions.* Under the No Action/No Project Alternative, some restoration actions in the Klamath Basin are currently underway and would be implemented regardless of the Secretarial Determination on the removal of the Four Facilities. The Fish Habitat Restoration activities could result in GHG emissions. This project would involve some limited construction activities that could result in short-term temporary GHG emissions in the Upper Basin. In addition, the Climate Change Assessment would ensure that long-term climate change in the Klamath Basin is assessed early and continuously. **The GHG emissions related to construction of ongoing restoration actions would be less than significant.**

**Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**  
**Effects of Climate Change on the Proposed Action**

The projected changes in precipitation would result in drier summers and increased frequency and severity of extreme events (USGCRP 2009; Barr et. al. 2010; OCCRI 2010). These precipitation changes would produce some adverse effects in the Klamath Basin. Adverse effects could include increased flooding, decreasing water quality (due mainly to the effects of higher water temperatures and changing vegetation), higher fire potential (with subsequent water quality impacts), and adverse low flow conditions due to summer droughts.

Average annual air temperatures are projected to increase by 3°F to over 8°F in the next century. Temperature changes would increase water temperature; water temperature increases could create stressful conditions for fish during some times of the year and reduce the migration window. The Proposed Action would create initial decreases in water temperature by removing dams and increasing river flows, but climate change could partially offset some of these temperature improvements.

The Proposed Action is positioned to respond to the changes in climate conditions compared to the No Action/No Project Alternative. Dam removal can increase ecosystem resiliency by restoring floodplain wetlands, which allow the river system to handle the projected changes in seasonal precipitation (Dinse et al. 2009). Also, sediment budgets may return to pre-controlled conditions, revegetation of the watershed can replace missing large woody debris, and more dynamic flow regimes can diversify channel morphology and increase habitat complexity.

Benefits of full dam removal would begin to offset the projected changes and impacts from climate change. These benefits include additional floodplain and riparian zone to reduce peak flooding impacts; improved water quality by removing large quiescent water areas that are subject to temperature increases and evaporation; increased woody debris and restored natural sediment budget to improve in-channel habitat diversity; more available stream channel habitat; a migration corridor for fish to move further upstream to find cooler water; access to the largest concentration of cold springs and spring-dominated tributaries in the Klamath Basin; and improved habitat quality, water quality, and riparian and floodplain functionality in and above Upper Klamath Lake. In contrast, the No Action/No Project Alternative would require modified management and dam operations to off-set flow regime changes; provide no new opportunities for new in-channel or riparian/floodplain habitat; and be subject to greater water quality impacts due to projected temperature increases.

As described in Section 3.2, Water Quality, removal of the reservoirs under the Proposed Action would result in a 1 to 2 degrees Celsius (°C) increase in spring water temperatures and a 2 to 10 °C decrease in late-summer/fall water temperatures immediately downstream of Iron Gate Dam. These effects would decrease in magnitude with distance downstream of the dam and would not be evident by the Salmon River confluence (approximately river mile [RM] 66) (PacifiCorp 2004, Duns Moor and Huntington 2006, North Coast Regional Water Quality Control Board 2010, Perry et al. 2011). General

warming of water temperatures under climate change is projected to be on the order of 1 to 3°C in the Klamath Basin (Bartholow 2005, Perry et al. 2011), which would partially offset anticipated water temperature improvements from the Proposed Action, particularly further downstream of Iron Gate Dam where the improvements would be of smaller magnitude. However, overall the primary effect of dam removal is still anticipated to be the return of approximately 160 miles of the Klamath River, from J.C. Boyle Reservoir (RM 224.7) to the Salmon River (RM 66), to a natural thermal regime. This return would also include increased daily fluctuations in water temperature immediately downstream of Copco 1 and Iron Gate Dams, as water temperatures once again achieve equilibrium with (and reflect) daily fluctuations in ambient air temperatures. In contrast, in the Bypass Reach downstream of J.C. Boyle Dam, daily fluctuations in water temperature would decrease under the Proposed Action, as hydropower peaking flows would not occur.

As described in Section 3.3, Aquatic Resources, improvement in the river thermal regime by the Proposed Action would likely moderate the anticipated stream temperature increases resulting from climate change.

### Effects of the Proposed Action on Climate Change

*Vehicle exhaust from dam removal activities could increase GHG emissions in the short-term to levels that could exceed the significance criteria.* The emission sources would include off-road construction equipment, on-road trucks, and construction worker commuting vehicles. These emissions would be temporary, occurring only during the dam removal period of nine months (January through September 2020). Table 3.10-4 summarizes uncontrolled annual emissions (not controlled by any mitigation measures) associated with the Proposed Action. Appendix N contains detailed GHG emissions calculations.

**Table 3.10-4. Uncontrolled Direct GHG Emissions Inventories for Proposed Action – Full Facilities Removal**

Location	Project Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>			
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O <sup>2</sup>	Total
<b>2020</b>				
Iron Gate	4,106	4	n/a	4,110
Copco 1	1,459	1	n/a	1,461
Copco 2	970	1	n/a	971
J.C. Boyle	2,016	<1	n/a	2,016
<b>Total Emissions</b>	<b>8,551</b>	<b>6</b>	<b>n/a</b>	<b>8,558</b>
California Total	6,535	6	n/a	6,542
Oregon Total	2,016	n/a	n/a	2,016

Notes:

<sup>1</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

<sup>2</sup> N<sub>2</sub>O emissions are not estimated directly from the various emission calculation models; therefore, emissions estimates are zero for most equipment.

Key:

CO<sub>2</sub> = carbon dioxide

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

Cofferdams would be constructed at the Four Facilities during deconstruction activities. Concrete rubble, rock, and earthen materials that would come from the dam removal activities would be used as possible to construct the cofferdams. Construction of the cofferdams from materials salvaged from the dam demolition activities would reduce the need for importing new construction materials.

It is likely that sulfur hexafluoride (SF<sub>6</sub>) would be released during deconstruction because the breakers would be emptied. Although SF<sub>6</sub> has a relatively high GWP, sufficient data was not available at the time of this writing to quantify emissions.

As Table 3.10-4 shows, there would be a net increase in GHG emissions from deconstruction of the dams; however, these emissions would be temporary and would not contribute to long-term emissions.

Construction related activities associated with decommissioning of the dams would contribute 8,558 MTCO<sub>2</sub>e to California's GHG emission for one year<sup>7</sup>. Amortizing these construction emissions over thirty years results in approximately 285 MTCO<sub>2</sub>e per year, well below the 10,000 MTCO<sub>2</sub>e threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 1,442 MTCO<sub>2</sub>e below the threshold. The 1990 GHG emissions level (and so the 2020 emissions target ascribed by AB 32) is 427 million metric tons of CO<sub>2</sub>e (MMTCO<sub>2</sub>e). The emissions from dam removal would be 0.002 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 MMTCO<sub>2</sub>e; therefore, the Proposed Action would equal approximately 1 percent of allowable construction emissions. **The one year construction emissions would not exceed the established significance threshold for ongoing industrial emissions. Therefore, the GHG emissions related to construction would be less than significant.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short-term and temporary GHG emissions from vehicle exhaust.* On- and off-road construction equipment would be used to complete the relocation and construction of the Yreka water supply pipeline. Sufficient information is not currently available to quantify emissions; however, the quantity of equipment required to complete the construction would be less than that required to complete dam demolition activities because of the scale of the two activities. Also, these emissions would occur in 2019 and would not overlap with other construction or demolition activities. Since dam demolition activities would be less than significant, it is likely that emissions from the construction of the Yreka water supply pipeline would also not exceed the significance criteria. **The impact on GHG emissions and climate change**

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<sup>7</sup> The value of 8,558 MTCO<sub>2</sub>e includes emissions from the JC Boyle Dam. Although JC Boyle Dam is located in Oregon, CEQA requires project impacts to be evaluated for significance. Since the Proposed Action includes the removal of JC Boyle Dam, emissions from its removal were included in the significance determination.

**from the construction of the Yreka water supply pipeline would be less than significant.**

*Activities associated with several IMs could result in short-term and temporary increases in GHG emissions from vehicle exhaust.* Prior to construction, IMs as described in the KHSA (KHSA Section 1.2.4) would be implemented and would control operations of the hydroelectric facilities. Several of the IMs in the Proposed Action could result in increased GHG emissions:

- IM 7: J.C. Boyle Gravel Placement and/or Habitat Enhancement
- IM 16: Water Diversions

IM 7 would require PacifiCorp to place suitable gravels in the J.C. Boyle Bypass and Peaking reaches using a passive approach before high flow periods or to provide for other habitat enhancement. The Proposed Action includes seven years of implementing this measure. GHG emissions could occur from trucks hauling gravel to the J.C. Boyle Bypass and Peaking reaches; however, the number of trucks required to deliver gravel is expected to be minor.

IM 16 would eliminate three screened diversions from Shovel and Negro Creeks and would also require the installation of screened irrigation pump intakes, as necessary, in the Klamath River. Limited construction equipment and haul trucks would be required to remove the screened diversions.

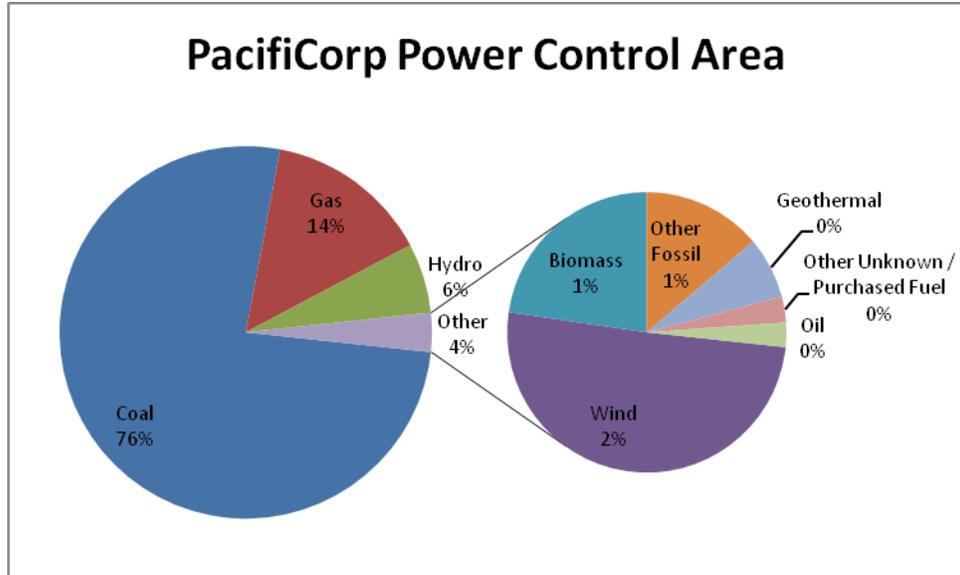
Since dam demolition activities would be less than significant, and the scale of emissions expected from the IMs is expected to be substantially less than dam removal, it is likely that emissions from implementation of the IMs would also not exceed the significance criteria. **The impact on GHG emissions and climate change from implementing the IMs would be less than significant.**

*Restoration actions could result in short-term and temporary increases in GHG emissions from the use of helicopters, trucks, and barges.* Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed sediment. Upper areas would be reseeded from a barge until the reservoir levels become too low to operate and access the barge. Aerial application would be necessary for precision applications of material near sensitive areas and the newly established river channel. Aerial hydroseeding is scheduled to begin on March 15, 2020 and last for 10 days at Iron Gate and 20 days at Copco. Trucks would also be used as necessary to provide seeding. Additional fall seeding may be necessary to supplement areas where spring hydroseeding was unsuccessful. Sufficient information is not currently available to quantify emissions; however, emissions are not expected to impede compliance with AB 32. The short duration of hydroseeding would minimize any emissions that would occur. Furthermore, the addition of new grassland and other vegetation would sequester CO<sub>2</sub> emissions in the long-term, but the sequestered CO<sub>2</sub> would likely not offset all of the emissions occurring during restoration on an annual

basis. It is possible that the addition of emissions from the barges and trucks to other dam demolition activities could cause emissions to exceed the 10,000 MTCO<sub>2</sub>e per year threshold; however, even if emissions doubled, amortized emissions over thirty years would not exceed the applicable threshold. **The impact on GHG emissions and climate change from revegetation would be less than significant.**

*Relocation and demolition of various recreation facilities could result in short-term and temporary increases in GHG emissions from vehicle exhaust.* The demolition of the Four Facilities would change recreational opportunities from reservoir-based recreation to river-based recreation. This change would require several recreation facilities to be relocated or demolished. On- and off-road construction equipment would be used to complete these activities, which would occur after the dam demolition actions. Sufficient information is not currently available to quantify emissions; however, the quantity of equipment required to relocate or demolish recreation facilities would be less than that required to complete dam demolition activities because of the scale of the two activities. Since dam demolition activities would be less than significant and changes to the recreation facilities would not overlap, it is expected that emissions from these activities would also not exceed the significance criteria. **The impact on GHG emissions and climate change from the relocation and demolition of recreation facilities would be less than significant.**

*Removing a renewable source of power by removing the dams could result in increased GHG emissions from possible non-renewable alternate sources of power.* GHG emissions could occur in the event that the renewable source of power represented by the Four Facilities was replaced by other emissions sources. As shown in Figure 3.10-3, the 2007 electricity generation resource mix for the PacifiCorp Power Control Area (PCA), which is a region of the power grid in which all power plants are centrally dispatched, is dominated by coal (76 percent), natural gas (14 percent), and hydroelectricity (6 percent). The data provided is the most recent data available from the USEPA (2010b) and represents the resource mix that would be available if any replacement energy was obtained from PacifiCorp's resource mix as of 2007. It is acknowledged that PacifiCorp's current resource mix is different than the 2007 data (PacifiCorp 2011), specifically with a decrease in the reliance on coal and an increase in reliance on natural gas, hydroelectricity, and other renewable energy sources; however, the information in the 2011 Integrated Resource Plan (PacifiCorp 2011) is not sufficient to develop emission factors.



Source: United States Environmental Protection Agency 2010b.

**Figure 3.10-3. PacifiCorp Power Control Area  
Generation Resource Mix (as of 2007)**

Although using the 2007 data provides emissions results that would be higher than the current resource mix, using Emissions & Generation Resource Integrated Database (eGRID) data is consistent with inventory requirements of multiple voluntary and mandatory reporting protocols; therefore, the 2007 eGRID data was used for the analysis.

Electricity originally produced from the Four Facilities, if removed, would likely be replaced with another source within the PacifiCorp PCA because the amount of electricity provided by the Four Facilities is approximately 2 percent of PacifiCorp's total generation capacity (CEC 2006a). Emission rates from the grid were estimated assuming that all power sources within the PCA would remain except for East Side, West Side, J. C. Boyle, Copco 1, Copco 2, Iron Gate Dams.

PacifiCorp's 2011 Integrated Resource Plan provides an overview of the company's available generation capacity. According to the Integrated Resource Plan, PacifiCorp will be at "summer peak resource deficit" beginning in 2011 (PacifiCorp 2011). This deficit is to be met in the short term with additional renewable, demand-side programs, and market purchases from other generating companies (PacifiCorp 2011). PacifiCorp outlined a series of actions in the plan to meet the widening resource deficit, including the addition of 800 megawatts (MW) of wind resources by 2020, the acquisition of 1,200 MW of demand side management programs by 2020, acquisition of 8.7 MW of solar, and economic investigation of 30 MW from solar hot water heating resources and over 100 MW of geothermal resources (PacifiCorp 2011). Although it may be possible for PacifiCorp to replace the existing hydropower from the Four Facilities with additional renewables, this analysis assumes the replacement power will come from the resource mix shown in Figure 3.10-3 of PacifiCorp power sources to provide a worst-case analysis

of emissions. The analysis was adjusted so that the base load was assumed to be served by this resource mix, while peaking power would be supplied by natural gas.

In the long-term, PacifiCorp is under obligation to meet the Renewable Portfolio Standard (RPS) goals in California and Oregon. The RPS goal for California is to have 33 percent of an electricity seller's load served with renewable power by 2020 (Executive Order S-14-08; and SBX1 2), while Oregon's RPS goal is for 25 percent of a utility's retail sales of electricity to be from renewable energy by 2025 (Senate Bill 838). PacifiCorp is currently on track to meet its Oregon RPS target, but it expected to be under California's RPS target (PacifiCorp 2011). PacifiCorp plans on using flexible compliance mechanisms (e.g., banking, earmarking, and tradable renewable energy credits) to meet California's RPS standards. In the long-term, it is expected that PacifiCorp would be able to eventually replace the lost energy from the dams with other sources of renewable energy.

Emissions were calculated assuming that PacifiCorp met its RPS obligations (i.e., 33 percent renewable power in California). As a result, the off-peak emissions were calculated assuming that 33 percent of the power would be served by renewable power (an increase from the existing portfolio assumption of approximately nine percent renewable power).

The average annual electricity generation from the Klamath Hydroelectric Project is 716,800 megawatt-hours (MWh). This includes generation from the following developments: East Side, West Side, J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, Fall Creek Dam, and Iron Gate Dam. Since East Side, West Side, and Fall Creek Dam are not part of the Proposed Action, then the total amount of power that would need to be replaced would be equal to 686,000 MWh<sup>8</sup>.

Data from eGRID was used to estimate GHG emissions from a potentially different mix of energy sources (USEPA 2010b). It is recognized that the FERC EIS used carbon intensity factors from Hadley and Sale (2000); however the carbon intensity factors were

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<sup>8</sup> The GHG analysis is based on an estimate of the annual reliable hydroelectric power generation for the PacifiCorp Klamath Hydroelectric Project. Power generation was estimated using annual electricity generation estimates provided for each alternative in Chapter 4 of the Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement (EIS) for Hydropower License (2007). The FERC EIS power generation results allowed for a quantitative comparison of GHG effects for all alternatives considered in this EIS/EIR using information publically available on June 14, 2010 when the notice of intent was published. Since that time, United States Department of the Interior (DOI) modeled annual reliable hydroelectric power generation with updated hydrology and inclusion of planned upgrades that would improve the efficiency and maximum capacity of the hydroelectric project (for the Alternative 1: No Action/No Project Alternative and Alternative 2: Proposed Action (DOI 2011a; DOI 2011b). Under the Alternative 1: No Action/No Project Alternative, annual reliable hydroelectric power generation is greater than the annual generation estimates in the FERC EIS. Therefore, under the Alternative 2: Proposed Action, the DOI model generated increased annual reliable hydropower generation, increasing the estimated replacement power needed to compensate for decommissioning of power facilities, and in turn increasing the overall GHG production attributed to the Proposed Action as compared to the FERC EIS. However, increased GHG production would not change the findings in this EIS/EIR because the significance determination for Alternative 2: The Proposed Action remains significant and unavoidable after mitigation. Therefore, evaluating GHG production using the DOI model to estimate annual production is not essential to a reasoned choice among the alternatives.

based on the entire Western Electricity Coordinating Council and represented CO<sub>2</sub> emissions only. The eGRID method of estimating emissions is consistent with the recommendations in multiple general and mandatory reporting protocols and was based on electricity generated by PacifiCorp-owned facilities. As a result, it reflects a conservative estimate of emissions.

The lead agencies acquired data for all of the plants within the PacifiCorp PCA and derived emission factors from this source with the applicable dams removed from the mix. The power plants within the PacifiCorp PCA are in California, Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming; all or most of the emissions from these plants would occur outside of the area of analysis. Table 3.10-5 summarizes replacement power emissions that would be associated with the removal of the dams assuming that the current power resource mix was used. Table 3.10-6 summarizes replacement power emissions that would be associated with the removal of the dams assuming that PacifiCorp's RPS obligations were met.

Iron Gate, Copco 1, and Copco 2 are California RPS-eligible facilities (CEC 2011)<sup>9</sup>. The reduction in renewable energy sources is contrary to implementation of AB 32 but the significance would diminish as new renewable sources are developed. Although it is expected that PacifiCorp would add new sources of renewable power that would replace the removed dams, this analysis provides a conservative assumption that emissions could still occur when the dams are removed.

**Table 3.10-5. Electricity Generation GHG Emissions from Replacement Sources after Removal of Four Dams (Existing Resource Mix)**

Location	Generation (MWh) <sup>1</sup>	Annual Emissions (metric tons per year) <sup>2</sup>			Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year) <sup>3</sup>			
		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total
Iron Gate	116,000	66,802	2	1	66,802	38	219	67,059
Copco 1	106,000	61,043	2	1	61,043	35	200	61,278
Copco 2	135,000	77,744	2	1	77,744	44	255	78,043
J.C. Boyle	329,000	189,465	5	2	189,465	107	622	190,194
Total	686,800	395,054	11	4	395,054	224	1297	396,575

Notes:

<sup>1</sup> Generation based on FERC EIS (based on 2007 generation data).

<sup>2</sup> Emissions assume that 64 percent of power would be generated on-peak using natural gas; the remaining 36 percent would be generated off-peak using the PacifiCorp PCA resource mix. Off-peak emission factors were calculated from the annual emissions and generation for all sources within the PacifiCorp PCA (USEPA 2010b) except for the dams proposed to be removed.

<sup>3</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

Key:

CO<sub>2</sub> = carbon dioxide

CO<sub>2</sub>e = carbon dioxide equivalent

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MWh = megawatt hour

lb/MWh = pounds

lb/GWh = pounds per gigawatt-hour

GWP = global warming potential

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

<sup>9</sup> For a hydroelectric facility to qualify for California's RPS, it must be 30 megawatts (MW) or less. Since JC Boyle's rated capacity is 98.7 MW, it does not qualify as a small hydroelectric facility.

**Table 3.10-6. Electricity Generation GHG Emissions from Replacement Sources after Removal of Four Dams (33 Percent RPS)**

Location	Generation (MWh) <sup>1</sup>	Annual Emissions (metric tons per year) <sup>2</sup>			Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year) <sup>3</sup>			
		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total
Iron Gate	116,000	57,545	2	1	57,545	35	173	57,753
Copco 1	106,000	52,585	2	1	52,585	32	158	52,774
Copco 2	135,000	66,971	2	1	66,971	41	201	67,212
J.C. Boyle	329,000	163,210	5	2	163,210	99	489	163,799
Total	686,800	340,311	10	3	340,311	207	1020	341,539

Notes:

<sup>1</sup> Generation based on FERC EIS (based on 2007 generation data).

<sup>2</sup> Emissions assume that 64 percent of power would be generated on-peak using natural gas; the remaining 36 percent would be generated off-peak using the PacifiCorp PCA resource mix. Off-peak emission factors were calculated from the annual emissions and generation for all sources within the PacifiCorp PCA (USEPA 2010b) except for the dams proposed to be removed. It was also assumed that PacifiCorp would meet its RPS obligation.

<sup>3</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

Key:

CO<sub>2</sub> = carbon dioxide

CO<sub>2</sub>e = carbon dioxide equivalent

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MWh = megawatt hour

lb/MWh = pounds

lb/GWh = pounds per gigawatt-hour

GWP = global warming potential

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

As previously described for the No Action/No Project Alternative, CH<sub>4</sub> would be released from the reservoirs because of poor water quality conditions. Under the No Action/No Project Alternative, CH<sub>4</sub> emissions from the reservoirs would range from 4,000 to 14,000 MTCO<sub>2</sub>e per year, which is equivalent to approximately 1 to 4 percent of replacement power emissions<sup>10</sup> of the 396,575 MTCO<sub>2</sub>e per year (based on the current electricity mix)<sup>11</sup>. Under the Proposed Action, these CH<sub>4</sub> emissions would cease to be a factor and would partially offset the possible increase in emissions from power replacement. Table 3.10-7 summarizes the expected range in emissions from power replacement that would occur when this emissions offset is considered.

<sup>10</sup> Emissions range is valid for both renewable portfolio standard assumptions (i.e., current grid mix or 33 percent renewable power).

<sup>11</sup> Approximately 2 to 8 percent of the 341,539 MTCO<sub>2</sub>e per year would be emitted assuming that the renewable portfolio standard goal of 33 percent was met. Emissions range is valid for both renewable portfolio standard assumptions (i.e., current grid mix or 33 percent renewable power).

**Table 3.10-7. Adjusted Power Replacement Emissions Without Methane Emissions from Reservoirs**

Scenario	Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year)	CH <sub>4</sub> Emissions from Reservoirs (MTCO <sub>2</sub> e/year)		Adjusted Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>	
		Low	High	Low	High
Current Grid Mix	396,575	4,000	14,000	392,575	382,575
33 Percent RPS	341,539	4,000	14,000	337,539	327,539

Notes:

<sup>1</sup> Adjusted emissions reflect the difference between each scenario and the estimated CH<sub>4</sub> emissions from the reservoirs.

Key:

CO<sub>2</sub>e = carbon dioxide equivalent

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

Restoration activities at the dam sites are expected to increase the carbon sequestration in the area. As shown in Table 3.10-3, restoration of formerly inundated areas could sequester 0.3 metric tons of carbon per acre per year, while conservation of riparian buffers could sequester 0.1 metric tons of carbon per acre per year. The total amount of acreage wetland/riparian and upland acreage expected to be restored at JC Boyle, Copco, and Iron Gate Dams would be 272 acres and 1,602 acres, respectively. As a result, the total amount of sequestered carbon would be approximately 508 metric tons of carbon per year, or 1,862 metric tons of CO<sub>2</sub> per year (based on equivalent weights of carbon and CO<sub>2</sub>). Although this sequestration would minimize the effects of GHG emissions, it would not eliminate the increased emissions from replacement power.

CARB expects that implementation of its Scoping Plan (2008) would reduce 21.3 MMTCO<sub>2</sub>e by 2020 (from 2005 baseline) from California's RPS; therefore, the possible increase in emissions from removing the dams would account for three percent of the expected emissions reduction. Under a business-as-usual scenario, which assumes that the Scoping Plan would not be implemented, this would impede California's ability to meet its emission reduction goal. **Emissions from power replacement would therefore be a significant impact. Mitigation Measures CC-1 through CC-3 would be implemented to reduce emissions from replacement power. Although these measures are expected to lessen the degree of significance, it is expected that GHG emissions would remain significant and unavoidable in the short term until PacifiCorp adds new sources of renewable power that would replace the removed dams.**

**Keno Transfer**

*Implementation of the Keno Transfer could cause short-term and temporary increases in GHG emissions.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the United States Department of the Interior (DOI). This transfer would not result in the generation of new impacts on greenhouse gases compared with existing facility operations. Following transfer of title, DOI would operate the Keno Facility in compliance with applicable law and would provide water levels upstream of Keno Dam

for diversion and canal maintenance with agreements and historic practice (KHS A Section 7.5.4). **Therefore, implementation of the Keno Transfer would result in no change from existing conditions.**

***East and West Side Facility Decommissioning***

*Decommissioning the East and West Side Facilities could cause short-term and temporary increases in GHG emissions.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHS A would redirect water flows currently diverted at Link River Dam in to the two canals, back into the Link River. Construction equipment used in the decommissioning action would be substantially less than the equipment required to complete dam demolition activities and the decommissioning action would be conducted in the years prior to 2020. Since dam demolition activities would be less than significant, it is likely that emissions from the decommissioning action would also not exceed the significance criteria. **The impact on GHG emissions and climate change from the East and West Side Facility Decommissioning would be less than significant.**

***KBRA***

The KBRA has several programs that could cause temporary increases in GHG emissions. The following KBRA programs could cause GHG and climate change impacts from various construction activities:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration
- On-Project Plan
- Power for Water Management
- Climate Change Assessment and Adaptive Management
- Water Use Retirement Program
- Fish Entrainment Reduction
- Drought Plan

*Construction activities associated with the KBRA programs involving construction could cause temporary increases in GHG emissions and climate change.* The above KBRA programs may cause some GHG emission impacts from the use of heavy equipment. Potential KBRA construction activities include channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. Emissions would occur both from on-site construction operations with heavy equipment and from off-site activities like the trap-and-haul of fish required under the Fisheries Reintroduction and Management Plan. Sufficient information is not currently available to quantify emissions; however, the quantity of equipment and associated emissions required to complete these activities is expected to be less than the equipment and resulting less than significant emission quantities required to complete the facility removal activities analyzed above. Emissions generated by these construction actions are not expected to exceed the SCAQMD's threshold of significance for industrial emissions (10,000 MTCO<sub>2e</sub> per year), especially when amortized over

thirty years. When considered together the emissions associated with KBRA construction actions and facility removal would also not be expected to exceed the SCAQMD's threshold of significance. **The impact on GHG emissions and climate change from construction activities associated with implementing the KBRA would be less than significant. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in GHG emissions from vehicle exhaust associated with trap-and-haul activities.* Potential operational emissions could occur from haul trucks moving fish around Keno Impoundment and Link River. Upstream-migrating fish would be collected downstream from Keno Dam and relocated to Upper Klamath Lake or its tributaries. Downstream-migrating fish would be collected at Link River Dam (and the East Side and West Side canals) and relocated downstream from Keno Dam. Operational emissions are not expected to exceed the SCAQMD's threshold of significance, especially when amortized over thirty years, because of the limited amount of haul trucks that would be expected to be used. When considered together the emissions associated with KBRA construction actions and facility removal, the total operational emissions would also not be expected to exceed the SCAQMD's threshold of significance. **The impact on GHG emissions and climate change from operational emissions associated with implementing the KBRA would be less than significant. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources which would provide affordable electricity to allow efficient use, distribution, and management of water.* This could also involve the development of renewable energy sources, which would provide green energy. However, given the uncertainty as to how the Power for Water Management Program would ultimately be implemented, this analysis will not consider the program as a mitigation measure. The Power for Water Management Program could however offset some of the effects of hydroelectric facility removal. **Implementation of the Power for Water Management Program could result in beneficial effects. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of the Drought Plan and the Climate Change Assessment and Adaptive Management Plan could affect climate change-related impacts.* The Drought Plan will identify water and resource management actions to minimize risk associated with drought, which is a projected climate change impact for the Klamath Basin and the Pacific Northwest. The Climate Change Assessment and Adaptive Management Plan includes early and frequent assessment of the existing and future impacts of climate change. The Climate Change Assessment and Adaptive Management Plan is also intended to develop actions to respond to climate change and protect the resources of the basin. These plans will assist the region in planning and responding to the climate change impacts identified in this EIS/EIR over the short-term, mid-term, and long-term

horizons. The Climate Change Assessment and Adaptive Management Plan could offset some of the effects of hydroelectric facility removal. **Implementation of these plans is expected to result in reduction in impacts of climate change to the resources and would have beneficial effects. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

**Alternative 3: Partial Facilities Removal of Four Dams Alternative**  
**Effects of Climate Change on the Alternative**

The Partial Facilities Removal Alternative would result in the creation of a free-flowing, unimpeded river, and the effects of climate change on this alternative would be the same as for the Proposed Action.

**Effects of the Alternative on Climate Change**

*Vehicle exhaust from dam removal activities could increase GHG emissions in the short-term to levels that could exceed the significance criteria.* Under the Partial Facilities Removal Alternative some of the structures at J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams would remain in place. Predicted GHG emissions are generally lower for this alternative than for the Proposed Action because this alternative would generate fewer materials that would need to be removed from the sites, and hence, less truck traffic. Please see Section 3.22, Traffic and Transportation, for additional analysis of expected truck trips.

Table 3.10-8 summarizes uncontrolled annual emissions inventories for the Partial Facilities Removal Alternative. Appendix N provides detailed calculations.

**Table 3.10-8. Uncontrolled Direct GHG Emissions Inventories for Partial Facilities Removal**

Location	Project Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>			
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O <sup>2</sup>	Total
<b>2020</b>				
Iron Gate	4,114	4	n/a	4,118
Copco 1	1,459	1	n/a	1,460
Copco 2	829	1	n/a	830
J.C. Boyle	1,341	<1	n/a	1,341
<b>Total Emissions</b>	<b>7,742</b>	<b>6</b>	<b>n/a</b>	<b>7,748</b>
California Total	6,401	6	n/a	6,408
Oregon Total	1,341	n/a	n/a	1,341

Notes:

<sup>1</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

<sup>2</sup> N<sub>2</sub>O emissions are not directly estimated from the various emission calculation models; therefore, emissions are estimated as zero for most equipment.

Key:

CO<sub>2</sub> = carbon dioxide

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

It is likely that SF<sub>6</sub> would be released during deconstruction because the breakers would be emptied. Although SF<sub>6</sub> has a relatively high GWP, sufficient data was not available at the time of this writing to quantify emissions.

As Table 3.10-8 shows, there would be a net increase in GHG emissions from deconstruction of the dams; however, these emissions would be temporary and would not contribute to long-term emissions. Demolition activities associated with the decommissioning of the dams would contribute 7,748 MTCO<sub>2e</sub> to GHG emission for one year<sup>12</sup>. Amortizing these construction emissions over thirty years results in approximately 258 MTCO<sub>2e</sub> per year, well below the 10,000 MTCO<sub>2e</sub> threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 2,252 MTCO<sub>2e</sub> below the threshold. The 1990 GHG emissions level (and so the 2020 emissions target ascribed by AB 32) is 427 million metric tons of CO<sub>2e</sub> (MMTCO<sub>2e</sub>). The emissions from dam removal would be 0.002 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 MMTCO<sub>2e</sub>; therefore, the Proposed Action would equal approximately 1 percent of allowable construction emissions. **The one year construction emissions would not exceed the established significance threshold for ongoing industrial emissions. Therefore, the GHG emissions related to construction would be less than significant.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river would result in short-term and temporary increases in GHG emissions from vehicle exhaust.* GHG emission impacts associated with the water supply pipeline construction would be the same as those discussed for the Proposed Action. **The impact on GHG emissions and climate change from the construction of the Yreka water supply pipeline would be less than significant.**

*Activities associated with several IMs could result in short-term and temporary increases in GHG emissions from vehicle exhaust.* GHG emission impacts associated with implementation of IMs would be the same as those discussed for the Proposed Action. **The impact on GHG emissions and climate change from implementing the IMs would be less than significant.**

*Restoration actions would result in short-term and temporary increases in GHG emissions from the use of helicopters, trucks, and barges.* GHG emission impacts associated with the restoration actions would be the same as those discussed for the Proposed Action. **The impact on GHG emissions and climate change from revegetation would be less than significant.**

*Relocation and demolition of various recreation facilities would result in short-term and temporary increases in GHG emissions from vehicle exhaust.* GHG emission impacts associated with the recreation facilities would be the same as those discussed for the

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<sup>12</sup> The value of 7,748 MTCO<sub>2e</sub> includes emissions from the JC Boyle Dam. Although JC Boyle Dam is located in Oregon, CEQA requires project impacts to be evaluated for significance. Since the Proposed Action includes the removal of JC Boyle Dam, emissions from its removal were included in the significance determination.

Proposed Action. **The impact on GHG emissions and climate change from the relocation and demolition of recreation facilities would be less than significant.**

*Removing a renewable source of power by removing the dams could result in increased GHG emissions from possible non-renewable alternate sources of power.* As with the Proposed Action, the Partial Facilities Removal Alternative would result in decreased capacity to generate electricity from all of the dams. Although some of this infrastructure would remain under this alternative, the power-generating ability of the dams would be eliminated. As a result, electricity generation would need to be replaced from other sources of power.

As discussed for the Proposed Action, in the long-term, it is expected that PacifiCorp would be able to eventually replace the lost energy from the dams with other sources of renewable power. Furthermore, some degree of GHG emissions could be offset with reforestation, but the increased carbon sequestration would not be sufficient to counteract increased emissions that may result from use of an alternative power source. The expected increase in GHG emissions from replacing these four dams with a different energy source would be the same as those shown in Table 3.10-5 and Table 3.10-6. The expected emissions increases that could occur when water is no longer impounded in the reservoirs would be the same as those shown in Table 3.10-7. **Emissions from power replacement would therefore be a significant impact. Mitigation Measures CC-1 through CC-3 would be implemented to reduce emissions from replacement power. Although these measures are expected to lessen the degree of significance, it is expected that GHG emissions would remain significant and unavoidable in the short term until PacifiCorp adds new sources of renewable power that would replace the removed dams.**

#### **Keno Transfer**

The effects of the Keno Transfer would be the same as those for the Proposed Action.

#### **East and West Side Facility Decommissioning**

The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action.

#### **KBRA**

*Construction activities associated with the KBRA programs involving construction could cause temporary increases in GHG emissions and climate change.* Similarly to the Proposed Action, under this alternative the KBRA would be fully implemented. The effects of implementing the KBRA would be the same as those described in the Proposed Action. **The impact on GHG emissions and climate change from implementing the KBRA would be less than significant.**

*Implementation of the Power for Water Management Program, the Drought Plan, and the Climate Change Assessment and Adaptive Management Plan could result in climate change-related impacts.* Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources as described for the Proposed

Action. Additionally, the KBRA includes two plans to assess and address climate change impacts as described in the KBRA discussion for the Proposed Action. **Implementation of these plans may cause beneficial effects to climate change.**

**Alternative 4: Fish Passage at Four Dams Alternative**  
**Effects of Climate Change on the Alternative**

The Fish Passage at Four Dams Alternative would likely result in a greater magnitude of consequences associated with climate change than the Full Facilities Removal Alternative. Greater needs for management actions, policies, and mitigation measures to protect the surrounding ecosystems and communities would likely be required without dam removal, and could result in costly future projects to either prevent or respond to the consequences of climate change. For example, disturbances caused by drought, changes to vegetation, and changes to water quality characteristics patterns might not be able to be adjusted to or absorbed as easily with the dams in place as without them.

Under existing conditions, summer and early fall water temperatures in the Klamath River regularly exceed the range of chronic effects temperature thresholds for full salmonid support (Section 3.2.3.2). The exception to this occurs in the J.C. Boyle Bypass Reach during daily powerhouse peaking periods, when warm reservoir discharges are diverted from the Bypass Reach allowing cold spring flows to dominate hydrology and water temperatures. Under the Fish Passage at Four Dams Alternative, water temperatures in the Hydroelectric Reach and the Klamath River downstream of Iron Gate Dam would not change from existing conditions (i.e., they would still exceed chronic effects thresholds during summer months), with the exception of the J.C. Boyle Bypass Reach where the extreme daily temperature fluctuations due to hydropower peaking flows would occur less frequently (i.e., weekly rather than daily) and would approach the (warmer) natural thermal regime of the river. Areas adjacent to the coldwater springs in the Bypass Reach would continue to serve as thermal refugia for aquatic species because the springs themselves would not be affected by the Fish Passage at Four Dam Alternative. Overall, this would be beneficial.

**Effects of the Alternative on Climate Change**

*Vehicle exhaust from construction of fish passage could increase GHG emissions in the short-term to levels that could exceed the significance criteria.* This alternative does not result in the removal of any excavated material from the sites, and instead only includes a reduced amount of material being hauled to the sites. Table 3.10-9 summarizes uncontrolled annual emissions inventories for the Fish Passage at Four Dams Alternative. Detailed calculations are provided in Appendix N.

**Table 3.10-9. Uncontrolled Direct GHG Emissions Inventories for Fish Passage at Four Dams**

Location	Project Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>			
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O <sup>2</sup>	Total
Iron Gate (2023)	1,599	1	n/a	1,600
Copco 1 (2025)	1,307	1	n/a	1,308
Copco 2 (2024)	302	<1	n/a	302
J.C. Boyle (2022)	820	<1	n/a	820
Maximum Annual Emissions <sup>3</sup>	1,599	1	n/a	1,600

Notes:

<sup>1</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

<sup>2</sup> Nitrous oxide (N<sub>2</sub>O) emissions are not directly estimated from the various emission calculation models; therefore, emissions are estimated as zero for most equipment.

<sup>3</sup> Construction of the fish ladders occur during different years and activities for each dam site do not overlap; therefore, the maximum emissions are shown to evaluate significance.

Key:

CO<sub>2</sub> = carbon dioxide

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

As Table 3.10-9 shows, there would be a net increase in GHG emissions from construction of fish passages; however, these emissions would be temporary and would not contribute to long-term emissions. Constructing fish passage would contribute a maximum of 1,600 MTCO<sub>2</sub>e to California's GHG emissions for one year. Amortizing these construction emissions over thirty years results in approximately 53 MTCO<sub>2</sub>e per year, well below the 10,000 MTCO<sub>2</sub>e threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 8,400 MTCO<sub>2</sub>e below the threshold. The 1990 GHG emissions level (and so the 2020 emissions target ascribed by AB 32) is 427 million metric tons of CO<sub>2</sub>e (MMTCO<sub>2</sub>e). The emissions constructing fish passage would be 0.0009 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 MMTCO<sub>2</sub>e; therefore, Alternative 4 would equal less than 1 percent of allowable construction emissions. **The one year construction emissions for fish passage would not exceed the established significance thresholds for ongoing industrial emissions. Therefore, the GHG emissions related to fish passage construction would be less than significant.**

*Reducing a renewable source of power by developing fish passage could result in increased GHG emissions from possible non-renewable alternate sources of power.* GHG emission effects could also occur following replacement of a renewable source of electricity with other, emission-generating sources of electric power. Although the dams would not be removed, there would be a decrease in power generation, which is necessary for successful operation of the fish passage. The FERC EIS (2007) states that the installation of fish passage would allow the Klamath Hydroelectric Project to generate an average of 533,879 MWh of electricity annually. Since the baseline generation (Iron Gate, Copco 1, Copco 2, and J.C. Boyle) is 686,000 MWh, the amount of power that may



As previously described for the No Action/No Project Alternative, CH<sub>4</sub> would be released from the reservoirs because of poor water quality conditions. Since the dams would remain in place under this alternative, CH<sub>4</sub> from the impounded water would continue to be emitted. CH<sub>4</sub> emissions from the reservoirs would range from 4,000 to 14,000 MTCO<sub>2</sub>e per year. Table 3.10-12 summarizes the expected range in emissions that could occur from power replacement and CH<sub>4</sub> released from the reservoirs.

**Table 3.10-12. Adjusted Power Replacement Emissions With Methane Emissions from Reservoirs**

Scenario	Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year)	CH <sub>4</sub> Emissions from Reservoirs (MTCO <sub>2</sub> e/year)		Adjusted Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>	
		Low	High	Low	High
Current Grid Mix	87,525	4,000	14,000	91,525	101,525
33 Percent RPS	75,431	4,000	14,000	79,431	89,431

Notes:

<sup>1</sup> Adjusted emissions reflect the difference between each scenario and the estimated CH<sub>4</sub> emissions from the reservoirs.

Key:

CO<sub>2</sub>e = carbon dioxide equivalent

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

In the long-term, it is expected that PacifiCorp would be able to eventually replace the lost energy from the dams with other sources of renewable energy.

CARB expects that implementation of its Scoping Plan (2008) would reduce 21.3 MMTCO<sub>2</sub>e by 2020 (from 2005 baseline) from California’s RPS; therefore, the possible increase in emissions from the replacement power generation allowing decreased electricity produced by the dams would account for one percent of the expected emissions reduction. Under a business-as-usual scenario, which assumes that the Scoping Plan would not be implemented, this would impede California’s ability to meet its emission reduction goal. **Emissions from power replacement would therefore be a significant impact. Mitigation Measures CC-1 through CC-3 would be implemented to reduce emissions from replacement power. Although these measures are expected to lessen the degree of significance, it is expected that GHG emissions would remain significant and unavoidable in the short term until PacifiCorp adds new sources of renewable power that would replace the removed dams.**

**Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could result in temporary increases in GHG emissions from vehicle exhaust.* Potential operational emissions could occur from haul trucks moving fish around Keno Impoundment and Link River. Upstream-migrating fish would be collected downstream from Keno Dam and relocated to Upper Klamath Lake or its tributaries. Downstream-migrating fish would be collected at Link River Dam (and

the East Side and West Side canals) and relocated downstream from Keno Dam. Operational emissions are not expected to exceed the SCAQMD's threshold of significance, especially when amortized over thirty years, because of the limited amount of haul trucks that would be expected to be used. **The impact on GHG emissions and climate change from operational emissions associated with trap and haul measures would be less than significant.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative**

#### **Effects of Climate Change on the Alternative**

The Fish Passage at Two Dams Alternative would result in the removal of two dams and the retention of two dams; the types of climate change effects from this alternative would be within the range of those described for the Proposed Action and the Fish Passage at Four Dams Alternatives. Temperature effects would likely be more similar to the Proposed Action than the Fish Passage at Four Dams Alternative because the Fish Passage at Two Dams Alternative would result in the removal of the two largest dams, which would have a greater role in warming the river water than the smaller dams.

#### **Effects of the Alternative on Climate Change**

*Vehicle exhaust from dam removal activities or construction of fish passage could increase GHG emissions in the short-term to levels that could exceed the significance criteria.* This alternative would essentially be a combination of the Proposed Action and the Fish Passage at Four Dams Alternative, and would have similar effects. Table 3.10-13 summarizes uncontrolled annual emissions inventories for the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative. Appendix N provides detailed calculations.

As Table 3.10-13 shows, there would be a net increase in GHG emissions from deconstruction of the dams; however, these emissions would be temporary and would not contribute to long-term emissions. The decommissioning of the dams would contribute 6,445 MTCO<sub>2</sub>e to California's GHG emission for one year.<sup>13</sup> Amortizing these construction emissions over thirty years results in approximately 215 MTCO<sub>2</sub>e per year, well below the 10,000 MTCO<sub>2</sub>e threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 3,555 MTCO<sub>2</sub>e below the threshold. The 1990 GHG emissions level (and so the 2020 emissions target ascribed by AB 32) is 427 million metric tons of CO<sub>2</sub>e (MMTCO<sub>2</sub>e). The emissions from dam removal would be 0.002 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 MMTCO<sub>2</sub>e; therefore, the Proposed Action would equal approximately 1 percent of allowable construction emissions. **The one year construction emissions would not exceed the established significance threshold for ongoing industrial emissions. Therefore, the GHG emissions related to construction would be less than significant.**

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<sup>13</sup> The value of 6,445 MTCO<sub>2</sub>e includes emissions from the J.C. Boyle Dam. Although J.C. Boyle Dam is located in Oregon, CEQA requires project impacts to be evaluated for significance. Since the Proposed Action includes the removal of J.C. Boyle Dam, emissions from its removal were included in the significance determination.

**Table 3.10-13. Uncontrolled Direct GHG Emissions Inventories for Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

Location	Project Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>			
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O <sup>2</sup>	Total
<b>2020</b>				
Iron Gate	3,944	4	n/a	3,949
Copco 1	1,474	1	n/a	1,475
Copco 2	269	1	n/a	269
J.C. Boyle	752	<1	n/a	752
Total Emissions (2020)	6,439	6	n/a	6,445
California Total	5,687	6	n/a	5,693
Oregon Total	752	n/a	n/a	752

Notes:

<sup>1</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

<sup>2</sup> Nitrous oxide (N<sub>2</sub>O) emissions are not directly estimated from the various emission calculation models; therefore, emissions are estimated as zero for most equipment.

Key:

CO<sub>2</sub> = carbon dioxide

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river would result in short-term and temporary increases in GHG emissions from vehicle exhaust. GHG emission impacts associated with the Yreka water supply pipeline would be the same as those described for the Proposed Action. **The impact on GHG emissions and climate change from the construction of the Yreka water supply pipeline would be less than significant.***

*Restoration actions would result in short-term and temporary increases in GHG emissions from the use of helicopters, trucks, and barges. GHG emission impacts related to restoration activities would be similar to those described for the Proposed Action but would only occur near the Iron Gate and Copco 1 dam sites. **The impact on GHG emissions and climate change from revegetation would be a significant impact. Available mitigation measures are not expected to reduce emissions to less than significant levels; therefore, emissions would remain significant and unavoidable.***

*Relocation and demolition of various recreation facilities would result in short-term and temporary increases in GHG emissions from vehicle exhaust. Recreation facilities near J.C. Boyle Reservoir would stay intact, and the Copco 2 area does not have any developed recreation facilities. Recreation facilities at Iron Gate and Copco 1 would be removed. Demolition activities would occur after dam demolition activities and are expected to be minimal. **The impact on GHG emissions and climate change from the relocation and demolition of recreation facilities would be less than significant.***

*Removing or reducing a renewable source of power by removing the dams or developing fish passage could result in increased GHG emissions from possible non-renewable*

*alternate sources of power.* It is expected that removing the existing hydropower capability from the two dams (Copco 1 and Iron Gate) would reduce power generation. Replacement power generation may result in changes in emissions. Although J.C. Boyle and Copco 2 Dams would not be removed, there would be a decrease in power generation, which is necessary for successful operation of the fish passage. The FERC EIS (2007) states that after retiring Copco 1 and Iron Gate the Klamath Hydroelectric Project would generate an average of 443,694 MWh of electricity annually. Since the baseline generation (Iron Gate, Copco 1, Copco 2, and J.C. Boyle) is 686,000 MWh, the amount of power that may need to be replaced would equal 242,306 MWh per year. Table 3.10-10 summarizes replacement emissions that would be associated with the replacement power needed after construction of this alternative.

Electricity that was originally produced from these dams would likely be replaced using another source within the PacifiCorp PCA; therefore, emission rates from the grid were estimated assuming that all power sources within the PCA would remain except for Copco 1 and Iron Gate Dams. Data from eGRID was used to estimate GHG emissions from the use of different energy resources (USEPA 2010b). The lead agencies acquired data for all of the plants within the PacifiCorp PCA and derived emission factors were derived from this source with the applicable dams removed from the mix. Table 3.10-14 summarizes the increase in emissions that could result from the use of replacement power from other sources assuming that the current power resource mix was used. Table 3.10-15 summarizes the increase in emissions that could result from the use of replacement power from other sources assuming that PacifiCorp met its RPS obligations.

**Table 3.10-14. Electricity Generation GHG Emissions from Replacement Sources after Removal of Two Dams (Current Resource Mix)**

Alternative	Generation (MWh) <sup>1</sup>	Annual Emissions (metric tons per year) <sup>2</sup>			Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year) <sup>3</sup>			
		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total
On-Peak	155,768	66,674	3	<1	66,674	57	90	66,821
Two Dams	86,538	72,435	1	1	72,435	22	366	72,824
Total	242,306	139,109	4	1	139,109	79	456	139,644

Notes:

<sup>1</sup> Generation based on FERC EIS (2007). The Two Dams Removed generation is based on the FERC EIS for the alternative that would retire Copco 1 and Iron Gate (443,694 MWh).

<sup>2</sup> Emissions assume that 64 percent of power would be generated on-peak using natural gas; the remaining 36 percent would be generated off-peak using the PacifiCorp PCA resource mix. Emission factors were calculated from the annual emissions and generation for all sources within the PacifiCorp PCA except for the dams proposed to be removed.

<sup>3</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

Key:

CO<sub>2</sub> = carbon dioxide

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MWh = megawatt hour

lb/MWh = pounds per megawatt-hour

lb/GWh =pounds per gigawatt-hour.

eGRID = Emissions & Generation Resource Integrated Database

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

**Table 3.10-15. Electricity Generation GHG Emissions from Replacement Sources after Removal of Two Dams (33 Percent RPS)**

Alternative	Generation (MWh) <sup>1</sup>	Annual Emissions (metric tons per year) <sup>2</sup>			Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year) <sup>3</sup>			
		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total
On-Peak	155,768	66,674	3	<1	66,674	57	90	66,821
Two Dams	86,538	53,213	1	1	53,213	16	269	53,499
Total	242,306	119,888	4	1	119,888	73	359	120,320

Notes:

- <sup>1</sup> Generation based on FERC EIS (2007). The Two Dams Removed generation is based on the FERC EIS for the alternative that would retire Copco 1 and Iron Gate (443,694 MWh).
- <sup>2</sup> Emissions assume that 64 percent of power would be generated on-peak using natural gas; the remaining 36 percent would be generated off-peak using the PacifiCorp PCA resource mix. Emission factors were calculated from the annual emissions and generation for all sources within the PacifiCorp PCA except for the dams proposed to be removed. It was also assumed that PacifiCorp would meet its RPS obligation.
- <sup>3</sup> GWPs from the IPCC's *Second Assessment Report* (1996) were used in the emission calculations. GWPs of 1, 21, and 310 were used for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively.

Key:

CO<sub>2</sub> = carbon dioxide

CH<sub>4</sub> = methane

N<sub>2</sub>O = nitrous oxide

MWh = megawatt hour

lb/MWh = pounds per megawatt-hour

lb/GWh = pounds per gigawatt-hour.

eGRID = Emissions & Generation Resource Integrated Database

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

CH<sub>4</sub> emissions would occur from water impounded in the reservoirs. Since Iron Gate and Copco 1 Dams would be removed under this alternative, the only remaining reservoir that would contribute to CH<sub>4</sub> emissions from impounded water would be at J.C. Boyle Dam. Assuming that this would be the only source of emissions, CH<sub>4</sub> emissions would range from 700 to 3,000 MTCO<sub>2</sub>e per year for the J.C. Boyle Reservoir, equivalent to approximately 0.5 to 2 percent of replacement power emission<sup>14</sup>. See Appendix N for detailed calculations. Table 3.10-16 summarizes the adjusted power replacement emissions that could occur when CH<sub>4</sub> emissions from impounded water at J.C. Boyle Reservoir is considered.

**Table 3.10-16. Adjusted Power Replacement Emissions With Methane Emissions from Reservoirs**

Scenario	Annual CO <sub>2</sub> e Emissions (MTCO <sub>2</sub> e/year)	CH <sub>4</sub> Emissions from Reservoirs (MTCO <sub>2</sub> e/year)		Adjusted Emissions (MTCO <sub>2</sub> e/year) <sup>1</sup>	
		Low	High	Low	High
Current Grid Mix	139,644	700	3,000	140,344	142,644
33 Percent RPS	120,320	700	3,000	121,020	123,320

Notes:

- <sup>1</sup> Adjusted emissions reflect the difference between each scenario and the estimated CH<sub>4</sub> emissions from the reservoirs.

Key:

CO<sub>2</sub>e = carbon dioxide equivalent

MTCO<sub>2</sub>e/year = metric tons carbon dioxide equivalent per year

<sup>14</sup> Emissions range is valid for both renewable portfolio standard assumptions (i.e., current grid mix or 33 percent renewable power).

In addition to the emissions from possible natural gas combustion, there could also be emissions associated with SF<sub>6</sub> leaks. Although there would be a decrease in SF<sub>6</sub> associated with the removal of transmission lines under this alternative, these emissions could be counteracted by increases from new power supplies that would be used to replace the existing power. As a result, determining the net SF<sub>6</sub> emissions is not possible. **Emissions from power replacement would be significant and unavoidable.**

#### **Trap and Haul – Programmatic Measure**

*Implementation of trap and haul measures could result in temporary increases in GHG emissions from vehicle exhaust.* The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. **The impact on GHG emissions and climate change from operational emissions associated with trap and haul measures would be less than significant.**

#### **3.10.4.4 Mitigation Measures**

As required by the KHSA, PacifiCorp would cooperate in the investigation or consideration of joint development and ownership of renewable generation resources, and purchase by PacifiCorp of power from renewable energy projects developed by Klamath Water and Power Authority or other parties. Although this effect cannot be quantified, the development of this power would help of offset the significant impacts expected from any use of replacement power following removal of the dams.

#### **Mitigation Measure by Consequence Summary**

CC-1 – Use the market mechanism under development as part of AB 32 development when feasible to mitigate GHG emissions impacts. The market mechanism program under AB 32 is targeted for implementation in 2012.

CC-2 – Establish an energy audit program to enable local residences and business to determine how much energy they currently consume and to identify measures that would reduce energy consumption.

CC-3 – Establish an energy conservation plan to reduce the region’s reliance on purchased electricity.

#### **Effectiveness of Mitigation in Reducing Consequence**

The effectiveness of the various mitigation measures would vary based on the type of measures that would be implemented. Market-based measures could potentially be 100 percent effective at offsetting the significant emissions, but may not be cost-effective depending on the availability of carbon credits. Plus, this measure would be contingent on the availability of carbon credits on the open market. If credits are scarce when they need to be purchased, then it may be difficult to offset the entire amount.

The effectiveness of the energy audits and conservation programs would vary based on the improvements that would be made following the audit. While the audits can identify

deficiencies in the energy efficiency of a residential or commercial source, there is no guarantee that the identified improvements would be made. The California Air Pollution Control Officers Association published a resource called *Quantifying Greenhouse Gas Mitigation Measures* (2010) that quantifies the effectiveness of various GHG emission reduction measures. For example, if a non-residential building is constructed to be more energy efficient than the 2008 Title 24 standards, the GHG emissions from electricity can be reduced up to 0.40 percent for every 1 percent improvement over 2008 Title 24. Installing energy efficient appliances could reduce GHG emissions up to 2.59 percent.

Table 3.10-17 summarizes the GHG emissions that would be expected from power replacement activities following dam removal. All alternatives would result in significant impacts from use of replacement power following removal of the dams or reductions necessary to properly maintain fish passage. Table 3.10-18 summarizes GHG emissions that would be predicted to occur from power replacement activities with CH<sub>4</sub> that would be produced from impounded water.

**Table 3.10-17. Impact Summary Table (Without Methane Generation from Reservoirs)**

Alternative	Emissions (metric tons CO <sub>2</sub> e/year)		
	Deconstruction	Power Replacement	
		(Current Resource Mix)	(33% RPS)
2	8,558	396,575	341,539
3	7,748	396,575	341,539
4	1,600	87,525	75,431
5	6,445	139,644	120,320

Key:

CO<sub>2</sub>e = carbon dioxide equivalent

RPS = Renewable Portfolio Standard

**Table 3.10-18. Impact Summary Table (With Methane Generation from Reservoirs)**

Alternative	Power Replacement and CH <sub>4</sub> from Impounded Reservoirs Emissions (metric tons CO <sub>2</sub> e/year)			
	(Current Resource Mix)		(33% RPS)	
	Low <sup>1</sup>	High <sup>2</sup>	Low <sup>1</sup>	High <sup>2</sup>
2	392,575	382,575	337,539	327,539
3	392,575	382,575	337,539	327,539
4	91,525	101,525	79,431	89,431
5	140,344	142,644	121,020	123,320

Notes:

<sup>1</sup> Low power replacement refers to minimum CH<sub>4</sub> emissions predicted to be emitted by the reservoirs.

<sup>2</sup> High power replacement refers to maximum CH<sub>4</sub> emissions predicted to be emitted by the reservoirs.

Key:

CH<sub>4</sub> = methane

CO<sub>2</sub>e = carbon dioxide equivalent

RPS = Renewable Portfolio Standard

### **Agency Responsible for Mitigation Implementation**

The Dam Removal Entity would be responsible for implementing mitigation measures CC-1, CC-2, and CC-3.

### **Remaining Significant Impacts**

Following implementation of the mitigation measures specified for a given alternative, GHG emissions would remain significant and unavoidable for all four action alternatives for power replacement.

### **Mitigation Measures Associated with Other Resource Areas**

*Mitigation Measures AR-1, 2, 5-7 would cause temporary increases in GHG emissions.* These mitigation measures would involve trap and haul of fish and mollusks to protect them from the reservoir drawdown and dam demolition activities. It is anticipated that as many as 150 truck trips would be required to transport juveniles from areas downstream of Iron Gate Dam to the confluence of the Klamath and Trinity Rivers between February and April 2020. The increase in daily truck trips is expected to be minor (approximately 2 trips per day) and would not contribute substantially to the existing emissions. **The impacts associated with increases in GHG emissions from these mitigation measures would be less than significant.**

*Mitigation Measure TR-1 could cause a temporary increase in GHG emissions.* Relocation of Jenny Creek Bridge and culverts near Iron Gate Reservoir would occur before the other construction phases of dam removal. On- and off-road construction equipment would be used to complete the necessary construction, but would be minor compared to the dam demolition emissions. **The impacts associated with increases in GHG emissions from Mitigation Measure TR-1 would be less than significant.**

*Mitigation Measure REC-1 could cause a temporary increase in GHG emissions.* REC-1 calls for the preparation of a plan to develop new recreational facilities along the new river channel once the reservoirs are removed. On- and off-road construction equipment would be used to complete the necessary construction, but would be minor compared to the dam demolition emissions, and would occur after the demolition was complete. **The impacts associated with increases in GHG emissions from Mitigation Measure REC-1 would be less than significant.**

*Several other mitigation measures may require construction, including Mitigation Measure H-2 (move or elevate structures with flood risk), GW-1 (deepen or replace wells), and WRWS-1 (modify water intakes). These measures could produce temporary impacts on GHG emissions during construction activities within localized areas.* These activities would take place before or after the primary construction and deconstruction activities associated with the Proposed Action and action alternatives. The same or similar elements as for the Proposed Action and action alternatives would be incorporated into these construction activities to avoid or reduce impacts on wildlife and plants, including special-status species, and sensitive habitats. **Impacts on GHG emissions from the implementation of H-2, GW-1, and WRWS-1 would be less than significant.**

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## **3.11 Geology, Soils, and Geologic Hazards**

Geomorphology and sediment transport in the Klamath River watershed have implications on water quality and the survivability of aquatic species that use the sediment beds for reproduction (e.g., egg laying, larval stages). This section provides material relevant to the analysis of each of these issues; however, specific impacts on water quality and aquatic biology are addressed in Section 3.2, Water Quality, and Section 3.3, Aquatic Resources. This section assesses the changes to geomorphology and the potential for shoreline landslides and erosion due to sediment transport processes within the Klamath River watershed. This analysis also assesses the potential for local sedimentation in eddies and other “dead” zones in the Klamath River channel, as well as the effects on the estuary both during and following dam removal activities. Finally, this section discusses the potential for impacts from geologic hazards such as seismology and volcanology in the project area.

### **3.11.1 Area of Analysis**

The area of analysis, or “project area,” for the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for geology, soils and geologic hazards includes the riverbed and reservoir banks at the sites of the Four Facilities as well as the riverbed and adjacent banks along the Klamath River downstream of Iron Gate Dam to its mouth at the Pacific Ocean.

### **3.11.2 Regulatory Framework**

Geology, soils, and geologic hazards within the area of analysis are regulated by state and local laws and policies, which are listed below.

#### **3.11.2.1 State Authorities and Regulations**

- Oregon Statewide Planning Goals and Regulations (Oregon Department of Land Conservation and Development, 2001)
- Oregon Revised Statute 455.477 (Oregon, State of, 2009 edition)
- Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code, Division 2, Chapter 7.5)
- Seismic Hazards Mapping Act (California Public Resources Code, Division 2, Chapter 7.8)

#### **3.11.2.1 State Authorities and Regulations**

- Siskiyou County General Plan, Land Use and Seismic Safety elements (Siskiyou County 1975, 1980)

### **3.11.3 Existing Conditions/Affected Environment**

The potential removal of the Four Facilities raises concerns regarding the amount and nature of sediments stored in the respective reservoirs. Data collected to date indicates

that approximately 13.5 million cubic yards (yd<sup>3</sup>) of deposits are stored in the four reservoirs and that these deposits consist of fine-grained particles (coarse sand and finer). The channel bed of the river mainstem downstream is primarily composed of cobble-sized material (Stillwater Sciences 2008; Department of Interior [DOI] 2010).

### **3.11.3.1 Regional Geology**

The Klamath Basin lies at or near the convergence of three tectonic plates that influence the geologic setting of the region: the Pacific, Juan de Fuca, and North American Plates. Consequently, the Klamath River flows through four distinct geologic provinces, each of which changes the character of the river's channel morphology and its tributary watersheds, varying the supply of inputs such as water, sediment, nutrients, and wood (Federal Energy Regulatory Commission [FERC] 2007). The Upper Klamath Basin lies in the transition zone between the Modoc Plateau and Cascade Range physiographic provinces, with the Klamath River cutting west through the Klamath Mountain province and then the Coast Range province where it reaches the Pacific Ocean near Requa, California (Figure 3.11-1; California Department of Conservation 2002; DOI 2010).

The Modoc Plateau abuts the Basin and Range Province where volcanic ramparts transition to escarpments with the valleys of the Basin and Range province. The Basin and Range province is an area of relatively young (Quaternary to Tertiary age) volcanic rocks with lesser amounts of intrusive rocks (DOI 2010). Basin and Range faults either displace the volcanic ramparts of the Modoc Plateau or are buried beneath them. The Klamath River passes through this province from the city of Klamath Falls to the Oregon-California state line. Below the state line, the river passes through the Cascades province. The portion of the basin that straddles the Modoc Plateau and Cascade Range provinces is typically called the "Upper" Klamath Basin. As the Klamath River flows towards the Pacific Ocean, downstream from Iron Gate Dam, it passes through the Klamath Mountains geomorphic province (which includes the Trinity Alps, Salmon Mountains, Marble Mountains, and Siskiyou Mountains). Rocks here are completely different from rocks upstream of Iron Gate Dam and are composed mostly of Cretaceous to Paleozoic age metamorphosed marine igneous and sedimentary rocks. Consequently, numerous faults and antiforms<sup>1</sup> are exposed along the river's path as it winds its way through the Klamath Mountains to the Pacific Ocean (DOI 2010).

Below river mile (RM) 40 (from the town of Weitchpec to the Pacific Ocean) the Klamath River traverses the Coast Range province. The geology of this area is underlain mostly by the Eastern Belt of the Franciscan Complex and a sliver of the Central Belt along the coast. The Eastern Belt is composed of schist and meta-sedimentary rocks (mostly metagraywacke) with minor amounts of shale, chert, and conglomerate. The Central Belt is principally an argillite-matrix mélangé that contains kilometer-sized slabs of greenstone, serpentinite, graywacke, and abundant meter-size blocks of greenstone, graywacke, chert, higher-grade metamorphics, limestone, and lenses of serpentinite

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<sup>1</sup> An antiform refers to a fold in the geology which curves upward but which the age of the geologic layers at the surface are unknown.

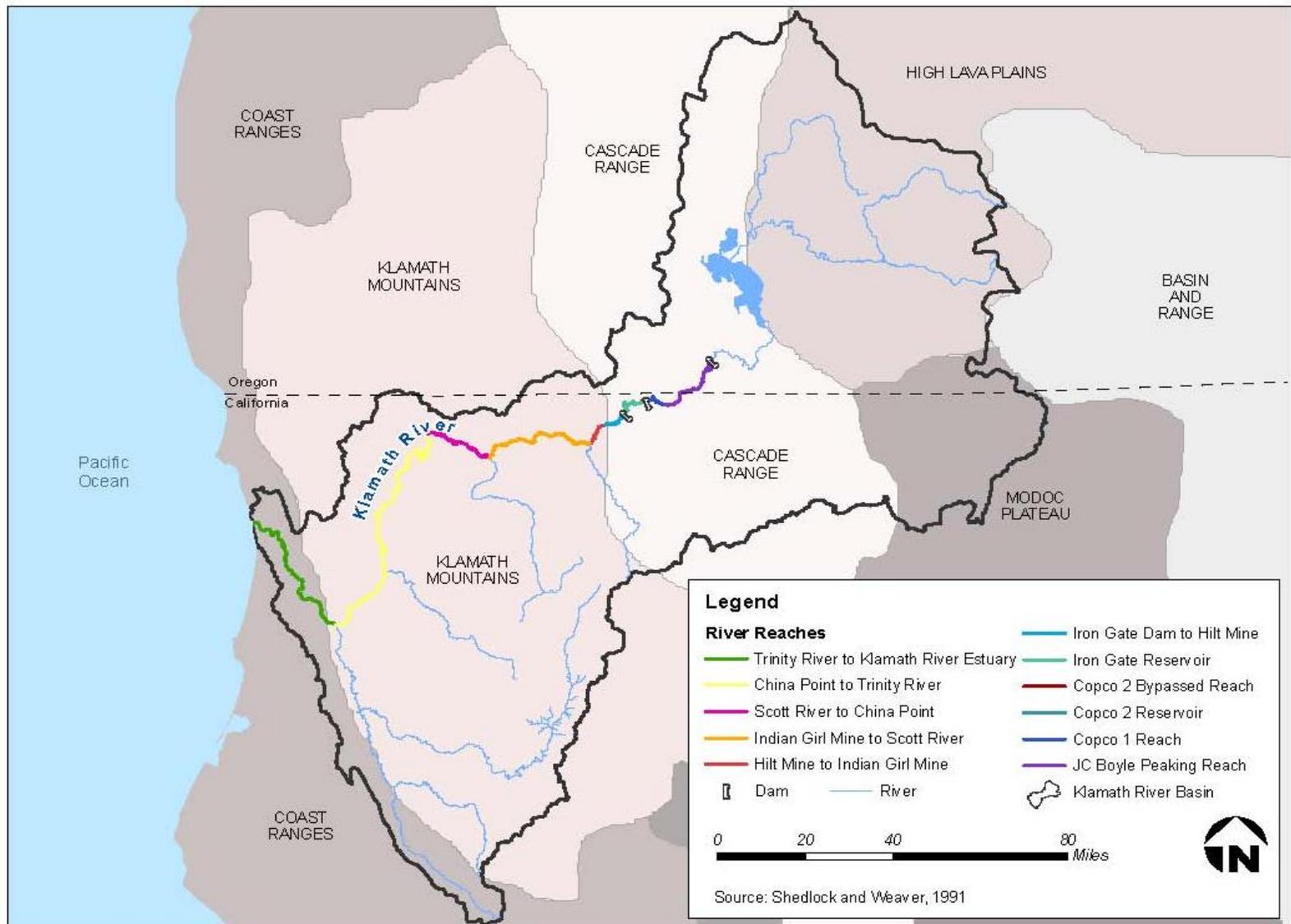


Figure 3.11-1. Klamath Basin Physiographic Provinces

(Jayko and Blake 1987). The Franciscan Complex generally consists of sandstone with smaller amounts of shale, chert, limestone, conglomerate, as well as serpentine and blueschist. Movement of the tectonic plates results in faulting in the Coast Range and the continued uplifting of the relatively young Franciscan rocks. This movement in conjunction with high precipitation rates and weak nature of the rocks has resulted in high erosion rates that create steep hillslopes and high sediment yields (FERC 2007).

### **3.11.3.2 Geomorphology**

In many ways the Klamath River is the reverse of most river systems. The headwaters flow through relatively flat, open country, and then flow through mountainous areas with input of cold water from the major tributaries. Accordingly, the river is warmer and flatter upstream of the project area, while downstream portions, beginning at the project area, tend to be colder and steeper. The Klamath River from the Oregon-California Stateline to downstream from Iron Gate Dam is a predominantly non-alluvial, sediment supply-limited river flowing through mountainous terrain. Downstream from the dam and for most of the river's length to the Pacific Ocean, the river maintains a relatively steep, high-energy, coarse-grained channel frequently confined by bedrock. Much of the course of the river in the Klamath Hydroelectric Reach is bedrock controlled, interspersed with relatively short alluvial reaches; thus, the influence of the Four Facilities on river geomorphology within the project area and downstream is limited. Floodplain development is minimal, and wider valleys allowing alluvial channel migration processes are rare. The following subsections provide a more detailed description of the geology and geomorphology of each of the subject reservoirs and associated river reaches, beginning with J.C. Boyle Reservoir and continuing downstream to the river estuary.

#### **J.C. Boyle Reservoir**

The bedrock surrounding and underlying J.C. Boyle Reservoir is principally composed of moderately well-bedded to massive, moderately well-consolidated sedimentary rocks containing volcanic material. Lava flows overlie these rocks and form many of the ridges above the reservoir. In the downstream portion of the reservoir (downstream from the Highway 66 Bridge), young lava flows line the sides of the reservoir (DOI 2010).

#### **J.C. Boyle Peaking Reach**

Downstream from J.C. Boyle Reservoir, the river canyon begins to open and channel slope decreases. This reach has a relatively low gradient (approximately 0.8 percent) and alternates between pools, bars, runs, and riffles. There is a wide terrace, which supports a riparian corridor of varying width along the channel, beyond which there is a floodplain. There are several side channels in conjunction with lateral bars and islands (FERC 2007).

#### **Copco 1 Reservoir**

The Copco 1 Reservoir is at a topographic transition area on the Klamath River, such that about 80 percent of the reservoir occupies a formerly lower gradient reach of the river. This break in stream gradient is largely the result of cinder cones and associated lava flows at the downstream portion of the reservoir (FERC 2007). Thus, geologic conditions in Copco 1 Reservoir are different than those in J.C. Boyle Reservoir, even

though the bedrock beneath and surrounding both reservoirs consists primarily of rocks formed from older volcanic flows overlain by younger lava flows. The rocks that underlie Copco 1 Reservoir contain thick deposits of airfall tuff and ash flows and there are several young volcanic eruptive cinders and cinder cones adjacent to the reservoir. Additionally a diatomite deposit along the southern downstream shore of the reservoir near Copco 1 Dam is even with or extending up to 20 feet above the reservoir surface (PanGeo 2008).<sup>2</sup> Several streams enter Copco 1 Reservoir, including Long Prairie Creek, Beaver Creek, Deer Creek, and Raymond Gulch. Sediment depositions and/or delta formations are present at the mouths of the larger streams in the reservoir (DOI 2010).

### **Copco 2 Reservoir**

Copco 2 Reservoir is a relatively short impoundment (extending just over 0.25 mile) that lies immediately downstream from Copco 1 Dam. The reservoir is narrow and confined by a narrow bedrock canyon formed by lava flow (FERC 2007). As it is at Copco 1 Dam, rock at the Copco 2 Dam consists of a combination of lava flows and shallow intrusions. The bedrock surrounding and underlying the reservoir comprises basalt and andesite and steep slopes consisting of volcanic cobbles and boulders lie along both sides (DOI 2010).

### **Copco 2 Bypass Reach (RM 198.3–196.9)**

Downstream from Copco 2 Dam, the Copco 2 Bypass Reach is characterized by a confined, boulder- and bedrock-dominated channel. The river in this reach is strongly influenced by the lava flow on the right bank of the river and there is minimal floodplain area. The average gradient of the reach is about 1.9 percent. Fossilized boulder-cobble bars dominate the channel cross section. Measurements of the bar by PacifiCorp during the FERC relicensing proceedings found that the median grain size was approximately 10 inches. Bedrock ledges also exist within the reach. Near the end of the reach, the Copco 2 Powerhouse discharges water into the Klamath River (FERC 2007).

### **Iron Gate Reservoir and Tributaries (RM 196.9–190.1)**

Like Copco 1 Reservoir, Iron Gate Reservoir overlies a topographic transition on the Klamath River, where a steeper reach of river upstream (that of the Copco 2 Bypass Reach and a portion of the river inundated by Copco 1 Reservoir and Copco 2 Reservoir) transitions into the lower gradient reach downstream from Iron Gate Reservoir. In this area, the topography widens, and the channel is less restricted by the localized basalt lava flow from north of the Copco 2 Bypass Reach (FERC 2007). The reservoir has relatively steep topographic side-slopes and a narrow channel with numerous side drainages. Three of these side drainages are large, and two (Camp Creek at Mirror Cove and Jenny Creek) likely contribute substantial amounts of sediment to the reservoir. Except for these three side drainages, Iron Gate Reservoir hosts a relatively similar depositional environment throughout its length (DOI 2010).

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<sup>2</sup> Diatomite is a chalk-like, soft, friable, earthy, very fine-grained, siliceous sedimentary rock, usually light in color. It is principally as a filter aid; but it has many other commercial applications, such as cement additives, absorbents, fillers, and insulation (USGS 2011).

**Iron Gate Dam to Hilt Mine (RM 190-181)**

The first reach downstream from Iron Gate Dam consists of a narrow floodplain and terraces confined by bedrock hills of the Western Cascade Volcanics and sedimentary rocks of the Cretaceous Hornbrook Formation. The channel is mostly single thread with a few areas of split flow that form mid-channel bars and side channels of short length. Most of the bars are at least partially vegetated, leaving few areas of exposed bars in the reach. Main tributaries that enter this reach include Brush Creek, Bogus Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek. With the exception of Cottonwood Creek, these tributaries form relatively small alluvial fans at their confluences with the Klamath River. Cottonwood Creek forms a large alluvial fan at its confluence with the river. Klamath River terraces are carved into the Cottonwood Creek alluvial fan deposits, suggesting that sediment input from Cottonwood Creek is limited to areas near and within the main channel of Cottonwood Creek (DOI 2011a).

**Hilt Mine to Indian Girl Mine (RM 181-174.6)**

In this reach, the change in the physical characteristics of the bedrock marks a transition in channel confinement, where more resistant rocks create a narrow canyon with narrow alternating terraces along the reach length. Few bars exist in this reach; at RM 179, a mid-channel bar appears to be associated with the Williams Creek alluvial fan, which enters at the upstream end of the high terrace of the Randolph Collier rest area. The Shasta River enters from the south near RM 177 and forms a small gravel bar at its confluence with the Klamath River. The only other notable tributary in the reach is Ash Creek, which forms a fan of negligible size at its confluence with the Klamath River. Other notable features in this reach are associated with in-stream mining, including cobble-boulder benches and bars and a few wing-dam pits (DOI 2011a).

**Indian Girl Mine to Scott River (RM 174.6-143)**

From Indian Girl Mine, the river valley broadens slightly within the canyon and allows for the preservation of broad gravelly terraces that have been extensively mined. In areas not obscured by mining, overflow channels are present on the terrace surfaces. Unvegetated bars are more prevalent in this reach and exist as point bars along the inside bends of channel meanders as well as mid-channel bar and side channel complexes. The channel maintains a mostly single thread meandering morphology with some areas of split flow around mid-channel bars.

At Gottville, several tributaries enter from the north and form a large alluvial fan complex that constricts the river and forms the Langley Falls rapid and associated large eddy directly upstream. Downstream from Gottville, between RM 166 and 161.5, the river valley narrows to about half the width of that upstream. Low terraces and point bars exist in this reach and have been extensively mined with tailings piles still visible on some of the surfaces. Channel morphology is less winding than that upstream and is single thread with a few small mid-channel bars. At the downstream end of this subreach, the Miller Gulch alluvial fan acts to constrict the channel. The river forms an eddy between the upstream end of the Miller Gulch fan and a small tributary fan from the opposite bank.

From Miller Gulch (RM 161.5) to Horse Creek (near RM 147), the river valley broadens again to include terraces with at least two levels and gravel bars. In several locations, the channel sinuosity increases. A narrow section exists in this reach from between RM 154 and RM 150 and is confined by bedrock on both sides of the river and by the Kohl Creek alluvial fan near RM 152. From RM 150 to Horse Creek, the river returns to a broader valley with a large remnant stream channel in the Cherry Flat area that has been extensively placer mined.

From Horse Creek to Scott River (RM 143), the river valley narrows and is confined by bedrock on both sides of the river. Terraces and bars are restricted to the insides of meander bends. Several small tributaries enter in this reach, forming steep alluvial fans at the confluence with the Klamath River, some of which have narrow terraces cut on their front edges. Channel morphology is single thread with a few small, unvegetated, mid-channel bars and point bars (DOI 2011a).

#### **Scott River to China Point (RM 143-118)**

Downstream from Scott River from RM 143 to 132, the extent and height of unvegetated gravel bars increases and bars become more prevalent with discontinuous narrow alluvial terraces forming along the canyon margins. Large alluvial fans control river position from RM 141 to 139 along the south side of the river. At Seiad Valley, large alluvial fans from Seiad Creek, Little Grider Creek and Grider Creek form a wider alluvial valley in which terraces are cut on the front edges of the fans and large bars and riffles are formed along the river channel as a result of tributary sediment contributions to the Klamath River.

From RM 130 to 121.5, the Klamath River flows through a winding bedrock canyon with unvegetated bars located on the insides of meander bends. Valley terraces and bedrock-cored bars are prevalent in this reach. From RM 121.5 to China Point, the canyon narrows as it enters bedrock of the Jurassic Galice Formation. Bedrock benches form along the channel margins. At China Point, an extensive, unvegetated gravel bar lies on the inside of the bend along with a higher alluvial terrace. On the south side of the river, a remnant channel is elevated above the present channel. Tributaries that contribute sediment to the river in this reach include Thompson, Fort Goff, Portuguese, Grider, Walker, O'Neil, and Macks Creeks (DOI 2011a).

#### **China Point to Trinity River (RM 118-43.5)**

From China Point to Deason Flat (RM 118-104), the channel is narrow with numerous valley terraces that have been extensively mined. Well-developed bars and riffles are formed at tributary confluences and meander bends. The lower three miles of this reach (RM 107-104) contain a greater number of unvegetated bars, which are formed by sediment inputs from Elk and Indian Creeks and channel constrictions downstream from RM 104. Tributaries in this reach contain large landslides, with Indian Creek watershed containing the most of any tributary.

From Deason Flat to Dutch Creek (RM 104-92), the river flows through a narrow bedrock canyon with low bedrock benches and gravelly veneers. Wider sections interspersed in this reach have small valley terraces that have been extensively mined and unvegetated gravel bars. This reach also contains notable landslides along the main stem, the largest of which is on the west side of the river between RM 98.5 and RM 93. Independence and Clear Creeks both contribute large amounts of sediment to the river in this reach.

From Dutch Creek to Trinity River (RM 92-43.5), the river is contained in a narrow bedrock canyon with intermittent alluvial reaches. This reach also includes the wider alluvial valley at Orleans (RM 58.5). Geomorphic features include valley terrace and bars, alluvial terraces and bars, bedrock benches and alluvial fans. Numerous landslides lie along the river and interact with the river through sediment contributions and controlling channel position. This reach is the downstream limit of channel mining on the Klamath River. Tributaries that are major contributors of sediment include Salmon River, Trinity River, Bluff Creek, Camp Creek and Ukonom Creek (DOI 2011a).

#### **Trinity River to Klamath River Estuary (RM 43.5-0)**

From Trinity River to Cappell Flat (RM 43.5-35), a narrow bedrock canyon with few bars and no floodplain or terraces exists, and is primarily bedrock controlled. Landslides and alluvial fans are less common, but locations still exist where these features have temporarily dammed the river based on remnant boulders in the channel and deposits on opposite banks.

From Cappell Flat to Starwein Flat (RM 35-10), the river flows through a narrow, confined valley with minimal floodplain and terraces. Bars are well developed and are either alternate bars formed in straighter reaches or point bars formed at meander bends. The extent of the bars increases in the downstream direction. Tributaries create split flow channels, mid-channel bars and riffles at their confluences with the main stem. Major sediment contributors include Blue, Pecwan, Cappell, Bear, and Tectah Creeks.

From Starwein Flat to the mouth (RM10-0), the river transitions into a wide valley with floodplain surfaces and narrow terrace remnants. Well-developed bars of variable height lie along the reach and several large pools and few riffles are present. Turwar Creek is the only major sediment producer in this reach, contributing mostly fine materials to the Klamath River (DOI 2011a). The lower seven miles of the Klamath River to its mouth at the Pacific Ocean is classified as a "Confined River System" with a relatively steep gradient. The river channel is largely confined by banks of hard bedrock, which keep it from forming shallow braided channels. Thus, the river is relatively narrow with cross-channel widths typically between 650 and 800 feet except at large bends and areas where bank/bar erosion is active. In these areas, the channel width increases up to 1,600 feet (the river makes several large bends that are controlled by the local geology). The relatively narrow river banks and highly variable flow (commonly 18,000 to +30,000 cubic feet per second [cfs]) make the river system "flashy", creating large variations in bedload capacity and bedload sediment gradations (DOI 2010).

The mouth of the river is characterized by a wave-dominated delta with a large barrier island parallel to the coastline (i.e., offshore sandbar). Behind the barrier island is a shallow lagoon about 2,500 feet long by less than 1,000 feet wide. This area of the Klamath River is highly dynamic, changing positions during large flood events and transporting most of its suspended load of silt and clay out to sea. The limited size of the lagoon is dominated by deposits of medium grained sand and silty sand with only very local accumulations of fine-grained materials (DOI 2010).

### **3.11.3.3 Sediment Supply and Transport**

The Klamath River is supply limited for fine material (sands and small gravels), but capacity limited for large material (cobbles and boulders) (DOI 2011a). Practically no substantial sediment is supplied to the Klamath River from the watershed above Keno Dam; because of its large surface area, Upper Klamath Lake traps practically all sediment entering it from its tributaries.

The Lead Agencies estimate average annual sediment delivery at approximately 200,000 tons per year (ton/yr) from Keno Dam to Iron Gate Dam. The Scott River supplies approximately 607,000 tons/yr; the Salmon River supplies 320,000 tons/yr; and the Trinity River supplies 3.3 million tons/yr. The total annual delivery of sediment to the ocean from the Klamath River is estimated at 5.8 million tons/yr. The total annual delivery of sediment with a size greater than 0.063 millimeters (mm) [coarse sand] is estimated to be 1.9 million tons/yr (DOI 2011a). Table 3.11-1 provides the cumulative annual sediment carried downstream by the Klamath River and shows the proportion of coarse material and fine material within the load.

### **3.11.3.4 Reservoir Substrate Composition**

In 2010, DOI conducted a sediment sampling study in the subject reservoirs to describe sediment composition and determine sediment thickness throughout all major sections of the reservoirs<sup>3</sup>. The study found that fine-grained sediment in all of the reservoirs but Copco 2 Reservoir consisted primarily of elastic silt and clay, with lesser amounts of elastic silt with fine sand. The sediment was determined to be mostly an accumulation of silt size particles of organic material such as algae and diatoms, and silt size particles of rock. The average grain size decreases nearer to the dams because smaller particles settle more slowly than larger particles. Accordingly, the upper reaches of each reservoir contained a higher percentage of silt, sand, and gravel than the lower reaches, which contain more clay, sandy elastic silt and elastic silt with trace sand. The elastic silt in all of the reservoirs had the consistency of pudding, and had very high water content (greater than 100 percent). The fine-grained sediment was also found to have a low cohesion and to be erodible; where water flowed greater than 2 to 4 miles per hour, accumulations of sediment were less than a few inches (DOI 2010). Table 3.11-2 describes the physical properties of the sediment in each reservoir, and the following paragraphs summarize the findings for each reservoir.

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<sup>3</sup> The study also addressed the chemical composition of the reservoir sediment. A summary of these results and the associated implications are addressed in Section 3.2 Water Quality.

**Table 3.11-1. Cumulative Annual Sediment Delivery to the Klamath River**

Source Area	River Mile	Cumulative delivery <sup>1</sup>		
		Total (tons/year)	% particles ≥0.063 mm	% particles ≤0.063 mm
Keno Dam to Iron Gate Dam	192.7	151,000	16%	84%
Iron Gate Dam to Cottonwood Creek	184.9	160,961	16%	84%
Cottonwood Creek	184.9	175,560	17%	83%
Cottonwood Creek to Shasta River	179.3	177,715	18%	82%
Shasta River	179.3	199,259	19%	81%
Shasta River to Beaver Creek	163.3	231,710	21%	79%
Beaver Creek	163.3	279,869	23%	77%
Beaver Creek to Scott River	145.1	373,073	25%	75%
Scott River	145.1	980,393	29%	71%
Scott River to Grider Creek	129.4	1,048,860	30%	70%
Grider Creek to Indian Creek	108.4	1,099,934	30%	70%
Indian Creek	108.4	1,173,246	30%	70%
Elk Creek	107.1	1,211,930	30%	70%
Clear Creek	100.1	1,253,972	30%	70%
Dillon Creek	85.8	1,282,389	30%	70%
Indian Creek to Dillon Creek	85.8	1,354,759	30%	70%
Dillon Creek to Salmon River	66.5	1,440,282	30%	70%
Salmon River	66.5	1,760,904	31%	69%
Salmon River to Camp Creek	57.3	1,785,769	31%	69%
Camp Creek	57.3	1,831,523	31%	69%
Camp Creek to Red Cap Creek	53.0	1,855,021	31%	69%
Red Cap Creek	53.0	1,897,796	31%	69%
Red Cap Creek to Bluff Creek	49.8	1,913,925	31%	69%
Bluff Creek	49.8	2,014,594	31%	69%
Bluff Creek to Trinity River	43.4	2,035,830	31%	69%
Trinity River	43.4	5,353,164	32%	68%
Blue Creek	16.1	5,455,971	32%	68%
Trinity River to Mouth	0.0	5,834,091	32%	68%

Source: Adapted from Stillwater Sciences 2010

Notes:

1. Density = 1.5 tons/yd<sup>3</sup>. Mass report in US short tons. Above Cottonwood Creek, assumes 16 percent of total load is ≥0.063 based on grains size distribution of reservoir sediment (Gathard Engineering Consulting 2006). Below Cottonwood Creek, assumes 10 percent of total load is bedload and 24 percent of suspended load is sand ≥0.063. Coarse sediment delivery to the ocean is less than presented in this table when attrition by abrasion is considered.

Key:

mm: millimeters

**Table 3.11-2. Physical Properties of Reservoir Sediment**

Reservoir	Location	Volume yd <sup>3</sup>	% Clay <sup>1</sup>	% Silt <sup>1</sup>	% Sand <sup>1</sup>	% Gravel <sup>1</sup>	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Porosity (%)	Dry Bulk Density lb/ft
J.C. Boyle	Upper Reservoir	380,000	17.3	26.2	56.5	0.0	45.5	14.7	173	0.82	29.5
	Lower Reservoir	620,000	38.2	49.7	12.1	0.0	173	60.6	345	0.90	16.3
	Pre-Reservoir		3.7	9.5	28.4	58.5	44.9	12.7	23.4	0.38	101
Copco I	Upper Reservoir	810,000	27.9	46.8	25.1	0.2	109.3	49.3	287	0.88	19.2
	Lower Reservoir	6,630,000	55.8	34.2	10.0	0.0	154.3	59.1	295	0.88	18.7
	Pre-Reservoir		35.6	42.2	22.2	0.0	105.0	41.5	153	0.80	32.6
Iron Gate	Upper Reservoir	830,000	35.4	43.1	21.6	0.0	70.9	29.9	192	0.83	27.0
	Lower Reservoir	2,780,000	60.7	25.5	13.5	0.4	118.7	51.4	276	0.88	19.8
	Pre-reservoir		33.6	16.9	20.4	29.1	60.6	32.5	37.9	0.50	81.8
	Upper Tributary	300,000	31.8	42.7	25.5	0.0	60.7	22.7	102	0.73	44.4
	Lower Tributary	800,000	61.8	32.0	6.1	0.0	112.2	49.6	284	0.88	19.3

Source: DOI 2010; DOI 2011a.

Notes:

<sup>1</sup>Clay = 0 to 0.005 mm; Silt = 0.005 to 0.075 mm; Sand = #200 to #4 sieve; Gravel = #4 to 3 inch

Key:

yd<sup>3</sup>: cubic yards

lb/ft: pounds per foot

### **J.C. Boyle Reservoir**

As shown in Table 3.11-2, the upper portion J.C. Boyle Reservoir primarily has coarse-grained sediment, both as pre-reservoir alluvium and reservoir sediment. The reservoir has an abundance of gravel/sand bars and cobbles exposed above the reservoir water surface, with sub-surface sand and gravel found by stab-sampling. The reservoir also likely has small, local accumulations of fine grained reservoir sediment within the upper 5,000 feet of the reservoir, but most of the reservoir sediment in this section is coarse grained. The reservoir sediment becomes finer grained with distance downstream. Sediment sampling conducted by the DOI indicates that about 5,000 feet downstream, reservoir sediment is three to five feet thick and composed of silty sand to poorly graded sand with silt with less than about 15 percent fine grained material (DOI 2010).

Only thin deposits of reservoir sediment were present at the sample sites in the middle section of the reservoir. The reservoir sediment consisted of fine-grained elastic silt with substantial accumulations of organic material. Pre-reservoir material consisted of coarse grained alluvium (silty gravel and sand), and bedrock consisted of volcaniclastic rock intensely weathered/decomposed to lean clay. Reservoir sediment was thickest in the lower section of the reservoir (ranging from 14 to 22 feet thick). Sediment in the lower section was uniformly elastic silt with greater than 90 percent fine-grained material. The sediment overlaid coarse grained pre-reservoir alluvium consisting mostly of silty gravel with sand (DOI 2010).

### **Copco 1 Reservoir**

The upper portion of Copco 1 Reservoir has a sediment thickness ranging from 3.5 to 8.0 feet consisting of elastic silt with sand. Sediments in the rest of the reservoir are relatively uniform and composed of elastic silt, containing between 88 and 99 percent fine-grained material. Sediment thickness in the main reservoir ranges from 1.3 to 9.7 feet deep (DOI 2010).

### **Copco 2 Reservoir**

The upper 500 feet of the Copco 2 Reservoir contained deposits primarily composed of cobble boulders. Similarly, the channel invert appeared to be covered mostly with angular gravel to boulder size talus and minor interstitial sand. Flow velocities in the reservoir channel at the time of sampling were relatively fast, therefore, it is likely that sediment composed of silt and clay did not deposit or had been previously eroded. Results of core drilling attempts show that cobbles, boulders, gravel, and sand formed the deposits in the bottom of the reservoir and there is a lack of fine-grained sediment (DOI 2010).

### **Iron Gate Reservoir**

Iron Gate Reservoir has relatively steep side-slopes and a narrow channel with numerous side drainages. Three of these side drainages are large, and two likely contribute substantial amounts of sediment to the reservoir. Except for the three principal side drainages, Iron Gate Reservoir has a relatively similar depositional environment throughout its length. Only the upper 6,000 feet of the reservoir has a substantial percentage of sand within the reservoir sediment. Sediment thickness ranged from 1.4 to

9.2 feet, with most samples having a thickness of less than 5 feet. Reservoir sediment was relatively uniform throughout the reservoir and consisted of elastic silt with 85 to 98 percent fine-grained material (DOI 2010).

#### **3.11.3.5 Slope Stability/Landslides**

Landslides (both into the subject reservoirs and the mainstem Klamath River) are one potential source of sediment supply to the river system. Potential landslide/rock fall areas include relatively steep slopes underlain by tuff, as well as areas of deep colluvium/talus slopes that could produce slumps and debris flows. Talus slopes are found along the Klamath River between J.C. Boyle Dam and Copco 2 Reservoir. Identified slope stability/landslide occurrences and observations at reservoirs in the study area include the following.

Recent observations of the subject reservoirs identified no areas of unstable slopes or existing landslides adjacent to J.C. Boyle Reservoir or Copco 2 Reservoir.

No areas of large-scale active landslides were observed in the slopes adjacent to Copco 1 Reservoir. Several small-to-medium sized landslide features are present on the north shore of the reservoir that may have been caused by rainfall and/or subsurface groundwater flows (Figure 3.11-2). However, the preliminary evaluation conducted by PanGeo indicates that the slopes in these areas are currently stable. Other areas of past landslides include an old, inactive slide that is visible on the westernmost end of the reservoir and a colluvium fan on the north shore immediately west of Spannus Gulch. In addition to potential sediment inputs from past landslides, wave action at the shoreline of the reservoir has eroded sand and volcanoclastic tuff beneath diatomite beds and has resulted in the calving of diatomite into the reservoir creating vertical exposures as high as 20 feet in the diatomite. The diatomite that has calved into the reservoir has most likely been eroded and re-deposited within the reservoir. Elsewhere around the reservoir, shoreline erosion has been minimal (PanGeo 2008).

Within Iron Gate Reservoir, the adjacent hillside slopes are generally considered stable with no active landslide areas. However, geomorphic features suggestive of old, inactive landslides (including small slumps a few meters wide and possible slides covering square miles) were identified on the south rim slopes above the reservoir and may have contributed to past sediment input into the reservoir. In addition, a low level of wave-induced shoreline erosion at the margin of the reservoir was observed and reported in the PanGeo (2008) study. However, the erosion has not substantially undercut or disturbed the hillside slopes, and the exposed material along the shoreline comprises relatively competent volcanic or volcanoclastic rock. According to the PanGeo study, recent erosion rills in the red volcanoclastic materials underlying the hillside slopes indicate that these fine-grained materials may be vulnerable to rapid erosion in the future if subjected to concentrated water flows (PanGeo 2008).



**Figure 3.11-2. Existing Potential Landslide Areas**

Potential landslide/rockfall areas downstream from the Four Facilities include all steep slopes underlain by tuff, as well as areas of deep colluvium/talus slopes that could produce slumps and debris. Talus slopes are found through the Klamath River Canyon (the stretch of river between J.C. Boyle and Copco 2 Dams). Continuous creep of talus and rapid rockfalls are likely on and near talus slopes, and the potential exists for slow-to-moderate migration of some of the large slides. Landsliding is also prevalent in the Franciscan geology of the lower Klamath River watershed and along tributary watersheds within the Klamath Mountain geomorphic province, such as the Salmon River (FERC 2007). As discussed above when describing the geomorphology of the river, existing landslide areas are present downstream from the Scott River confluence.

### **Soils**

#### **Upper Klamath River**

Soils in the vicinity of the Upper Klamath River, surrounding J.C. Boyle Reservoir, and along the river south to the Oregon-California border generally consist of lacustrine and alluvial clay, silt, fine-grained sand and peat (Priest et al 2008). The primary soil association along both sides of the river is Skookum-rock outcrop-Rubble land complex with 35 to 70 percent slopes. Immediately surrounding Keno Impoundment, soils consist of the Bly-Royst complex (Natural Resources Conservation Service [NRCS] 2005).

#### **Klamath Hydroelectric Project**

Soils along the Klamath River and on reaches between the subject reservoirs are less homogenous in California. However, the various soil formations can be grouped generally into those on steeper slopes, floodplain or terrace surfaces, or directly along the river itself. The soils on steeper slopes are shallow to moderately deep and comprise a 7-8 inch surface horizon of gravelly loam, and an underlying horizon of gravelly, clayey loam. Floodplain and terrace soils are comprised of deep, well-drained alluvium and colluvium. Directly along the river, soils are comprised of unconsolidated alluvium, colluvium, and fluvial deposits. These geologically recent deposits consist of unconsolidated sand, silt, and gravels deposited by water or erosion (FERC 2007).

#### **Below Iron Gate Dam**

Soils along the Klamath River below Iron Gate Dam are generally composed of associations consisting of gravelly clay loam and gravelly sandy loam (Holland-Clallam, Skalan, Weitchpec, and Lithic Mollic Dubakella associations). Soils on steeper slopes are deeper (22 to 60 inches) than those on less steep slopes and along the floodplain. These soil associations are all classified as well-drained, with low to no flooding frequency or ability for ponding water. Soils directly along the river in floodplain areas are comprised of alluvial deposits consisting of sand and gravels (NRCS 2007 and 2008).

#### **3.11.3.6 Faults and Seismicity**

Review of available fault and earthquake epicenter maps for northern California and southern Oregon show no fault lines or earthquake epicenters beneath Iron Gate Dam or the Copco Dams and Reservoirs. However, volcanic vents occur very close to the two Copco Dams. Faults exist beneath the J.C. Boyle Dam and Reservoir. However, these faults have not moved within the past 1.5 million years and, therefore, are termed not

active (Personius et al. 2003). No earthquake epicenters are mapped beneath the J.C. Boyle Reservoir, but one of the largest earthquakes ever recorded in Oregon occurred in 1993 in and around the Klamath Falls areas approximately 15 miles north of the J.C. Boyle Reservoir.

In California, the nearest active fault to the Four Facilities is the Meiss Lake fault, approximately five miles east of the Klamath River near the California/Oregon Stateline in Siskiyou County. The next nearest California-zoned active fault in relation to the Four Facilities is the Mahogany Mountain fault zone approximately 6 miles east (Jennings and Bryant 2010).

### **3.11.3.7 Volcanic Activity and Associated Strata**

The High Cascades geomorphic province consists of a narrow band of shield volcanoes built on top of the eastern portion of the Western Cascades strata. The High Cascades are represented in the vicinity of the Four Facilities by the extinct cones of Eagle Rock Mountain to the south of the Klamath River valley, the Secret Spring Mountain and McGavin Peak to the southeast, and Mount Shasta to the Northwest. There are also a series of basaltic volcanoes extending northward into Oregon towards Klamath Falls, which have been dissected by subsequent basin and range block faulting (PanGeo 2008).

In addition to the large shield volcanoes with their multiple eruptive events, numerous smaller vents and volcanoes are present in the area. The majority of the volcanism in the Upper Klamath Basin consists of single events from a given vent and most of the smaller explosive cones are formed from the interaction of flow material intersecting ground water (hydrovolcanic events). High Cascades volcanism continues to the present day (PanGeo 2008). During the last 10,000 years, Mount Shasta has erupted once per 800 year period, and once per 600 years over the last 4,500 years. The last known eruption was radiocarbon dated to approximately 200 years ago (Miller 1980).

The rocks in the vicinity of the Four Facilities range in age from roughly 45 million years old up to the present. Copco and Iron Gate Dams are in the Western Cascades. The volcanic activity that formed the Western Cascades is thought to have started between 42 and 45 million years ago (Eocene) and continued until approximately 10 and 5 million years ago. Over time, the main area of volcanic activity shifted eastward and narrowed. The intensity of volcanism also diminished and erosion activity erased much of the evidence of the original volcanoes. Estimates of the thickness of the Western Cascades strata range from between 12,000 and 15,000 feet to greater than 20,000 feet (PanGeo 2008).

In the vicinity of Copco Reservoir, up to half of the Western Cascade strata are exposed in the Klamath River Canyon as a result of river down cutting. In this exposure, the Western Cascade strata are comprised of inter-bedded tuffs, ash, and lava flows dipping to the east at approximately 25 degrees. The eastern dipping strata of the Western Cascade is overlain by the nearly flat lying High Cascade strata composed of younger Pliocene lava flows with a thickness of up to 500 feet. The inter-bedded strata of the Western Cascade can form aquifers and when coupled with a remnant volcanic heat

source and sealed by overlying High Cascade lava flows, geothermal reservoirs can form (Hammond 1983).

### **3.11.4 Environmental Consequences**

#### **3.11.4.1 Environmental Effects Determination Methods**

The environmental consequences of the alternatives focus on changes to geomorphology and sediment transport. This analysis discusses potential increases in geologic hazards downstream from the reservoirs, as well as potential increases in erosion in the Upper Klamath Basin under implementation of each of the alternatives.

DOI used the Sedimentation and River Hydraulics-One Dimension Version 2.4 sediment transport model to analyze the potential transport of reservoir sediment downstream based on different drawdown scenarios. The analysis below uses the results of DOI's sediment transport modeling to evaluate changes in downstream sediment regimes and the effect of the changes on shoreline geology downstream from the reservoirs. The analysis also qualitatively analyzes the potential for local sedimentation in eddies and other low gradient zones in the Klamath River channel.

#### **3.11.4.2 Significance Criteria**

For the purposes of this EIS/EIR, impacts would be significant if they would result in the following:

- Substantial soil erosion into reservoir areas or along the Klamath River.
- Cause new or exacerbate existing landslides along the banks of the reservoirs.
- Incomplete flushing of sediment with substantial deposition downstream, which adversely affects other associated resources (i.e., Water Quality, Fish Resources, Mollusks, and Benthic Invertebrates).
- Exposure of people or structures to adverse effects resulting from rupture of a known earthquake fault, strong seismic ground shaking, or volcanic activity.
- Remove access to diatomite beds for extraction.

#### **3.11.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

*Under the No Action/No Project Alternative, J.C. Boyle, Iron Gate, and Copco 1 Reservoirs would continue to trap sediment at rates similar to historical rates. Based on historic sediment trapping rates and sediment levels in each reservoir, it is estimated that approximately 23.5 million yd<sup>3</sup> of sediment would be stored behind the dams in 50 years time (i.e., by 2061). Studies conducted by DOI indicate that the trapping efficiency of J.C. Boyle Dam may decrease slightly as the reservoir capacity decreases but the rate at which this may happen is uncertain and is not likely to change substantially over the next 50 years (DOI 2011a). It is likely that after the storage capacity reduces to a certain level, sedimentation in the reservoirs would stop and sediment would begin to pass through the reservoir pools and be transported downstream. Table 3.11-3 summarizes the*

current estimated volume of sediment in each reservoir, the respective sediment trapping rate, and the anticipated sediment volume in each reservoir in 50 years.

No future substantial erosion or landslides are expected to occur downstream from any of the Four Facilities under the No Action/No Project Alternative. As described in Section 3.11.3 (Existing Conditions/Affected Environment), river elevation downstream from the dams is primarily controlled by large boulders and bedrock, and only limited adjustment is possible. **There would be no change from existing conditions as a result of the No Action/ No Project.**

**Table 3.11-3. Estimated Future Sediment Volume in Reservoirs under the No Action/No Project Alternative**

Reservoir	Original Storage Capacity (acre-ft)	Current Sediment Volume (yd <sup>3</sup> )	Sedimentation Rate (yd <sup>3</sup> /yr)	2061 Sediment Volume (yd <sup>3</sup> )	% Reduction in Storage Capacity
J.C. Boyle	3,495	1,000,000	19,600	2,020,000	36
Copco 1	46,867	7,400,000	81,300	11,600,000	15
Copco 2	73	0	0	0	0
Iron Gate	58,794	4,700,000	100,000	9,900,000	10
Total	109,229	13,100,000	201,000	23,500,000	13

Source: DOI 2011a

Key:

yd<sup>3</sup>: cubic yards

yd<sup>3</sup>/year: cubic yards per year

lb/ft: pounds per foot

*Under the No Action/No Project Alternative, Copco 1 Reservoir would continue to prohibit access to diatomite beds. Diatomite beds are at the southern shore of the reservoir near the dam and are even with or extending up to 20 feet above the reservoir surface. Wave action at the shoreline has eroded the diatomite. Because of their location in the reservoir and existing erosion, diatomite resources are currently inaccessible for extraction purposes. **There would be no change to the existing conditions of diatomite beds under the No Action/No Project Alternative because the resources would continue to be inaccessible.***

**Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

*Soil disturbance associated with heavy vehicle use, excavation, and grading could result in erosion during removal activities. As described in the Affected Environment, shoreline erosion is generally not a substantial factor affecting the Iron Gate and J.C. Boyle Reservoirs, although it is an issue at Copco 1 Reservoir, where eroded sand and volcaniclastic tuff has resulted in the subsequent calving of diatomite into the reservoir. This existing erosion is caused by wave action in the reservoir (PanGeo 2008). Soil disturbance associated with heavy vehicle use, excavation, and grading could result in*

erosion during removal activities at Iron Gate and J.C. Boyle Reservoirs and could exacerbate existing erosion at Copco 1 Reservoir. Prior to demolition, coverage under the General Stormwater National Pollution Discharge Elimination System (NPDES) Permit for Construction Activities in both Oregon and California would be required as per Section 402 of the Clean Water Act. Coverage under this permit requires the development and implementation of an Erosion and Sediment Control Plan prior to deconstruction that describes best management practices (BMPs) to prevent erosion during demolition activities. Implementation of these BMPs would minimize the potential for erosion into the reservoir areas. **Erosion impacts into the reservoir areas would be short-term and less than significant.**

*Drawdown of the four reservoirs could cause instability along the banks of the reservoirs.* Reservoir drawdown proposed under the Proposed Action could trigger new landslides or exacerbate existing landslides along the banks of reservoirs in the project area. Slumping and some mudflows are expected to occur from reservoir drawdown actions. Slopes with inclinations from 18 to 40 degrees would be most susceptible to slumping. The amount of slumping that could occur would be dependent on the drawdown rate (slower drawdown rates would result in fewer slides and less slumping). The slumping that would occur is part of the design, in that it would remove the unstable portions of the newly-exposed slopes while there is sufficient flow in the river to transport the material downstream. The PanGeo (2008) study, which was described in Section 3.11.3 (Existing Conditions/Affected Environment), concluded that the hillside slopes below the pool levels behind Iron Gate, Copco 1, and J.C. Boyle Dams would likely perform relatively well and remain stable during drawdown activities. In addition, no large-scale landslides are anticipated in newly exposed areas and any new slides that may develop would most likely be below the existing water level in the reservoirs, although such slides could create higher deposition on the terraces above the newly formed river channel. **These potential landslide impacts would be short-term and less than significant.**

*Reservoir drawdown at Copco 1 would reduce the potential for erosion and future landslides.* Because existing erosion at Copco 1 Reservoir is largely the result of wave action, emptying the reservoir would remove this source of shoreline erosion. As noted above, no large-scale landslides are anticipated in newly exposed areas during drawdown. In the long-term with implementation of reservoir restoration actions including hydro seeding, landslides and erosion would not be expected at a higher frequency or of a larger size than what is currently contributed from the slopes adjacent to the reservoirs. **Thus, long-term impacts with regards to erosion and potential landslides at Copco 1 Reservoir would be less than significant.**

*Drawdown of reservoirs could cause bank erosion downstream.* The drawdown of the four reservoirs would occur simultaneously beginning in January 2020. Based on the current project schedule and drawdown rate restrictions, the controlled released would maintain the minimum required flows in each reach. Section 3.6, Flood Hydrology, discusses historic flow rates and discharge statistics for each of the reservoirs. The proposed drawdown rates are consistent with the historic discharge rates from the

reservoirs and would be adjusted depending on the water year; therefore, flow rates downstream from the dams are not anticipated to increase substantially above median historic rates, if at all (discharges from the reservoirs would be similar to seasonal 10-year flood flows from the reservoirs).

Although some landslides and erosive areas have been identified in the lower river, based on the expected flow rates that are similar to existing flow rates, substantial amounts of additional erosion are not expected to occur downstream from any of the dams as a result of reservoir drawdown. **Any erosion downstream would be minimal; these impacts would be short-term and less than significant.**

*Drawdown of reservoirs and release of sediment would result in short-term increases in sedimentation in slow-moving eddies and pools downstream from the reservoirs and in the Klamath River estuary.* During reservoir drawdown in 2020, the sediment behind the four dams would be released downstream. DOI conducted modeling of the reservoir drawdown and erosion of reservoir sediment. The drawdown of Iron Gate Reservoir would ultimately control sediment released from Copco 1 and 2, and J.C. Boyle Reservoirs due to its location furthest downstream. Since all reservoirs would be drawn down concurrently, sediment released from the upstream reservoirs would remain suspended and is not anticipated to settle within Iron Gate Reservoir. However, the released sediment would likely exceed the carrying capacity of the river during some water year types, and would result in sedimentation and particle settling downstream in eddies, pools, and the Klamath River estuary. The potential for deposition downstream is dependent on particle size and the water year type in 2020, and subsequent years. In general, sediment transport capacity in a dry year would be small and any downstream sediment deposition would stay in place, until the next substantial series of storms or snowmelt came. In contrast, during a wet year, suspended sediment would be more likely to be carried through the river to the ocean without substantial settling and deposition<sup>4</sup>.

To determine how much sediment would be moved through the river, a study compared the settling velocity<sup>5</sup> of the reservoir sediment to the velocity profiles downstream from Iron Gate Dam. Based on the slope of the river and composition of river substrate downstream from the dam, as well as the daily average discharge (approximately 3,000 cfs), the study found that particles with a settling velocity less than 0.23 ft/s have the potential to be mobile as suspended sediment. This corresponds to sediment particles finer than 0.68 mm (coarse sand) (Table 3.11-4; Stillwater Sciences 2004).

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<sup>4</sup> Representative dry, median, and wet water years were defined as the 90%, 50%, and 10% exceedance flow volumes for the period from March to June at Keno on the Klamath River. The dry, median, and wet water years were 2001, 1976, and 1984, respectively.

<sup>5</sup> Settling velocity is the rate at which particles suspended in a fluid subside and are deposited. Settling velocity is dependent on gravitational force, the type of fluid, how smoothly and quickly the fluid is flowing, and the particle size and shape.

**Table 3.11-4. Estimated Particle Sizes that would be Suspended at Average and Maximum Daily Discharge Rates**

Discharge	3,000 cfs	7,000 cfs
Shear velocity	0.58 ft/s	0.76 ft/s
Maximum settling velocity for suspension	0.23 ft/s	0.34 ft/s
Corresponding particle size	0.42 mm	0.68 mm
Corresponding size class	Medium sand	Coarse sand

Source: *Stillwater Sciences 2004*

Key:

cfs: cubic feet per second (discharge rate)

ft/s: feet per second

mm: millimeters

Modeling conducted by DOI analyzed the deposition rate of the released sediment downstream of Iron Gate Dam for a two year period following commencement of drawdown activities. Three types of water year scenarios were analyzed (dry, wet, and average). The results of the modeling found that under all three water year types, fine sediment would be transported downstream as suspended sediment (DOI 2011a). As described in the Affected Environment, sediment sampling in the reservoirs has indicated that, with the exception of Copco 1, the majority of sediment is composed of fine-grained elastic silt. Therefore, it is expected that deposition would occur in pools or along vegetated area during low-flow periods, but that the deposition would be flushed downstream during high-flow events. Any settling or sedimentation of fine sediment in eddies or pools is expected to be minimal and short-lived. Further, as described in Section 3.11.3.2, Geomorphology, there is no sandbar within the mouth of the Klamath River itself; rather the sandbar is located offshore. As a result, the majority of the suspended sediment load from the river is carried out to sea and does not remain in the estuary itself. The amount of sediment delivered to the ocean in a given year is entirely dependent on the water year type.

In a wet year, the additional sediment load from removal of the dams would be relatively small compared to a dry year. However, the amount of sediment delivered to the ocean following removal of the dams is still expected to be less than the average annual supply. The only reservoir material that would be transported to the estuary would be fine material which is not expected to deposit at the estuary (DOI 2011a). Downstream of Iron Gate Dam, a substantial increase in sand content is expected in the reach between the dam and Bogus Creek. Sand is expected to increase by up to 40 percent in the month immediately following reservoir drawdown. Under a wet year scenario, the sand would decrease to below 20 percent within a year; however, under a median or dry scenario, a subsequent wet year would be required to flush the sand material from the bed. Downstream of Bogus Creek, it is expected that sand may take longer to be flushed downstream and under dry or median year scenarios it could take 5 to 6 years for sand in the bed to return to equilibrium levels between Bogus Creek and Willow Creek and up to 10 years between Willow Creek and Cottonwood Creek (DOI 2011a).

Particles greater than coarse sand would be deposited in eddies and slow-moving pools downstream following dam removal, primarily between Iron Gate Dam and Cottonwood Creek. Under the wet year scenarios, the coarse sediment load would take approximately 15 months (until March 2021) to be completely flushed downstream and into the Pacific Ocean. Although the coarse material would deposit temporarily in slow-moving portions of the river, there would be no substantial change in river bed elevation. In contrast, if drawdown were to occur during a dry year, modeling indicates that substantial deposition would still be present between Iron Gate Dam and Shasta River at the end of the two year modeling period. However, the model results indicated that under all three water type scenarios, the maximum thickness of sediment deposition immediately downstream from Iron Gate Dam would be less than 2 feet (DOI 2011a). Further, when considered in comparison to sediment loading from other existing sources along the Klamath River (refer to Table 3.11-1 above), the magnitude of the anticipated sediment release from behind the reservoirs is relatively small. A study by Stillwater Sciences (2010) assessed the sediment loading to the Klamath River based on the cumulative sediment load already contributed by tributaries to the river. The numeric modeling predicted high, medium, and low values for reservoir sediment release based on different hydrologic scenarios and the assumed dimensions of the new channel that would be created within the former reservoirs. The model predicted that the median fine-grained and total sediment load released by dam removal would not be substantially more than the cumulative average annual fine-grained and total sediment delivery between Iron Gate Dam and the Scott River. The model also predicted that the overall contribution of reservoir sediment to the river system decreased substantially downstream (Stillwater Sciences 2010).

The total sediment transport capacity of the river was not assessed in the Stillwater Sciences Study, and as such it does not demonstrate that the additional sediment load from dam removal would not deposit in the Klamath River. Rather, the findings of the analysis suggest that the release of sediment downstream during reservoir drawdown would not exceed the existing sediment load added by any tributary, and as such, the transport capacity of the river may be sufficient to transport the additional load, particularly since the river is supply-limited in regards to fine-grained material and sand.

Sedimentation impacts are therefore expected to be short-term. The significance of impacts with regard to sediment deposition is dependent on the corresponding impacts of the deposition on aquatic biology (see Section 3.3, Aquatic Resources) and water quality (see Section 3.2, Water Quality). As discussed in these sections, sediment deposition would not result in substantial adverse impacts and no mitigation measures are indicated. **Therefore, impacts with regard to sediment deposition downstream of Iron Gate Dam would be short-term and less than significant.**

*Drawdown of reservoirs could result in changes to seismic or volcanic activity.* As described in the Affected Environment, although the Four Facilities are in a historically seismic active area, the nearest active fault is approximately five miles from the dams proposed for removal. It is noted that faults do exist under J.C. Boyle Reservoir. However, these faults are reported not to have moved within the past 1.5 million years and, therefore, are termed as not active (Personius et al. 2003). Under the Proposed

Action, the Four Facilities would be removed within a one year period between November 2019 and December 2020. Sediment currently held behind the dams would be released during the same year period. Although there is substantial literature regarding the inducement of seismicity by reservoir filling, little is documented with regard to the drawdown of reservoirs of this size. Consequently, it is not expected that reservoir draining would cause such actions. Reservoir draining is also not expected to cause volcanic activity due to the distance from volcanic hazards (e.g., Mount Shasta). Further, following removal of the Four Facilities, no new structures would be constructed in the project area. **Therefore, the impacts with regard to increased risk of hazards associated with ground rupture or seismic shaking during reservoir drawdown would be less than significant.**

*Following dam removal, reservoir sediment remaining could result in changes in the amount of erosion in the river channel.* DOI 2011a, using representative dry, median, and wet years from the hydrologic period of record between 1961 and 2008, indicated that if dam removal occurred during a wet year, up to 56 percent of the reservoir sediment would be eroded. In contrast, if removal were to occur during a dry year, about 38 percent of the sediment would be eroded. The remaining sediment would be expected to remain on the reservoir terraces and dry. However, as discussed in Section 3.11.3.4 (Reservoir Substrate Composition), sediment in the reservoirs is fairly shallow (4-8 feet thick). Therefore, following erosion of the sediment during dam removal, the remaining sediment would be much more like a landscape veneer than a wedge along the newly formed river channel.

Field tests (DOI 2011a) were conducted to determine the characteristics of dried reservoir sediment. Table 3.11-5 shows a comparison of the depth of wet and dry sediment samples. As the table shows, the desiccated depth of the sample was about 60 percent of the initial depth. Deep cracks developed in the soil and the sample pulled away from the container edges. The estimated reduction in volume of the sample was about 66 percent. The porosity changed from 0.82 to approximately 0.46 and the bulk density increased from 29.5 pounds per cubic foot (lb/ft<sup>3</sup>) to approximately 87 lb/ft<sup>3</sup>. The bulk density of the dried reservoir sediment would be similar to that of the pre-dam sediment in the reservoir area. Erosion tests conducted by the Agricultural Research Service (Simon and Bell 2010) found that the erosion resistance of dried sediment was more than 10 times higher than the resistance of wet sediment. Therefore, minimal erosion is expected following completion of reservoir drawdown and dam removal activities. **The impact of dam removal on erosion would be long-term but less than significant.**

**Table 3.11-5. Comparison of Wet and Dry Reservoir Samples**

Container	Initial Thickness (inches)	Final Thickness (inches)	% of Original Thickness
1	7.00	4.25	60
2	7.88	4.63	59
3	4.50	2.75	61

Source: DOI 2011a.

*Following dam removal, reservoir sediments remaining could result in changes to downstream sediment deposition.* As discussed above, once dry, the remaining sediment in the former reservoir areas would be unlikely to erode downstream except during storm and other high-flow events. As previously discussed, the Klamath River is supply-limited for fine-grained material. Further, based on the estimated settling velocity of the remaining sediment and average flows during wet years and storm events, it is expected that any eroded sediment would be transported as suspended sediment flushed downstream. **Therefore, impacts of dam removal on downstream sediment supply would be long-term, but less than significant.**

*Following dam removal, the reservoir sediment remaining would dry and could affect restoration activities and/or future road construction activities.* As discussed previously, following dam removal an estimated 44 to 62 percent of the sediment in the reservoirs would remain and is expected to settle on the terraces of the new river channel. Initial sampling conducted on the sediment indicates that once dry, it has a tendency to crack and substantially decrease in porosity. This characteristic would not necessarily limit the range of restoration activities but could limit future construction activities (e.g., access road construction, recreation facilities) that could occur in the former reservoir area. Limitations on future construction due to sediment properties are analyzed in the Reservoir Restoration Study (DOI 2011b). **The potential limiting characteristics of the remaining sediment in the reservoirs would be considered a significant impact, but mitigation measure GEO-1 would reduce these impacts to less than significant.**

*Following dam removal, diatomite beds near Copco Reservoir would be inaccessible.* Under Proposed Action, the ownership of the reservoir land would be transferred to the Dam Removal Entity (DRE). After transfer it is likely that the DRE would not allow access to the diatomite beds for commercial extraction. Additionally, any paleontological resources potentially contained within the diatomite beds would remain inaccessible. **Therefore, there would be no change from existing conditions for diatomite beds under the Proposed Action because the resources would continue to be inaccessible.**

*Following reservoir drawdown, the Yreka water supply pipeline would be relocated.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and would have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline would either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Bridge just downstream of Iron Gate Dam. The construction of a pipe bridge would not affect sediment supplies, contribute substantially to erosion, or expose people or populations to geologic hazards. Placing the pipe along the Lakeview Bridge would have less impact than the construction associated with the pipe bridge. **Therefore, there would be no change in the existing conditions of geology, soils, or geologic hazards as a result of the pipeline relocation.**

*Following reservoir drawdown, recreational facilities currently located on the banks of the existing reservoirs would be removed.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities would be removed. The removal of the recreational facilities would not affect sediment supplies, contribute substantially to erosion, or expose people or populations to geologic hazards. **Therefore, there would be no change in the existing conditions of geology, soils, or geologic hazards as a result of the recreational facilities.**

#### **Keno Transfer**

*The Keno Transfer could have adverse effects to geology, soils, or geologic hazards.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on geology and soils compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (Klamath Hydroelectric Settlement Agreement [KHSA] Section 7.5.4). **Therefore, the implementation of the Keno Transfer would result in no change from existing conditions.**

#### **East and West Side Facilities**

*The decommissioning of the East and West Side Facilities could have adverse effects to geology, soils, or geologic hazards.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Redirection of flows would not change sedimentation rates in Upper Klamath Lake and the action would have no impact to geology and soils. **Therefore, the decommissioning of the East and West Side Facilities would result in no change from existing conditions.**

#### **KBRA**

The KBRA has one element that could result in changes to geology, soils and geologic hazards:

- Phases I and II Fisheries Restoration Plans

#### **Phases 1 and II Fisheries Restoration Plans**

*Implementation of the Phase I Fisheries Restoration Plan could result in construction related sediment erosion.* Several ongoing resource management actions related to fishery health and water quality may be amplified under the Phase I Plan (Section 2.4.3.9). The following sections describe the ongoing actions and types of new programs that could be implemented, and their anticipated short-term and long-term effects at a programmatic level.

#### *Floodplain Rehabilitation*

Floodplain rehabilitation work would include activities to improve or restore connections between channels and floodplains to create and maintain off-channel habitat accessible to overwintering juvenile salmonids. In the short-term (i.e., during construction activities), these activities may involve the use of backhoe equipment to dig channels, remove/reposition levees and dikes, and conduct mechanical planting. These construction activities could result in increased erosion as a result of ground disturbance. In the long term, increased seasonal off-channel habitat, wetland restoration, and levee setbacks, may reduce sediment erosion due as a result of potential reduction in flood flow velocity in some flood events through the reestablishment of floodplains.

#### *Woody Debris Placement*

In-stream and streambank large woody debris placement may include both mobile wood (i.e., unanchored) and complex stationary (i.e., anchored) structures and may be used to create off-channel fish habitat or provide cover in deeper pools. In the short term, these activities may involve the use of construction equipment to place large wood in the stream channel or along banks. These activities could result in increased erosion as a result of ground disturbance in construction staging areas and on the stream banks and in the streambeds.

#### *Fish Passage Correction*

Correction of fish passage issues throughout the Klamath Basin may include culvert upgrades or replacement to meet current fish passage standards and correction of other fish blockages to restore access to new or historical habitats. In the short term, these activities may include in-channel construction of culverts through existing roadways, which could result in increased erosion as a result of ground and riverbank disturbance.

#### *Mechanical Thinning and Prescribed Burning*

Mechanical thinning and prescribed burning of upland forest areas may be used to mimic some of the functions and characteristics historically provided by a natural fire regime. In the short term, thinning and prescribed burning could increase sediment erosion through reduction in groundcover. In the long term, thinning and prescribed burning may reduce the potential for catastrophic fires and the associated high rates of erosion and nutrient release (primarily phosphorus) to tributaries and the main-stem Klamath River.

#### *Road Decommissioning*

Road decommissioning would reduce road densities in areas with a high potential for slope failure and would stabilize hillsides. In the short-term these construction activities could result in increased erosion as a result of ground disturbance. In the long-term, these activities would decrease the incidence of road failure and would minimize a source of landslide and erosion generated input of sediment into water bodies in the Klamath Basin.

#### *Gravel Augmentation*

Gravel augmentation involves the direct placement of spawning size gravel into the stream channel. Gravel augmentation can increase spawning habitat in systems by increasing the amount of area with suitable substrate. Gravel augmentation activities

may involve transportation of gravel from an off-site source using dump trucks and placement in the stream using backhoes. In the short term, this could introduce fine sediments into the river channel. Depending on the water year during which gravel augmentation takes place, this sediment could result in temporary deposition downstream.

#### *Summary*

Construction actions including the operation of construction equipment and the associated soil disturbance could result in erosion into the active river channel and could cause new or exacerbate existing landslide areas. Additionally gravel augmentation could result in temporary sediment transport and deposition downstream of the construction site. Construction activities associated with the Restoration Plan would not occur in the same location or at the same time as hydroelectric facility removal. Therefore, erosion effects would not add to potential effects of dam removal activities. However, negative short-term effects of increased sediment erosion, and landslides generated by the restoration plan's construction activities could occur, but would be reduced by construction-related BMPs that would be implemented. **Given implementation of BMPs (see Appendix B), the short-term effects on sediment erosion and landslides and would be less than significant. In the long-term, implementation of the Phase I and II Fisheries Restoration Plans would be expected to generate a beneficial reduction in sediment erosion through improved river channel stability, and generate no change from existing conditions for landslides. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

Under this alternative, short-term demolition activities and drawdown of reservoirs would still occur; however, demolition would consist only of in-stream facilities and select ancillary facilities. Impacts to soils and sediments would be the same as those described for the Proposed Action.

#### **Keno Transfer**

The geology and soils impacts of the Keno Facility Transfer under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **East and West Side Facility Decommissioning**

The geology and soils impacts of the East and West Side Facility Decommissioning under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **KBRA**

Under this alternative, the KBRA would be fully implemented; therefore, impacts to soils and sediments would be the same as those described for the Proposed Action.

#### **Alternative 4: Fish Passage at Four Dams**

*Short-term construction under the Fish Passage at Four Dams Alternative could change erosion patterns.* Under this alternative, no demolition of the Four Facilities would take

place; however, short-term construction activities would occur during installation of fish passage at the four dams. The potential exists for short-term increases in erosion along the banks of the reservoirs during construction activity. Prior to any construction, coverage under General Stormwater Permits and the development and implementation of Erosion and Sediment Control Plans would be required as per Section 402 of the Clean Water Act. **Accordingly, erosion impacts would be short-term and less than significant.**

*Under the Fish Passage at Four Dams Alternative, J.C. Boyle, Iron Gate, and Copco 1 Reservoirs would continue to trap sediment at rates similar to historical rates.* The reservoir drawdown and sediment transport impacts described under the Proposed Action would not occur. **The reservoirs would continue trapping sediment and there would be no change from existing conditions.**

*Under the Fish Passage at Four Dams Alternative, the Copco 1 Reservoir would continue to prevent access to the diatomite beds.* Diatomite resources and any associated paleontological resources are currently inaccessible due to the presence of the Copco 1 Reservoir. **There would be no change from existing conditions for the diatomite beds because the resources would continue to be inaccessible.**

#### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

*Reservoir drawdown could cause instability along the banks of the reservoirs, reservoir bank instability, and construction generated erosion.* Under this alternative, only Iron Gate and Copco 1 Dams would be removed and fish passage would be installed at Copco 2 and J.C. Boyle Dams. Impacts associated with short-term construction and demolition activities would be as described for the Proposed Action. **Impacts associated with reservoir drawdown and sediment transport would be similar to the impacts described for the Proposed Action. However, the magnitude of any impacts would be less than described for the Proposed Action due to the retention of sediment behind J.C. Boyle and Copco 2 Dams.**

*Following dam removal, the diatomite beds near Copco Reservoir would become more accessible.* Diatomite resources and any associated paleontological resources are currently inaccessible due to the presence of the Copco 1 Reservoir. **Therefore, there would be no change from existing conditions for the diatomite beds because the resources would continue to be inaccessible.**

#### **3.11.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequences Summary**

Mitigation Measure GEO-1 – Prior to commencing construction of new recreation facilities or access roads in the former reservoir areas, geotechnical analysis of the proposed site should be conducted by a qualified geologist to determine the limitations of construction on the sediment. If geotechnical tests indicate that the sediment is not suitable to accommodate the proposed activities, the site should be avoided or a sediment removal or treatment plan should be developed and sediment should be removed prior to beginning construction activities.

### **Effectiveness of Mitigation in Reducing Consequences**

Implementation of Mitigation Measure GEO-1 would ensure that any remaining sediment in the former reservoir areas are appropriately studied and dealt with prior to construction, such that any future proposed activities do not result in significant erosion or sedimentation downstream.

### **Agency Responsible for Mitigation Implementation**

The Dam Removal Entity would be responsible for implementing mitigation measure GEO-1.

### **Remaining Significant Impacts**

Following implementation of GEO-1, no significant adverse impacts associated with Geology and Soils are anticipated. If the deposition of reservoir sediment downstream resulted in adverse impacts to fish habitat or habitat for other aquatic species, impacts would be considered significant. The potential for such impacts and mitigation for them have been addressed in the relevant chapters of this EIS/EIR.

### **Mitigation Measures Associated with Other Resource Areas**

Several other mitigation measures require construction, including mitigation measures H-2 (flood-proof structures), GW-1 (deepen or replace affected wells), WRWS-1 (modify or screen affected water intakes), REC-1 (develop new recreational facilities and access to river), TR-6 (assess and improve roads to carry construction loads), and TR-7 (assess and improve bridges to carry construction loads). These measures could disturb soil because of construction activities associated with heavy vehicle use, excavation, and grading. Prior to demolition, coverage under the General Stormwater NPDES Permit for Construction Activities in both Oregon and California would be required as per Section 402 of the Clean Water Act (refer to Section 3.2, Water Quality, for more information). Coverage under this permit requires the development and implementation of an Erosion and Sediment Control Plan for each reservoir area. Implementation of these plans would minimize the potential for erosion during demolition activities. **These impacts would be short-term and less than significant.**

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### 3.12 Tribal Trust

Indian trust resources consist of certain real property, natural resources and related rights, held in trust by the federal government for federally recognized Indian Tribes or individual Indians. Trust resources attributed to tribes are called “tribal” trust resources, and trust resources attributed to individual Indians (usually called “allottees”) are called “individual” trust resources. Some tribes have the right to use trust resources that are transitory or migratory in nature and that move beyond the reach of federal or tribal management (e.g., fish and water). In such cases, it is a tribe’s *right* to use the resource that is the trust resource, but does not necessarily exclude other users from access to the resource. In the case of the Klamath Basin Indian Tribes, the federal government has the responsibility to safeguard the fishery to ensure that tribes with fishing rights are able to practice those rights. Water quality is essential for success of a safeguarded fishery, with some Klamath Basin tribes also maintaining federally recognized water rights. Tribes of the Klamath Basin also have traditionally used resources they do not currently have a legally vested right to use/take. For the purposes of this document, these resources are referred to as resources traditionally used by tribes.

Cultural values related to a tribal way of life centered on rivers and lakes are composed of myriad values, styles, practices, resources, and items transmitted and evolving through time that together define the unique identities of the Yurok, Hupa, Karuk, Shasta, Klamath, Modoc, and Yahooskin (a band of Snake) cultures. Cultural values more specifically can be described as the unique manner in which tribal people access, take, prepare, administer, consider and otherwise use natural resources in unique tribal ways. To the extent that such resources and related values are diminished by ecosystem degradation, related cultures are also degraded and cultural transmissions become inhibited, which can contribute to the detriment of the mental, spiritual, and physical health of the Indians of the Klamath Basin.

This section provides a history of the Indian Tribes of the Klamath Basin, their salmon based economy and barter system, their trust resources, other resources traditionally used by the tribes, and traditional cultural practices associated with these resources. This section also documents the effects of the Klamath Hydroelectric Project dams on these resources and values and also reflects the replacement of a salmon based economy (cyclic based upon nature and natural occurring events) with that of an industrial economy (dams). The information presented in this section is primarily drawn from two 2011 United States Department of the Interior (DOI) reports: 1) Current Effects of Implementing the Klamath Hydroelectric Settlement Agreement (KHSa) and Klamath Basin Restoration Agreement (KBRA) on Indian Trust Resources and Cultural Values (2011a); and 2) Potential Effects of Implementing the KHSa and KBRA on Trust Resources and Cultural Values<sup>1</sup> (2011b).

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<sup>1</sup> Unless otherwise cited the information in this section is drawn from these reports.

### **3.12.1 Area of Analysis**

The area of analysis for Indian trust resources and other traditional resources includes the entire 263 miles of the Klamath River and the Klamath Basin.

### **3.12.2 Regulatory Framework**

Tribal Trust, within the area of analysis are regulated by several federal laws and policies, which are listed below.

#### **3.12.2.1 Federal Authorities and Regulations**

- American Indian Religious Freedom Act
- Federal Power Act
- Executive Order 13007
- Executive Order 13084

### **3.12.3 Existing Conditions/Affected Environment**

The information presented in this section is primarily drawn from the 2011 DOI reports on Indian trust resources and cultural values in the study area. These reports identify Indian trust resources in the study area and document the effects of the Klamath River dams on those resources. Where no citations appear in Section 3.12.3, the information and discussion presented is based on the 2011 DOI reports. Section 3.13, Cultural and Historical Resources, presents additional information regarding the Indian Tribes in the area of analysis.

This section presents individual histories of the six tribal governments in the study area. The federally recognized tribes in the study area include The Klamath Tribes, Quartz Valley Indian Community, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe, and Resighini Rancheria. These tribes live along different reaches of the Klamath River and in different areas of the Klamath Basin. Each tribe has a unique history of its long-term occupation and use of the study area and establishment of its tribal government, reservations, rancherias, or other tribal lands. The section is organized by tribe to highlight the tribes' individual histories and to identify the specific Indian trust resources of each tribe and the impacts of the Klamath Hydroelectric Project on those trust resources.

#### **3.12.3.1 The Klamath Tribes**

##### **The Klamath Tribes History**

The Klamath Tribes are composed of three historically separate tribes: the Klamath Tribe, the Modoc Tribe, and the Yahooskin band of Snake Indians. The current membership is about 3,400 and the current total land base is approximately 600 acres<sup>2</sup>.

The Klamath Tribes Treaty of 1864 (16 Stat. 707) (Treaty) was signed in the Wood River subbasin on October 14 near modern-day Fort Klamath. The Klamath, Modoc, and Yahooskin Tribes signed the treaty, ceding more than 22 million acres of their traditional

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<sup>2</sup> As discussed below, the land base of the Klamath Tribes was substantially eliminated as the result of the United States' Termination Policies of the 1950s.

territories to the United States. These ceded lands included much of south-central Oregon as well as portions of north-central California. Based on the language in the Treaty, from the date the Treaty was signed the Klamath, Modoc, and Yahookskin became known as The Klamath Tribes.

Under the Treaty, approximately 1.9 million acres, primarily Klamath ancestral lands, were retained for the Klamath Indian Reservation. As a result, the Klamath Reservation was the largest reservation in the state of Oregon. Under the Treaty, The Klamath Tribes also reserved the rights to hunt, fish, trap, and gather plants throughout the reservation in perpetuity.

In 1887, Congress passed the General Allotment Act, which fundamentally changed the nature of land ownership on the Klamath Reservation. Under the allotment system, approximately 25 percent of the original Klamath Reservation passed from tribal to individual Indian ownership over a number of decades. Subsequently, many of these individual Indian-owned allotments passed into the hands of non-Indians.

The construction of Copco 1 Dam in 1918 and the resulting loss of anadromous fish had disastrous effects on The Klamath Tribes; however, The Klamath Tribes continued to harvest staple fish, game, and plant materials both on and off-reservation.

In 1954, as part of a nationwide effort to assimilate Indian Tribes into the cultural and economic mainstream, the federal government chose The Klamath Tribes for the experiment of “termination,” effected by the Klamath Termination Act (25 USC §564, et seq.). The Klamath Tribes were chosen in part because of their self-sufficiency, which was due, in part, to the resource harvest; however, termination ultimately resulted in separating the Tribes from the factors that had enabled their self-sufficiency.

Throughout the termination process, the United States divided the reservation into large timber tracts, intending to sell them to private timber companies; however, for various reasons, only one such tract was actually sold, and the government found it impossible to dispose of the others. In 1961, the United States itself purchased large forested portions of the former Klamath Reservation. This forestland became part of the Winema National Forest under the jurisdiction of the United States Forest Service. The balance of the reservation was placed in a private trust for the “remaining” tribal members who had opted to retain an interest in the tribal lands. In 1973, these remaining Indian lands were condemned and purchased by the government, and added to the Winema National Forest.

Termination ended The Klamath Tribes’ status as a federally recognized Indian Tribe, dissolved the federally recognized tribal government, and nullified most federal fiduciary responsibilities to the tribal community. It did not, however, dissolve the Tribes’ own government and social organization, and did not convert Indians into non-Indians in any way other than in the most technical and legal terms. The social, economic, and cultural consequences of termination were both significant and complex and are generally viewed as dire by Klamath Tribes’ members.

Reservation employment and benefits disappeared, and access to traditional lands and resources quickly eroded. Control over irrigation water supporting tribal farms diminished as well, as government-owned irrigation infrastructure was privatized and fell into non-Indian control. Under this Termination Act, tribal members were encouraged to give up their interest in tribal property in return for cash. A large majority of the tribe chose to do this. A provision of this Act continued the Indians' right to hunt, fish, trap, and gather on the former reservation land. Cash payments for liquidated tribal assets were distributed irregularly within the tribal community, and those lands retained by tribal members were often lost to taxes and acquired by non-Indians. Once a model of economic self-sufficiency, the former members of The Klamath Tribes now had poverty levels that were three times those of their non-Indian neighbors.

Over the next three decades, tribal members and their families continued to reside principally on former reservation lands. Despite the loss of tribal lands, most continued to practice traditional subsistence harvests of game, plants, and fish, especially within the former reservation boundaries. Today The Klamath Tribes have re-acquired about 600 acres of their former reservation. The United States holds title to approximately 70 percent of the former reservation lands.

On August 26, 1986 The Klamath Tribes officially regained federal recognition under the Klamath Restoration Act (25 USC §566, et seq.). However, the Restoration Act did not restore The Klamath Tribes' former reservation lands and tribal efforts to regain a tribal land base continue.

The Tribes are now acquiring lands in the former reservation as they can and are placing them in federal trust. Significantly, for the present discussion, restoration did not restore to the Tribes the anadromous fisheries lost due to the construction of Copco 1 Dam and the other Klamath River dams. The tribal members continue to practice their cultural traditions, including traditional subsistence practices and related ceremonies. The Tribes maintain active natural and cultural resources departments.

### **The Klamath Tribes' Cultural Practices**

#### **Fishing**

The federal courts have confirmed that The Klamath Tribes' hunting, fishing, gathering, trapping, and water rights survived Termination. These resources, especially fish, have played a central role in the physical, social, and spiritual well-being of the Klamath people for millennia. The Klamath Basin from Link River to the headwaters of the Wood, Williamson, Sprague, and Sycan River subbasins once had an almost continuous geographical distribution of traditional sites and activities including resource harvest areas, ceremonial sites, and burials areas, which surrounded the major population centers.

The Klamath Tribes relied heavily on upland game (e.g., deer, elk, and pronghorn antelope) and plant foods (e.g., yampah, wild plum, and many other fruits and berries), but riverine and especially marsh resources were of equal importance. Salmon and multiple species of sucker, trout, eel, lamprey, mussels, and other fish were dietary staples, while marsh and riparian plants, such as the yellow pond lily (Wocus or Wokus),

tule, cattail, and willow provided staple foods and materials for essential tools and crafts. The Klamath, Modoc, and Yahooskin traditionally recognized all of the plants and animals of their traditional territory as possessing their own spiritual powers; tribal members took active steps from ceremonial activities to active management techniques to maintain respectful relationships with the species on which they most depended to ensure that the species would return abundantly in future years. These ritual activities were an essential part of the ceremonial tradition of the historical Klamath Tribes, and they have continued into the modern day.

The confluence of Spencer Creek and the Klamath River was a particularly important salmon fishing site for the Modoc tribe. The site also afforded fishing opportunities that were rare downstream of the Link River because of natural shallows that obstructed the salmon during low-water years until levels began to rise from springtime snowmelt. Salmon were speared there in large numbers. In the 19th century, Modocs still gathered there and “pulled salmon out with pitchforks” just downstream of this shallows. Captain Jack, leader of the Modocs during the Modoc War, was said to have fished the Klamath Canyon extensively and most commonly fished Spencer Creek. Following the Modoc War, some Modoc families maintained ties to the area. For example, Indian women married to white men stayed in the area, providing a lasting foothold in the Klamath River corridor.

Klamath Canyon, particularly the zone from Spencer Creek downstream, was a major historic center of settlement, salmon procurement, and trade for the Klamath and Modoc Indians. During salmon fishing time, Klamaths, Shastas, and Modocs occupied separate groups of structures within larger, multi-tribal communities. The communities along the Klamath Canyon floor were important centers of social, ceremonial, economic, and political activity timed to coincide with the peak salmon harvest. The presence of fish at sites downriver from the Upper Klamath Basin drew some Modocs and Klamaths downstream into the canyon; but since some fish worked their way into the Upper Basin, Klamaths and Modocs did not have to go to the canyon to fish.

Salmon were numerous throughout much of The Klamath Tribes’ traditional territory, including the Upper Basin. The fish were commonly said to arrive in runs so large that “it looked like you could walk across their backs;” and the fish were packed so tightly in shallow river channels that they could be speared with ease. Klamath men used spears to catch fish, and, during the 19th and early 20th centuries, it was common knowledge that the large numbers of salmon thrashing in the Sprague, Williamson, Link, and Wood River basins would “spook the horses” and people understood not to ride close to the rivers during salmon runs to avoid being thrown. Because salmon were numerous and relatively ubiquitous, the location of fishing stations reflected not wholly the extent of fish distribution, but rather areas convenient for fishing, such as naturally available shallows where fish could be easily speared, natural barriers that caused the fish to become “bunched up,” nearby settlements and secondary resources, springs and spawning grounds, and other factors that influenced the locations of salmon fishing within the Klamath and Modoc territories.

Historically, The Klamath Tribes fished not only for salmon and steelhead, but also for mullet, suckers, trout, sturgeon, eels, and lamprey. Anadromous lampreys were harvested in large numbers during salmon season, often being gilled or speared. Most large-scale fishing within the Upper Klamath Basin was timed to coincide with salmon runs, but all species were taken at these times and places. Salmon and mullet appeared at roughly the same times and at the same places. Trout also appeared with these fish to consume the spawn of both species. Together, these fish provided a tremendous, dependable food resource for the Klamath and Modoc people.

Detailed environmental knowledge once guided tribal member movements to and between salmon fishing sites, and some of this knowledge persists today. They knew which fishing stations and which riffles would provide the right conditions for salmon fishing based on the level of the water in front of their home village. Today, experienced Klamath fishermen still possess the knowledge of how water levels near their home relate to the exposure or submersion of riffles as well as general fishing conditions at trout-fishing sites.

Salmon-fishing sites were usually accompanied by settlements or seasonal encampments. Many of the largest Klamath and Modoc winter villages were close to large salmon fishing stations. The Indians said, “where the fish were, we were.” Springtime salmon fishing marked the end of the lean winter months, and the proximity of winter villages to salmon fishing sites ensured that salmon would be detected and thus available from the onset of each year’s spring migration. Although late spring and summer involved other subsistence activities far from these villages, the fall Chinook salmon run was said to draw people back to many of these villages. The success of fall fishing had major implications for a community’s food supplies when alternative resources were limited, and a poor fall salmon run indicated a potentially difficult winter ahead. Salmon thus occupied a crucial position within the seasonal round, with salmon runs marking both the beginning and the end of annual resource procurement.

Multi-village and multi-tribal gatherings centering on the salmon harvest were important social and ceremonial events. The movement of the tribes associated with the salmon runs shaped much of Klamath and Modoc social life: “Early spring finds them leaving for favorable fishing stations where there are successive fish runs,” one local reported. Salmon fishing at certain productive fishing stations, such as those on the Klamath Canyon, Link River, and Beatty Springs, were “where you met the person you were going to marry.” Gambling contests, races, and group dances were facilitated by these large gatherings of families from different villages. Dried salmon was used in trade, particularly with interior populations such as Paiutes and interior Pit River bands, providing the Klamath and Modoc with access to trade goods from these interior locations. Mobility and social diversity of the population participating in the salmon harvest fostered multi-tribal gatherings even at sites quite distant from salmon-fishing stations. For example, Tule Lake villages, including those at the Lava Beds, served as a stopover point for Modocs, Paiutes, and other tribes traveling to and from the Klamath Canyon to catch or barter for salmon.

Salmon was also typically shared within the community. Tribal members typically caught surplus salmon to feed the elderly, children, and those with disabilities who were unable to participate in the salmon harvest. This practice also appears in classic ethnographic studies of The Klamath Tribes and is an ongoing one today. This redistribution of the salmon catch cemented social bonds within and between communities, in addition to ensuring food security in the community as a whole. These practices are still a source of pride among many tribal members today. Young people still share the catch of other fish species, especially trout and mullet, in the traditional manner. “You always give away fish to the elders...you always give away the first deer you kill...our grandparents taught us that and young people still need to listen to that,” a tribal member described. Young men who go on salmon fishing trips outside of the Upper Klamath Basin also redistribute modest quantities of salmon among tribal members, and such salmon is highly prized. Young people “always drop by to drop off fish” after these long-distance fishing trips, said one tribal member. Access to fishing sites and fishing gear is viewed as essential to a family’s security; some tribal members mentioned that they have inherited fishing gear from their elders, which is understood as a sign of one’s obligation to continue fishing for the extended family in the elder’s absence.

Affidavits of tribal members compiled in the early 1940s suggest that between one-half and one-sixth of the aboriginal diet consisted of salmonid fish. Rates of salmon consumption likely varied over time and between individual communities and households, but a review of both written accounts and contemporary oral histories suggests that salmonid fish were consumed in large quantities by most Klamaths and many Modocs as a dietary staple.

Salmon was an essential part of the Klamath Basin ecology, with salmon carcasses in particular providing food for many species of animals and nutrients that facilitate the health of marsh plant communities. Tribal members identified the following effects associated with a reduction in salmon:

“When the salmon leave, everything else falls apart.”

“A lot of other fish started to disappear as soon as the salmon were gone.”

“Trout fed on the salmon spawn...once the salmon were gone, they went after the sucker spawn more...and then there weren’t as many trout and suckers.”

The Klamath Tribes’ members also report that their ancestors used to manage fish populations. Staple fish, such as salmon, trout, mullet, and suckers were harvested according to a rule that “you should never take more than you needed...you take what you need, then quit” and this rule still guides the actions of many tribal members today. Chub and other species were known to eat salmon and trout eggs, and increases in chub populations corresponded with subsequent decreases in salmon and trout populations. For this reason, when fish populations were thought to be out of balance, men sometimes intentionally caught large numbers of chub and tossed them onto the banks to be eaten by birds and other creatures. This practice is said to have continued into the 20th century.

### **Religious Practices**

Salmon played an important ceremonial and religious role in Klamath and Modoc culture. The tribes have creation stories that relate to salmon fishing and salmon fishing sites, and most of the large salmon fishing dams were historically viewed as the handiwork of the Creator, *Gmukampc*. "...the special creation of [*Gmukampc*] was man, and whatsoever stands in direct connection with his existence, welfare, and customs, as fishing places..." noted ethnographer Gatschet (1890). Gatschet further notes that events in Klamath oral tradition were sometimes said to center on *tsiäls-hä'mi*, ("salmon time") that is part of the Klamath seasonal round.

It is understood by The Klamath Tribes that salmon possess a spirit and that this spirit must be respected and honored in order to ensure the return of the fish. Salmon fishing was guided by certain protocols, which acknowledged the belief that the fish possessed a spirit and sentient qualities. For example, unused portions of fish carcasses were put back in the water "so that they will come back" in following years. Tribal members also conducted first salmon ceremonies at the beginning of each year's run to ritually distribute salmon flesh and honor the salmon. These ceremonies could last two or three days, and involved large salmon feasts celebrating the return of the salmon and the end of winter hunger. Currently, traditional ritual activity continues by The Klamath Tribes' members to ritually ensure the return or resuscitation of salmon, mullet, and other important species and to influence water levels and water quality for the benefit of fish.

### **Oral Traditions**

The Klamath Tribes' oral traditions, including the "*Gmukampc* tears down the fish dam" story, are said to impart teachings that still guide tribal members in dealing with moral or ethical dilemmas. These stories are tied to particular landscape features that are prominent in the vicinity of traditional salmon fishing sites. In some cases, certain landscape features of religious significance distant from salmon fishing sites also possess ceremonial associations with salmon fishing. These oral teachings relate to salmon fishing and impart lessons from *Gmukampc*, the Creator, regarding fundamental moral and ethical principles. One principal story reflects The Klamath Tribes' sentiments regarding the Klamath Hydroelectric Project and its effects on fish populations and their ability to acquire fish:

The people who lived there [below the Chiloquin forks] had a big fish dam. They got greedy and kept building it higher, catching all the fish until no fish could get past them...the people upstream couldn't catch anything and were starving. They said the Creator got angry...and he asked the animals to help him tear down the dam....After the dam was gone, the people were all turned into rocks...they got punished. People fishing there could always see those rocks...it reminded them. (Spier 1930)

### **The Klamath Tribes' Potentially Affected Trust Resources**

A government-to-government consultation meeting concerning the effects of current Klamath River dam operations on The Klamath Tribes' trust resources and other

resources traditionally used by The Klamath Tribes was held on October 4, 2010. A variety of trust resources have been affected by current dam operations; however, the meeting focused on The Klamath Tribes’ fish resources and water conditions that relate to the health of the fishery. Table 13.12-1 identifies trust resources and rights associated with The Klamath Tribes.

**Table 13.12-1. Effects of Current Dam Operations on Klamath Tribes Trust Resources and Rights**

Trust Resource/Right	Effects
Water resources	Poor flow management (e.g., peaking regimes, flow pulses, flow homogenization, aquatic ecosystem functionality)
	Altered water temperature regime
	Reduced bedload sediment transfer
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
Terrestrial resources	Reduced population size
	Reduced food availability
	Loss of riparian habitat

Source: DOI 2011a, 2011b

Among the anadromous fish The Klamath Tribes used as staple foods are fall and spring Chinook salmon, steelhead, Pacific lamprey, and possibly coho and sockeye salmon. These fish entered the Klamath Reservation along the drainages of the Sprague, Williamson, and Wood Rivers and were also found in the open waters of Upper Klamath Lake. Historically, The Klamath Tribes also depended on a variety of other resident fish species, primarily the adfluvial and resident rainbow trout, *c’waam* or Lost River sucker, and *koptu* or shortnose sucker, cutthroat trout, Klamath smallscale sucker, Klamath largescale sucker, Pit-Klamath brook lamprey, blue chub, tui chub, and speckled dace. Although the exact quantity of fish historically consumed by The Klamath Tribes is difficult to establish, anadromous salmonids were staple foods. Anadromous salmonids were the focus of extended multifamily fishing operations often lasting weeks or months, and were an important source of wealth and stability to The Klamath Tribes prior to the construction of Copco 1 Dam in 1918.

The construction of Copco 1 Dam blocked anadromous fish runs into the Upper Klamath Basin and abruptly ended The Klamath Tribes’ access to all anadromous fish. Two other major fisheries, adfluvial and resident salmonids (trout) and Catostomids (suckers), could still be used by The Klamath Tribes after the demise of the anadromous fisheries. The catostomid fishery consisted primarily of *c’waam* (Lost River sucker) and *koptu* (shortnose sucker) until the Tribes closed their fishery in 1986 to protect it in the face of severe population declines. This move by the Tribes in turn prompted the federal government to list these fish as endangered in 1988 under the Endangered Species Act.

As the only surviving tribal fishery, adfluvial and resident salmonids today represent an invaluable resource to tribal members.

Water quality and flows in the Klamath River and its tributaries associated with current dam operations are an important issue to The Klamath Tribes. Water conditions affect the ability of anadromous fish species to survive. The Klamath Tribes retain a right to instream water quantities in on-reservation and off-reservation locations at levels that are sufficient to support fishing and other harvest rights on former reservation lands, as affirmed in 1984 with the 9th Circuit Court of Appeals' decision in *United States v. Adair*, 723 F.2d 1394. A number of ritual traditions of The Klamath Tribes depend on access to clean water from natural sources, which is used in ritual purification of people, places, and objects, as well as in rituals associated with drought abatement and other environmentally restorative activities. However, the water of the Klamath River is widely viewed as inappropriate for these ritual uses because of the effects of the dams on water temperature, algae development, and other variables of water quality.

The current operations of the Klamath River dams have had a range of secondary effects on The Klamath Tribes. Among these effects are the decline of fish and wildlife in addition to the loss of cultural and social practices, diminished economic opportunity, and negative health effects resulting from dietary changes that became necessary with the loss of traditional food sources.

Tribal oral tradition suggests that the timing of catostomid (sucker) and trout population declined following the extirpation of anadromous salmonids, reflecting partial dependence of these resident fish on marine protein from salmonid sources. In recent interviews, numerous tribal members noted that the once-abundant numbers of these other culturally significant species have diminished, attributing this change in part to the absence of anadromous fish within the Upper Klamath Basin. Recent studies have confirmed that no fewer than 137 other wildlife species depend on salmon consumption for some portion of their life cycle, drawing sustenance from smolts, adult salmon, or salmon carcasses. Subsistence fish and wildlife species affected by the absence of salmon include, but are not limited to, black bear, mule deer, and a large number of waterfowl species. Several salmon-dependent wildlife species are of traditional cultural significance to members of The Klamath Tribes beyond their subsistence value, including but not limited to the Bald and Golden eagles, coyote, cougar, American marten, weasel, bobcat, red and gray foxes, northern river otter, various bat species, raven, crow, red-tail hawk, blue jay, and a variety of songbirds.

Many non-salmon species and ecologically linked plants are significant for the cultural and economic well-being of The Klamath Tribes. The Klamath Tribes traditionally used pelts, feathers, and other body parts from some of these animals in ceremonial regalia, traditional crafts, and for other purposes. In a few cases, tribal members relied on the sale of pelts from some of these species for supplemental income. In ethnographic interviews, tribal members referred to a number of culturally preferred riparian and marsh plant species that are said to have declined in population in the last century. Foremost among these is the yellow pond lily (*Wocus*), a source of edible seeds that has served as

one of the most important staple plant foods of The Klamath Tribes. The decline in some riparian plant species may correlate with declines in the fish population of the Upper Klamath Basin and may reflect the reduction in nutrient loading to marsh plant procurement areas.

Prior to the extirpation of anadromous salmonids from the Upper Klamath Basin, salmon were the focus of a complex of cultural traditions, including distinctive fish harvesting and processing technologies; traditional ecological knowledge relating to fish habitats and behavior; and ritual traditions centering significantly on the maintenance of harvestable fish populations through ceremonial displays of respect for the fish, the Creator, and other spiritual forces said to influence the return of the fish. Through such practices, The Klamath Tribes have always played an active role in the stewardship of anadromous fish resources, and many contemporary tribal members perceive this role as a cultural right and responsibility.

The absence of the fish has compromised the ability of members of The Klamath Tribes to pass knowledge from generation to generation relating to the fish and their harvest. The importance of salmon harvest is further reflected in The Klamath Tribes' languages, place names, songs, stories, and the moral teachings provided to children. Large gatherings associated with the fish harvest once served as a venue for economic exchanges, reunion with kin from other communities, and the forging and maintenance of intercommunity ties within the larger tribal population. The demise of the fish populations has interrupted the performance of these important social and cultural functions.

Although The Klamath Tribes have the most direct interest in resources upstream from the four Klamath River hydroelectric dams, the current operations of the Klamath Hydroelectric Project have affected The Klamath Tribes' resource interests in the footprint of the dams and impoundments, and downstream from the dams in lands ceded to The Klamath Tribes. In the Klamath River corridor, for example, harvest activities historically focused on riparian resources. Plants, animals, soil, and rocks are all of concern to Klamath Tribes members, both economically and environmentally. The Indians commonly gathered riparian vegetation, including but not limited to willows for basketry and drying racks; tree species such as cottonwood for firewood; sedges, rushes, cattails, and tule for basketry mats and bedding; and a variety of berries and medicinal plants uniquely concentrated in the riparian corridor. Game in the riparian corridor, such as white- and black-tail deer, rabbit, groundhog, and birds, were also taken.

Various forms of evidence suggest that The Klamath Tribes' gathering activities were concentrated in relatively recent alluvial deposits consisting of gravel bars and fresh deposits of silt, loam, and sand-sized particles. At these sites, culturally prized early successional vegetation was abundant and desirable. For example, roots used in basketry were unusually long, straight, and easy to dig. Additionally, tribal members gathered rocks for use as cooking stones along the riparian corridor, especially basalt cobbles and other dense, nonporous stones.

### **The Klamath Tribes' Health Impacts**

Because salmon was the first dietary staple to be lost to The Klamath Tribes, its depletion was said to have initiated dramatic dietary shifts among tribal members. For a time, this fostered increased consumption of deer, mullet, and sucker, which some tribal members believe resulted in localized overuse of these resources, particularly in the light of game management practices of the State of Oregon. For some, the loss of the salmon was the catalyst for a dietary transition that led to the ultimate dependence of The Klamath Tribes on the purchase of processed foods and the use of supplementary commodity foods.

Tribal members attributed a number of historical health problems to the loss of salmon. A 1920s tuberculosis epidemic was said to have been worsened by the rapid impoverishment of the diet in preceding years. Recent Indian Health Service studies endorsed by The Klamath Tribes concluded that a host of physical ailments plaguing members of The Klamath Tribes have been linked to the demise of the aboriginal diet. Diabetes, hypertension, obesity, and related cardiovascular ailments are particularly widespread, reflecting dramatic changes in food consumption and procurement patterns. A number of tribal members expressed the view that the loss of salmon was among the most significant components of this dietary shift.

### **Alternative 1: No Action/No Project Alternative - The Klamath Tribes and Damming of the River**

*Continued impoundment of water could affect tribal trust resources.* The current Klamath River dam operations have measurable consequences on the exercise of The Klamath Tribes' Treaty harvest rights on the former Klamath Reservation; consequences which would continue under the No Action/No Project Alternative. In addition, the current Klamath River dam operations would have measureable consequences on the condition of lands held in trust status for The Klamath Tribes; consequences which would continue under the No Action/No Project Alternative. In response to the loss of the Klamath Reservation as a result of the 1954 Klamath Termination Act and the absence of provisions for the reservation's return in the 1986 Klamath Restoration Act, The Klamath Tribes have been actively acquiring lands within the boundaries of the former reservation and placing them in trust status. Existing and pending trust lands include properties that are transected by waters formerly housing populations of anadromous fish. These trust lands are affected by the same environmental variables that apply to the entire Upper Klamath Basin.

Salmon have not been sighted in the areas upstream of the dams in about 100 years. However, in 1907, before the dams went into service, Barrett (1910) reports that "Fish were abundant in the lakes, salmon and salmon trout being especially esteemed by the Indians." Other firsthand observations confirm the presence of salmon before the dams were built. In the 1940s, in preparation for a lawsuit against Copco for blocking the anadromous fish runs, Bureau of Indian Affairs (BIA) Superintendent B. G. Courtright interviewed 50 older members of the Klamath Tribe and non-Indian settlers in the area about salmon in the Klamath Basin. These unpublished affidavits unanimously report there were salmon in fisheries as far upstream of Klamath Lake as the Sprague and

Williamson rivers, Upper Klamath Lake, and Spencer Creek. Spier (1930) reported that salmon in the Klamath Basin “...ascend all the rivers leading from Klamath Lake...going as far up Sprague River as Yainax, but are stopped by the falls downstream of the outlet of Klamath marsh.” A tribal elder in the 1940s also stated that he had observed salmon as far up the Sprague River as Bly.

Salmon continue to be symbolically and culturally important to members of The Klamath Tribes. Moreover, tribal members insist that traditional salmon fishing stations are still being used today, whether for subsistence purposes, ceremonial activities, or instruction of children on tribal history and culture. Resources that were once harvested secondarily to the salmon harvest have now become the focus of subsistence activity at these stations, and tribal members still use certain historic campsites at these stations during subsistence, social, and ceremonial activities. Tribal members continue to participate in ritual activities “to bring back the salmon,” while The Klamath Tribes government continues to explore legal and administrative options to achieve the same goal.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin, as noted above. However, the current operations of the four Klamath River dams adversely affect the trust resources of The Klamath Tribes and other resources traditionally used by the tribes, and, by extension, their cultural values (Table 3.12-1), and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

**Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)**

*Removal of the Four Facilities could affect tribal trust resources.* Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Proposed Action, including the KHSA and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

**KBRA<sup>3</sup>**

The KBRA has several programs that could result in impacts/effects to trust resources and other traditional resources used by The Klamath Tribes. Specific KBRA programs potentially affecting trust resources and other traditional resources include:

- Tribal Fisheries and Conservation Management Program

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<sup>3</sup> Tribal Trust Resources and other traditionally used resources are also discussed in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

- Klamath Tribes Interim Fishing Site
- Mazama Forest Project

Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

*Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources.* As the original stewards of the natural resources of the Klamath Basin, The Klamath Tribes hold special positions in the Basin and have interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are anticipated to support in trust resources would contribute to the positive effects of hydroelectric facility removal. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to trust resources and other traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

*Establishment of The Klamath Tribes Interim Fishing Site could result in impacts/effects to Trust Resources and other traditionally used resources.* Actions associated with The Klamath Tribes Interim Fishing Site include establishment of an interim fishing site for Klamath Tribal members between Iron Gate Dam and Interstate -5. The improvement in salmon fishery access generated by development of The Klamath Tribes Interim Fishing Site would contribute to the positive effects of hydroelectric facility removal. Establishment of The Klamath Tribes Interim Fishing Site would generate beneficial effects to trust resources by providing tribal members with access to the salmon fishery prior to hydroelectric facility removal.

*Implementation of the Mazama Forest Project could result in impacts/effects to Trust Resources and other traditionally used resources.* Actions associated with the Mazama Forest Project include the purchase and management of 90,000 acres of timberland on former reservation land owned by the Klamath Tribe. The improvement in trust resources and other traditionally used resources generated by the Mazama Forest Project would contribute to the effects of hydroelectric facility removal. Implementation of the Mazama Forest Project would generate beneficial effects to trust resources and other traditionally used resources because of the implementation of appropriate forest management plans. Implementation of specific plans and projects associated with the Mazama Forest Project will require future environmental compliance as appropriate.

### **Alternative 3: Partial Facilities Removal of Four Dams**

*Partial facilities removal could affect tribal trust resources.* Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for fish passage. Keno Dam would be transferred to the DOI, The East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long-term benefit water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

### **Alternative 4: Fish Passage at Four Dams**

*Fish passage at four dams could affect tribal trust resources.* Under the Fish Passage at Four Dams Alternative, operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

### **Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

*Fish passage at two dams and facilities removal of two dams could affect tribal trust resources.* Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by The Klamath Tribes (Table 3.12-1), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

#### **3.12.3.2 Quartz Valley Tribe**

##### **Quartz Valley Tribe History**

Most of the Quartz Valley Indian Reservation tribal members are descendants of people of Karuk ancestry, although a few tribal members are also of Shasta ancestry. Therefore, their cultural traditions are similar to those described in the Karuk section of this report.

The Quartz Valley Indian Reservation is a federally recognized tribe representing people of upper Klamath (Karuk) and Shasta Indian ancestry. The Quartz Valley Indian

Reservation is in Siskiyou County near the community of Fort Jones. The population is around 126, with a tribal enrollment of about 150. Total reservation size is 174 acres. Some tribal members are descendants of the same tribal leaders that signed the unratified 1851 Treaty R negotiated between Indian Agent Redick McKee and Indian inhabitants of Scott Valley and the upper Trinity and Klamath Rivers. The original Quartz Valley Reservation, once near the present-day reservation, was abolished in the 1960s.

The current Tribal mission is stated as:

While on earth we must practice stewardship, protection, and enhancement of the air we breathe, the water we drink, the soil that supports us, and the lives we cherish. It is our duty to protect and enhance these resources for the continued prosperity of the Quartz Valley Indian Tribe and our fellow brothers and sisters we share this earth with.

In partial fulfillment of the mission statement, the tribe employs several full-time and part-time positions to operate the Tribal Environmental Protection Agency. Current achievements are creek restoration projects, salmon surveys, establishment of a native garden, and the recent opening of a microbiology lab for testing the Tribe's groundwater.

#### **Quartz Valley Tribe Cultural Practices**

##### **Fishing, Trade and Barter, Religious Practices, and Oral Traditions**

The Indians of the Quartz Valley Reservation are related to Karuk people and thus share their cultural practices and values with the general culture described for the Karuk Tribe.

#### **Quartz Valley Tribe Potentially Affected Trust Resources**

Government-to-government consultation was held with the Quartz Valley Indian Community on September 30, 2010. The tribe refrained from making any comments.

The Quartz Valley Reservation does not have a reserved Klamath River fishery. The Tribe is not reliant on Klamath River water, nor does the Tribe retain Klamath River reserved water rights. The Tribe's land base is not along the Klamath River. Therefore, there are no primary effects on Quartz Valley trust resources and other resources traditionally used by the Tribe. While there may be secondary effects on tribal health and cultural well being, these were not asserted in the government-to-government consultation.

#### **Quartz Valley Tribe Health Impacts**

The members of the Quartz Valley Reservation refrained from making any comments.

#### **Alternative 1: No Action/No Project - Quartz Valley Tribe and Damming of the River**

The members of the Quartz Valley Reservation refrained from making any comments. The current operations of the four Klamath River dams under the No Action/No Project Alternative would result in no change from existing conditions.

### **Quartz Valley Tribe Consequences of Action Alternatives**

The Quartz Valley Reservation is not along the Klamath River and the Tribe does not have a reserved Klamath River fishery or reserved water rights. Therefore, implementation of the Proposed Action or alternatives would not affect Quartz Valley Reservation trust resources or other resources traditionally used by the Tribe.

#### **3.12.3.3 Karuk**

##### **Karuk History**

The Karuk Tribe has been federally recognized since 1979 and occupies territory along the middle section of the Klamath River. The 2000 United States Census reported tribal membership to be 2,702 individuals. In 2004, the California Department of Housing and Community Development reported tribal membership to be 3,164 individuals. Currently, Karuk are one of the largest tribes in California with approximately 4,800 members. The Karuk maintain offices in Orleans, Humboldt County; Happy Camp, Siskiyou County; and Yreka, Siskiyou County, all in California.

The tribe's ancestral territory was about 1.4 million acres. Currently, the Karuk own 652 acres in trust status. The Karuk Tribe is a Self-Governance Tribe under Indian Self-Determination Act of 1975 (California Department of Housing and Community Development, California Indian Assistance Program 2004, as cited in DOI 2011a and b). The tribe has a constitution that was initiated in April 1985 and the Karuk maintain a robust Natural Resources Department.

##### **Karuk Cultural Practices**

The Karuk Tribe has effectively maintained its cultural identity and traditional practices. Tribal members still engage in traditional hunting, gathering, and resource management activities. This includes preservation and use of the Karuk language, basket-making, fabrication of regalia, practice of traditional religious ceremonies, and stewardship of natural resources through use of fire and harvest management techniques.

##### **Fishing**

The Klamath and Salmon River fishery and other resources supported more than 100 ancestral Karuk villages along the Klamath and Salmon Rivers. Karuk established villages on beaches, river bends, benches, and near fishing sites to exploit riverine resources. Indeed, Karuk incorporate ritual, spiritual, and technical elements of their culture to facilitate management and enrichment of local ecosystems. These culturally based natural resource management practices are articulated in the Karuk Tribe's Eco-cultural Resources Management Plan.

The Karuk diet traditionally consisted mostly of salmon, deer, and acorns. Fish, especially salmon, have always been a major food resource and the focus of ceremonies for the tribe. Karuk use several methods, both traditional and contemporary, to catch fish. Fish important to the Karuk include spring-run Chinook or king salmon, fall-run Chinook, out-migrating Chinook smolt, coho or silver salmon (also called dog salmon), steelhead, trout, sucker, bullhead, sturgeon, and Pacific lamprey. Freshwater mussels

also have cultural significance for the Karuk not only as food, but also as important tools. For example, a mussel tool, an *ishuvar*, is used in traditional basket-making.

### **Religious Practices**

Ceremonies provide insight into the cultural life and underlying values of the Karuk. These ritualistic celebrations also demonstrate the interrelationship of Karuk and other tribes along the Klamath River. In one respect, the ceremonies are reenactments of stories involving the *ikxareeyavsa*, or immortal ones. However, these ceremonies go beyond symbolism to teach important practical lessons about careful management of resources, hard work, and the importance of observing rituals.

The Karuk are known among tribes in the Klamath Basin as “The Fix-the-World People” because of their role in the annual *Piky’avish*, or World Renewal Ceremonies. *Piky’avish* starts with the First Salmon Ceremony in early spring and continues throughout late summer into early fall. The scheduling of the dance cycle is determined each year by a ceremonial leader, who also appoints a *fataveenaan* (medicine man or priest) each year. This appointment is both a source of honor and a great deal of work because the *fataveenaan* is required to undergo a lengthy ordeal of fasting, praying, and walking the medicine trails.

The First Salmon Ceremony marks the passing of the first spring Chinook salmon up the Klamath River. This migrating salmon was allowed to pass all the way up the Klamath River to its spawning ground. Indians believed that the first spring Chinook migrating upstream would leave its scales at each spawning location for the rest of the salmon run to follow. Eating this first migrating salmon of the year was considered taboo; if eaten, it was believed to cause convulsions and death. Permitting this fish to pass safely upstream lifted the taboo and allowed the people to fish for salmon in the river. The dramatic decline in the spring Chinook run has made it impossible for the Klamath Basin tribes to conduct the First Salmon Ceremony.

The Karuk and Yurok Tribes coordinate the performance of their First Salmon Ceremonies based on the appearance of fish in the Klamath River. Chinook historically spawned as far north as the Williamson River, an area that was available as spawning grounds prior to the damming of the Klamath River and the reconstruction of Klamath Lake in its present form. The First Salmon Ceremony is typically conducted around April when the fish first breach the sandbar at the mouth of the river, marking their transition from the Pacific Ocean back to the fresh water of the Klamath River.

The most important of Karuk ceremonies is *Piky’avish*, or literally “fix the world.” Called by different names in by different tribes, many tribes of the Klamath as well as the Pacific Northwest practice a similar ceremony. In Kroeber and Gifford’s *Karok Myths* (1980), tribal member Georgia Orcutt captured the emotional nature of the *Piky’avish* as follows: “At the beginning of the *Piky’avish*, it looks like everything down, nobody happy. *Piky’avish* means ‘making the world right.’ *Fatawanun* [*fataveenan*] fixed it so everything is coming up nice.”

According to Kroeber and Gifford (1980), the Karuk ceremony has three major aspects:

The first is a period of usually not more than ten days during which the priest remains much in the sweathouse, fasts, and prays for abundance of food, the elimination of sickness and the stability of the world. He also visits sacred spots; and young men engage in archery contests. The second part is the climax of the ceremony, when the priest keeps an all-night vigil by a sand pile called *yuxpit*. This vigil is accompanied and followed the next day, by the Deerskin Dance, or its surrogate, an imitation affair employing branches instead of deerskins; at *Inam* [*Inaam*] and *Katamin* [*ka'tim'iin*] the War Dance is part of the dance ritual. The third part is the anticlimactic retreat of the priest and other officials.

The ceremonies feature a variety of ritual dances. The Jumping Dance (or Jump Dance) is held in the spring during the first salmon run. The Deerskin Dance is held in the fall in association with the acorn harvest and the second salmon run. It is performed in alternating years with the Medicine Dance, during which other decorated skins including martin and otter are displayed rather than the famous white deerskins. Both dances feature displays of wealth, along with dancing and singing.

According to Karuk creation stories, fishing weirs were created by one of the immortals. The fishing harpoon also appears in one of a series of creation stories that present accounts of the origins of humans, institutions, and tools. In the story, the Blue Heron develops the two-pointed harpoon so that even people without rights or nets could still catch fish. According to the story, *Chukchuk* took a long stick and fastened two smaller sticks to the end of it. He thought, “I will spear salmon. Let me make that kind. Let me make it so that if a man has no fishing place and he sees salmon he can catch them. If he has no net he will kill them in this way” (Kroeber 1925a).

#### **Karuk Potentially Affected Trust Resources**

In a government-to-government consultation meeting concerning Karuk Tribe trust resources affected by current dam operations held on September 30, 2010, the Karuk Tribe asserted the following as tribal trust resources: water, fish, mollusks, riparian plants, wetlands, and all other plants and wildlife dependent on a healthy river and playing a role in Karuk ceremonies. This assertion was coupled with the assertion that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Tribe and its membership. In addition, the Karuk assert that federal government has responsibilities to the Tribe in the areas of social welfare, education, and health and a responsibility to uphold certain federal laws, such as the National Historic Preservation Act and the American Indian Religious Freedom Act. The United States does not necessarily agree that all of the above resources are in trust (and therefore form the basis of a trust relationship), but the resources are important to the Karuk (and thus to the United States) for their traditional ceremonial use. Table 3.12-2 identifies Karuk traditionally used resources that are affected by the four Klamath River dams.

**Table 3.12-2. Effects of Current Dam Operations on Resources Traditionally Used by the Karuk Tribe**

Other Resources Traditionally Used By The Tribe	Effects
Water resources	Altered flows
	Altered water temperature regime
	Reduced bedload sediment transfer
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
	Diminished aesthetics
	Human exposure to toxic water while conducting cultural activities
	Diminished opportunity for traditional bathing
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
	Loss of traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity
	Depression, alienation, and possible suicide
	Tribal members leaving ancestral territory
Lost opportunities for transmitting traditional knowledge	
Terrestrial resources	Reduced food availability
	Loss of riparian habitat
	Diminished plant availability for cultural practices and related benefits
	Loss of opportunity for inter-generational traditional knowledge transmission

Source: DOI 2011a, 2011b

Unlike the other Federally-recognized tribes in the Basin, Congress never formally ratified the treaty negotiated between the United States and the Karuk Tribe in 1851, and no statute or executive order otherwise set aside reservation lands for the Tribe.

However, the United States has more recently taken lands into trust for the benefit of the Karuk Tribe, including over 810 acres in Siskiyou County and approximately 40 acres in Humboldt County. Most of the Tribe's aboriginal lands along the Klamath River, above the Klamath Trinity Confluence, now form part of the Klamath National Forest. Any fishing and concomitant water rights to which the Karuk Tribe may be entitled have not yet been determined. Regardless, the Karuk assert that an inability to use traditional resources affects their general health and well being and cultural values.

In the consultation meeting, only effects on fish and water were discussed in detail. Nonetheless, the lack of fish in the local economy has secondary effects on general tribal health and cultural well being. The Karuk Tribe, when asked if such resources were affected by the current dam operations, emphatically responded, "Yes." Tribal representatives at the meeting stated that water quality and fish returns have diminished,

and, being a tribe that lives along the river, their aesthetic quality of life has also diminished. They rarely bathe in the river, as they did historically, and in an area with fewer available fish, tribal members are likely to consume less of the traditional food base and pay less attention to the culturally inherited management traditions of a “Salmon People.” This situation has exacerbated related impacts on tribal health, such as higher rates of obesity, diabetes, heart disease, stroke, and mental diseases such as depression.

Since the construction of the dams on the Klamath River, the numbers of a variety of river species have plummeted. Some of these fish had traditionally been a source of food and cultural ceremonies and practices for the Karuk Tribe, as well as a means of trade and income. Not only salmon, but also steelhead, sturgeon, suckers, lampreys, clams, mussels and other aquatic species appear to have declining populations as a result of the dams effects on water flow, temperature, and on the river environment.

Karuk believe one of the most significant impacts of the Klamath River dams is the way that the natural process of seasonal warming and cooling trends in the river is altered by the presence of reservoirs. In effect, the reservoirs appear to create a “thermal lag” in both the spring and the fall. This means that the river warms more slowly in the spring and cools more slowly in the fall than it would without the dams. The result of these thermal effects is a delay in timing of runs for the migration of fall Chinook salmon. For Karuk, this translates into a shorter fishing season in the fall. Before construction of Iron Gate Dam, Karuk fishermen report that fishing at Katimiin started in late July. Since construction of Iron Gate Dam, fish do not typically arrive at Ishi Pishi Falls until early September. In addition to limiting the number of fishing days available in the fall, the opportunity to harvest spring Chinook salmon has been completely lost to the Karuk since construction of Iron Gate Dam.

Water quality plays a very significant role in Karuk tribal culture because of its effect on culturally relevant aquatic species. Water quality also affects the ability of *Fataveenan*, or World Renewal priests, to conduct ceremonies. *Pikiavish* starts with the Spring Salmon Ceremony in early spring and continues throughout late summer into early fall. Key ceremonial participants bathe multiple times a day in the Klamath River for 10 days in a row. This is the time of year when the blooms of the toxic algae, *Microcystis aeruginosa*, are at their peak.

To avoid interfering with cultural and religious ceremonies and practices, the water conditions in the Klamath River must allow for specific species to be present in adequate supplies. This includes species that are consumed by participants, such as salmon and lamprey as well as species used in ceremonies, such as crayfish and willows. Water conditions must also be safe for what is usually termed “recreational contact” as well as human consumption.

Degraded water quality in the Klamath Basin, including the seasonal presence of algal toxins in the Klamath River and reservoirs, has impaired the ability of Karuk to use the water for cultural purposes. Known and/or perceived health risks associated with degraded water quality have resulted in the alteration of cultural ceremonies to exclude or limit ingestion of river water. Additionally, known or perceived risk of exposure to degraded water quality conditions during ceremonial bathing and traditional cultural activities, such as gathering and preparing basket materials and plants for other purposes, has resulted in an impairment of cultural use.

According to Karuk cultural biologist Ron Reed, the World Renewal Ceremony is held on the Klamath River at Clear Creek, Somes Bar, and Orleans during July, August, and September of each year. The medicine man, who leads the ceremony, walks 14 miles through the ridges and hills along the Klamath River and is joined halfway through his journey by children and adults of the tribe who follow him the rest of the way for good luck. Traditionally, when the medicine man reached the Klamath River at the end of this walk, he drank water from the river to complete the ceremony. Currently, this does not occur very often because blooms of *Microcystis aeruginosa* have led to health warnings along the river. However, children are still known to jump in the river and drink the water.

Bathing in the river is an important part of most Karuk ceremonies. For example, bathing in the Klamath River and its tributaries is a requirement for participants in the Brush Dance Ceremony. Bathing is also associated with funeral services, subsistence practices, recreational swimming, courtship, and individual hygiene. Bathing associated with funeral rituals occurs year around and includes preparation for burial and purification after burial.

Karuk tribal member collect willow roots, wild grape, cottonwood, and willow in the riparian zone along the Klamath River and use these materials to make baskets. Traditional collection of these basketry materials often involved wading in the water, and washing and cleaning the materials in the river. Willows are peeled by mouth following cleaning with river water, and plants are also collected for food, medicine, and other cultural functions. Given current degraded water quality conditions, ingestion of water as a result of traditional cultural activities or use of materials harvested from the river may pose a potential health risk.

Prior to construction of dams on the Klamath River, steelhead spawned freely not only in the Klamath River and its tributaries, but in Upper Klamath Lake and beyond. An estimated 650 miles of salmon habitat were lost with the construction of four dams in the Klamath River (unpublished report prepared for The Klamath Tribes and Yurok Tribe). This is a significant amount of habitat no longer available for spawning and rearing. In interviews with Karuk tribal members, they refer to loss of steelhead runs that were once vigorous, supplying fish even at times of the year when salmon runs were no longer taking place. Furthermore, steelhead eat juvenile salmon; therefore, without a healthy salmon run, there will not be a healthy steelhead run.

Steelhead can be a resident fish or they can be anadromous. One prevalent theory about the loss of migratory steelhead is that steelhead produced in the hatchery at Iron Gate Dam comprises a resident population. They are released from the hatchery into a nutrient-rich system immediately downstream of Iron Gate Dam, where there are no triggers to force them to migrate. They have enough food to keep them there; and no other steelhead are coming from downriver to compete with them, increase the densities, and compel them to move. The result is a resident population of non-migratory steelhead.

This lack of migratory steelhead affects the local economy and the well-being of the Karuk. Steelhead fishermen from outside the area used to pay for the privilege of fishing for the Klamath steelhead, bringing money into the local economy to the benefit of the Karuk. In the late 1960s and early 1970s, steelhead fishermen lined the banks of the Klamath River. Today, the numbers of steelhead are so low that the sport is no longer viable.

Karuk tribal members who harvest lamprey eels report an extreme decline in their numbers. Lamprey has traditionally been an important food source for the Karuk and has augmented salmon in their diet, particularly as salmon have become scarce.

Freshwater mussels have also been both an important food source for the Karuk and other groups and an essential part of tribal ceremonies. During the early 20th century, mussels were gathered for food and for use in rituals late in the season when the river flows were low. These low flow periods are unfortunately the time of year when the mussels are most contaminated. Even though there are few to be found, people continue to use freshwater mussels as a food source, but their use in ceremonies has been greatly reduced. Historically, women also used the mussel shells for spoons, tools, and jewelry.

### **Karuk Health Impacts**

The Karuk have been denied traditional food sources such as salmon over the last 150 years, and have increasingly adopted western foods. The decrease in the availability of traditional foods, including salmon, trout, eel (various species of lamprey), mussels, and sturgeon, is responsible for many diet-related illnesses among Indians, including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney problems, and strokes (Karuk Department of Natural Resources 2007). These conditions result from the lack of proper nutrient content in foods consumed in place of the traditional foods, as well as from the decrease in exercise associated with fishing and gathering food.

The health of many people, including the Karuk, is closely linked to the health of the river. The three largest tribes in California eat fish from the Klamath River, and the declining river system is directly related to the inability of tribal members to continue eating traditional diets. Although early anthropologists described the Klamath River tribes as some of the wealthiest people in California, since European contact, they have become some of the poorest. One result is that the Klamath corridor has some of the lowest incomes and the highest rates of hunger in California. Local populations have traditionally had much of their food supplied by the Klamath River. This continues to be

the case, but with the decline in river health this becomes increasingly difficult. Given the economic impoverishment of the region, there is no general access to healthy alternative foods without subsistence fishing and gathering (See also Section 3.16, Environmental Justice). As a result, hunger is significantly related to the presence and effects of the dams, and these effects are directly connected to the traditional subsistence economy.

The estimated diabetes rate for the Karuk Tribe is 21 percent, nearly four times the U.S. average, and the estimated rate of heart disease for the Karuk is 39.6 percent, three times the U.S. average. Spring Chinook salmon represented a large volume of healthy food for the Karuk people until the 1960s and 1970s. Diabetes is a recent occurrence in the Karuk population. In the 2005 Karuk Health and Fish Consumption Survey, Karuk families were asked when diabetes first appeared in their family and when spring salmon stopped playing a significant role in their family diet. Over 90 percent of reporting families say that before 1950 spring salmon played a significant role in the family diet and less than 15 percent reported occurrence of diabetes. By 2005, no families claimed that spring salmon played a significant role in the family diet and nearly 100 percent reported occurrence of diabetes (Norgaard 2005).

Historically, consumption of fish by the Karuk Tribe was estimated at 450 pounds per person per year, whereas in 2003, the Karuk people consumed fewer than 5 pounds of salmon per person. In 2005, more than 80 percent of Karuk households surveyed reported that they were unable to harvest adequate amounts of eel, salmon, or sturgeon to fulfill their family needs. Furthermore, 40 percent of Karuk households reported that there are fish species that their family historically caught that are no longer harvested.

Difficulty in meeting basic needs can result in overwhelming physical and psychological stress. Traditionally, fishing is done by Karuk men. With the loss of the salmon comes a loss of a man's sense of pride in being able to provide food for his family and tribe. For a tribe that has called itself The People of the Fish, there is an indisputable loss of identity when there are no fish. For a people whose belief system includes their specific role on earth, that they have a predefined relationship with nature that needs to be honored, there is a sense of failure when they are unable to fulfill that role.

The changes that have caused wildlife to becoming scarce and the rivers polluted, may make it hard for young people to understand the ways of their parents and grandparents. They wonder why the tribe focuses on ceremonies that revolve around periodic fish runs and ritual eating of salmon when the availability of fish is so erratic. Never having seen it themselves, they do not understand that in the past there could be eight yearly runs of salmon in the Klamath when all they see is one-half of a fall run. Without tradition as an anchor, young people are sometimes drawn to gangs to establish a feeling of belonging, and leave Karuk territory for cities (DOI 2011a, 2011b).

The act of eating salmon from the Klamath River affirms sense of place, identity, connection, and community. This orientation draws individuals into relationships of responsibility to care for the fish. Such a world view and set of relationships are in stark

contrast to the separate, individualistic modality of the dominant culture in which plants and animals are “resources” and people are expected to watch out for their individual interests. Relationships between Karuk people and plants and animals fulfill profound mental, emotional, and spiritual functions. In the absence of these food species, traditional activities such as dip net-fishing, eeling, or berry picking have come to an end.

The destruction of the Klamath River fishery has led to both poverty and hunger. As described above, prior to contact with Europeans and the destruction of the fisheries, the Karuk, Hoopa, and Yurok Tribes were the wealthiest people in what is now known as California, and now they are amongst the poorest. The devastation of the resources, especially the fisheries, is directly linked to the disproportionate unemployment and low socioeconomic status of Karuk people today. This dramatic reversal is directly linked to the destruction of the fisheries resource base. Poverty and hunger rates for the Karuk Tribe are among the highest in the state and nation. Median income for Karuk families is \$13,000. The poverty rate for Karuk tribal members in Siskiyou County is 88.4 to 91.9 percent. Section 3.16, Environmental Justice, offers more information regarding poverty and employment levels among populations in the area of analysis.

### **Effects Determinations**

#### **Alternative 1: No Action/No Project - Karuk and Damming of the River**

*Continued impoundment of water could affect tribal trust resources.* The dams are responsible for a drastic reduction in spawning habitat and many other changes in the river system, such as water quality, water temperature, and flow regimes. All of these changes have created an environment in which it is difficult or impossible for many species to flourish. In addition to environmental effects, the changes in the river caused by the dams secondarily have resulted in diminished physical, mental and social health. For thousands of years the Indians who depend on the river have been part of a functioning social, economic, and cultural health system that is currently dying.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath Basin have significantly decreased over the last several decades, and timber extraction in the basin has slowly become controlled by better regulations at the federal and state levels.

However, the current operations of the four Klamath River dams adversely affect the resources traditionally used by the Karuk and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

#### **Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)**

*Removal of the Four Facilities could affect tribal trust resources.* Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Proposed Action,

including the KHSA and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources traditionally used by the Karuk (Table 3.12-2). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

### **KBRA**

The KBRA has several programs that could result in impacts/effects to traditional resources used by the Karuk. Specific KBRA programs potentially affecting traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

*Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to traditionally used resources.* As the original stewards of the natural resources of the Klamath Basin the Karuk hold a special position in the Basin and have interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are anticipated to support in trust resources would contribute to the effects of hydroelectric facility removal. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

### **Alternative 3: Partial Facilities Removal of Four Dams Alternative**

*Partial facilities removal could affect tribal trust resources.* Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSA and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources traditionally used by the Karuk (Table 3.12-2). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

### **Alternative 4: Fish Passage at Four Dams**

*Fish passage at four dams could affect tribal trust resources.* Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully

resolve the water, aquatic, and terrestrial resources issues related to traditionally used resources identified by the Karuk Tribe (Table 3.12-2). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to traditionally use resources would persist.

**Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

*Fish passage at two dams and facilities removal of two dams could affect tribal trust resources.* Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address issues associated with the water, aquatic, and terrestrial resources traditionally used by the Karuk (Table 3.12-2), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

***Hoopa Valley Indian Tribe***

**Hoopa Valley Indian Tribe History**

The Hoopa Valley Indian Reservation is in the northeastern corner of Humboldt County in northern California, approximately 50 miles inland from the Pacific Ocean, and encompasses roughly 20 percent of Hupa aboriginal territory. The reservation, known as “the 12-mile square,” is laid out geometrically with sides approximately 12 miles in length for a total of a little less than 144 square miles. At close to 90,000 acres, the reservation is the largest in California.

The northern portion of the reservation is in Yurok ancestral territory. The Trinity River bisects the reservation. A small length of the northern border of the reservation includes about a quarter mile reach of the Klamath River called Saints Rest Bar several miles upriver from Weitchpec, California. The 2000 U.S. Census counted 2,633 people on the reservation, and the tribe listed an enrollment of 2,130 in 2004.

The word Hupa is from the Yurok name for the Hoopa Valley. Hoopa is used when referring to the name of the tribe, and Hupa is used when referring to the people, place, or culture. The Hupa called themselves *Natinook-wa*, meaning “people of the place where the trails return.” The Hupa are culturally related to the Yurok and also the Karuk.

Currently, the Hoopa Valley Tribe employs hundreds of people and has established a wide array of industries that support numerous business enterprises. Timber extraction, gravel extraction, modular house manufacturing, a hotel, a restaurant, and a small casino are the major economic enterprises of the Hoopa Valley Tribe. The Hoopa Valley Tribe also maintains a modest fishery program.

## **Hoopa Valley Indian Tribe Cultural Practices**

### **Fishing**

The Trinity River is of prime importance to the Hoopa Valley Tribe because it is the river that runs through the Hoopa Valley Indian Reservation. Fish destined for the Trinity River must pass through the lower Klamath River and are therefore affected by Klamath River conditions. Poor conditions in the Klamath River could affect fish populations available to the Hoopa Valley Tribe.

The Trinity River is of unique and irreplaceable value to the Hupa. It is a vital natural resource that is the foundation of their social and cultural way of life. At its most basic level, the river has always been a source for food and other necessities of daily Hupa life. The river also provides basket materials, fish net materials, and a means of transportation. Even rocks from the river are used by Hupa people in their traditional cultural practices. Uses of the Trinity River by the Hupa people are highlighted by maintenance of fisheries and religious ceremonies (e.g., ceremonies that involve prayers offered by people trained to make medicine).

Many natural foods were available to the Hupa, with salmon and acorns providing the bulk of the native diet. When the salmon entered the Trinity River each spring and fall, the year's supply of fish was taken by Hupa using a variety of efficient devices. Other important fish include steelhead, sturgeon, and lamprey eels. Surplus stocks of fish were preserved for future consumption by drying in the smoke of fires.

### **Religious Practices**

Religious beliefs and practices played an important role in everyday life for the Hupa people. An almost endless series of taboos had to be scrupulously observed, daily supplications were made for health and wealth, and acts were performed to ensure luck. In addition, each person was supposed to maintain a devout frame of mind throughout the day, particularly during important group rituals when reverent thoughts by participants and onlookers were considered essential for their success.

The religion of the Hupa is based on individual effort through ritual cleanliness as well as ceremonies that bring the entire tribe together. The tribes of the region, including the Hoopa, practice the annual World Renewal Ceremonies, which involve songs and dances that have been preserved for generations. The Hoopa and Yurok tribes also practice the White Deerskin Dance. These rituals are associated with the river as well as with medicine to cure sickness, but also roots, herbs, and bark used to promote spiritual health. The Brush Dance, for example, is a social event as well as a healing ceremony in which certain tribal members dance, sing, make medicine, and pray to bless a particular sick child or infant.

The Hoopa Valley Indians continue to conduct many of their traditional religious ceremonies, and the cultural significance of the Trinity River is captured in many of these ceremonies. Ancient religious sites on the river were believed to be designated by spiritual deities at a time beyond living memory are still used in current tribal rituals.

Prayers conducted at the dances are directed toward the well-being of everyone, and food, particularly fish, is shared with all who attend the ceremonies.

The greatest divinity for the Hupa people is *Yimantuwingyai*, “the one lost (to us) across (the ocean),” also known as *Yimankyuwinghoiyan*, “old man over across,” who establishes the order and condition of the world and is the leader of the *kihunai*, or ancestors. *Yimantuwingyai* seems to be a combination of the tricky and erotic *Wohpekumeu* and the more heroic *Pulekukwerek* of the Yurok, who is also similar to the Hupa *Yidetuwinyai*, “the one lost downstream” (Kroeber 1925b:134). A traditional story concerning *Yidetuywingyai* tells of the time when the sun and earth alone existed. From the sun and earth were born twins, *Yidetuywingyai* and the ground on which men live. This particular cosmogony has not been found among the Yurok or Karuk and may have reached the Hupa through the influence of more southerly tribes (Kroeber 1925b:134).

The White Deerskin and Jump Dances, the Flower Dance, and the Brush Dance all demonstrate the importance of the river flows to the Hupa people and how vital the rivers are to Hupa familial and tribal material well-being and self-esteem. Unfortunately, the Hupa report that, although these dances and other religious ceremonies have continued in modern times, the decline of the Trinity River’s health has made their practice increasingly difficult for Hupa medicine people, dancers, and others. Thus, the adverse impacts of an unhealthy river extend beyond the fisheries to religious ceremonies.

The Hupa honor the Earth and the Creator for providing sustenance and for allowing the continuance of the tribe in two major ceremonies celebrating world renewal, the White Deerskin Dance and the Jump Dance. Both ceremonies are closely tied to the river. A Hupa name for the White Deerskin dance is *hun’q’ehch’idilye*, “along the river religious dance.” This important ceremony is conducted at village sites and resting places near the Trinity River and involves travel on the river. The exact timing of the dances depends on the river and its waters. The White Deerskin Dance is held from late August into September. The Jump Dance follows 10 days after the conclusion of the White Deerskin Dance. Both dances are elaborate ceremonies that take place over a period of 10 days. As part of the rituals, the Hupa offer salmon they have caught at their fishing sites for the ceremony and to share with the participants and attendees.

The Jump Dance takes place along the river and has its own dance steps, songs, and regalia, and is dedicated to the good of the world. The completion of the Jump Dance signals a blessing for the year to come, with the hope that all people may be satisfied with small quantities and have their needs met. Both the White Deerskin Dance and the Jump Dance depend on a healthy river for fish, basket materials, bathing, and ambiance. The flows of the river are also a central element of these dances as they influence the dancers’ ability to travel the river in the manner of their ancestors. The Hupa claim that as the river’s flows have declined, so has the Hupa’s ability to practice these ceremonies.

The Boat Dance is a spectacular segment of the White Deerskin Dance involving dancing and singing while crossing the Trinity River. As the Boat Dance proceeds, the camps

follow the dancers from the east side of the river to the west side. In this way, the dance echoes the river's flows and their connotation of river health. The next day, as the dance continues, the camps move to different sites until the dance concludes.

The Brush Dance is held for the purpose of curing a sick baby or child. Hupa people traditionally bathe in the Trinity River each morning of the dance, and they use baskets made with willows growing along the river in the ceremony. The dance is called the Brush Dance because part of the ceremony requires the participants to fill their quivers with willow brush. Operations along the Trinity River are thought to have reduced the abundance of willow brush and other basket-making materials vital to this dance.

The Flower Dance is held at various Hupa towns along the river. The purpose of this dance is to train a girl who has just reached adolescence to lead a good life as an adult woman. The girl for whom the dance is held traditionally bathes at seven sacred places in the river during training in the Flower Dance ceremony.

**Hoopa Valley Indian Tribe Potentially Affected Trust Resources**

A government-to-government consultation meeting concerning the effects of current dam operations on Hoopa Valley Indian Tribe trust resources was held on November 8, 2010. Although current operations of the four Klamath dams are more likely to affect resources of the Klamath River, Klamath water quality affects resources traditionally used by the Hoopa and their fishing rights by adversely affecting fish destined for the Trinity River, which must pass through approximately 42 miles of the Klamath River before turning up the Trinity River and through the Hoopa Valley, where Hoopa Tribal members participate in a tribal subsistence fishery. Table 13.12-3 identifies Trust Resources and rights associated with the Hoopa Valley Indian Tribe.

**Table 13.12-3. Effects of Current Dam Operations on Hoopa Valley Indian Tribe Trust Resources and Rights**

Trust Resource/Right	Effects
Water resources	Altered flows
	Altered water temperature regime
	Reduced bedload sediment transfer
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
Terrestrial resources	Reduced food availability
	Loss of riparian habitat

Source: DOI 2011a, 2011b

The Hoopa Valley Tribe also provided information suggesting that no mitigation was historically required for the reduction of miles of salmonid fishery habitat upriver of Copco 1 and Copco 2 Dams because such mitigation was not required when the dams were completed. When other dams were constructed, mitigation was required for the loss of fish habitat, but only for the several miles between Iron Gate Dam and Copco No. 2 Dam, (i.e., the Iron Gate Fish Hatchery was not built to mitigate for the loss of all upriver habitat). The hatchery does not manage spring Chinook salmon because these fish were primarily affected by previous dam construction, and to a lesser extent than Iron Gate Dam.

### **Hoopa Valley Indian Tribe Health Impacts**

The secondary effects of the Klamath River dams on the people of the Hoopa Valley Tribe include emotional and physical health effects such as increased obesity, diabetes, heart disease due to loss of the traditional salmon diet, and depression, alienation, and suicide. Additionally, the tribal members experience a loss of opportunity for intergenerational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation for opportunity elsewhere (DOI 2011a, 2011b).

### **Effects Determinations**

#### **Alternative 1: No Action/No Project - Hoopa Valley Indian Tribe and Damming of the River**

*Continued impoundment of water could affect tribal trust resources.* Members of the Hoopa Valley Tribe have offered firsthand accounts of the decline of the river and its effects on the people. Tribal member Jill Sherman stated:

Even when there are salmon in the rivers, tribal nets fill with moss because flows aren't adequate to keep the water cool, a depressing reminder that the rivers are no longer healthy. Watching the rivers deteriorate each year, unable to protect those resources they so cherish, has had a tremendous adverse psychological effect on the region's native peoples.

Byron Nelson, a Hupa elder, stated:

Though many Hupa and Yurok still hold to traditional beliefs and engage in certain time-honored practices such as shamanism and basketry, the decline of the rivers' health, the center of their culture and spirituality, has led to a loss of self-esteem, an increase in cynicism, and has greatly hurt the cohesiveness and health of these tribal communities. The rivers are the focalizing element of the society; with their loss, it seems much of the hope has also been lost.

According to Nelson, cultural stress related to an unhealthy river has resulted in a broad spectrum of social and educational problems, including the disruption of traditional occupations and the loss of opportunities for religious practice and community participation in tribal culture. Limitations in the tribes' access to resources has restricted the practice of some of their most important traditions, including freely fishing the once

prolific seasonal salmon runs and participating in the concurrent cycle of ceremonies. It appears that the access to resources may also be a cause of younger tribal members leaving the area.

The damming of the river has wide-ranging effects on the culture of the Hoopa Valley people. Despite significant degradation of the river ecosystem of the Klamath/Trinity region through the end of the 19th century and the first half of the 20th century, the Hupa persisted in their traditional reliance on the rivers and their resources. Although they found it increasingly difficult, the tribes continued to practice their ceremonies and religions; gathered vegetation for baskets, food, medicines, and other purposes; and met and ate together along the riverbanks. Fish caught by the tribes, as much as possible, continued to be an important component of their diets. Many of the current tribal members grew up with a strong physical connection to the rivers and great appreciation for the traditions and ways of life of their ancestors.

A reason for the ability of the tribes to maintain some of their traditional relationship to the rivers was that the rivers' flows remained relatively unimpeded. This all changed with the building of the dams. The dams, along with other diversions and impoundments in the Klamath/Trinity Basin, have dramatically altered the region's rivers. Fishing and traditional-use sites have become clogged with debris, and declines in fish population persist.

In the past, federal regulations governing fishing on the Hoopa Valley Indian Reservation have permitted the taking of fish for ceremonial purposes even when the fisheries were closed to harvest. This fact is evidence that the federal government recognizes that fishing and fish are an integral and indispensable part of the religious and ceremonial life of the tribe. Unfortunately, the poor condition of the fishery in recent times has in some instances forced the Hupa to purchase fish from sources off their reservations to provide for all who attend their ceremonies. Tribal elder Byron Nelson stated:

A lack of fish has resulted in the scaling down or even cancellation of ceremonies. The continual practice of ceremonies represents an important means for keeping tribal members who live off the reservations connected to their culture and families. However, without enough salmon, many do not come back; and the planning of ceremonies, once a time to appreciate nature's abundance and of spiritual celebration, often brings significant anxiety to the region's native peoples.

According to a report by the California Department of Fish and Game, the fish kill of 2002 affected all of the tribes along the Klamath River; however, the Trinity River in the Hoopa territory was also affected. Although a larger number of Klamath River fall-run Chinook died, a greater proportion of the Trinity River run was affected by the fish kill. This is because the Trinity run is substantially smaller than the Klamath run on an annual basis, and the Trinity run was at its peak during the height of the fish kill. The effects were more pronounced in the Trinity River than the Klamath River because the fish kill

occurred downstream of the confluence of the Trinity and the Klamath, and thus eliminated much of the fishing opportunity on the Trinity River.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin, as noted above. However, the current operations of the four Klamath River dams significantly affect the trust resources of the Hoopa Valley Tribe and other resources traditionally used by the Hoopa, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

**Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)**

*Removal of the Four Facilities could affect tribal trust resources.* Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, The East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Proposed Action, including the KHSAs and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

**KBRA**

Upon becoming a Party to the KBRA in accordance with Section 38, the Hoopa Valley Tribe will be eligible for funding to implement programs under the KBRA. The KBRA has several programs that could result in impacts/effects to Trust Resources and other traditional resources used by the Hoopa Valley Tribe. Specific KBRA programs potentially affecting Trust Resources and other traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

*Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources.* As the original stewards of the natural resources of the Klamath Basin the Hoopa Valley Tribe holds a special position in the Basin and has interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are anticipated to support in trust resources would contribute to the effects of hydroelectric facility removal analyzed above. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to Trust Resources

and other traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and Conservation Management Program will require future environmental compliance as appropriate.

**Alternative 3: Partial Facilities Removal of Four Dams**

*Partial facilities removal could affect tribal trust resources.* Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSAs and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

**Alternative 4: Fish Passage at Four Dams**

*Fish passage at four dams could affect tribal trust resources.* Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

**Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

*Fish passage at two dams and facilities removal of two dams could affect tribal trust resources.* Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Hoopa Valley Indian Tribe (Table 3.12-3), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

## **Yurok**

### **Yurok History**<sup>4</sup>

With more than 5,000 members, the Yurok Tribe is the largest tribe in California. The tribe's ancestral territory covers approximately 350,000 acres and includes approximately 50 miles of Pacific coastline. Today, the tribe's reservation, located in Del Norte and Humboldt Counties, California, encompasses approximately 57,000 acres, and consists of a strip of land extending a mile along each side of the Klamath River from just upstream of the confluence of the Klamath and Trinity rivers about 50 miles inland. This reservation configuration came about through a complex series of federal reports and legislative acts.

Today the Yurok Tribe, headquartered in Klamath, California, with an upriver office located in Weitchpec, California, employs more than 200 people, boasts one of the most substantial fishery programs on the entire Klamath River, and self-regulates its subsistence and commercial fishery. The tribe actively participates in the in-river and upslope restoration of its ancestral lands and has signed a collaborative management agreement with the DOI that memorializes the prime role that the Yurok Tribe maintains in managing its resource base (DOI 2011a, 2011b).

In summary, Sloan (2011:55) states:

The inseparable relationship of the Yurok people with the environment and resources provided by the rivers of the Klamath-Trinity Basin cannot be overemphasized. The Klamath River is a vital natural resource which is the foundation of Yurok social and cultural way of life. At its most basic level, the River has always been a source for food and other necessities of daily life...Even rocks from the river are used by Yurok people to practice their cultural ways. The Yurok River is traveled during religious ceremonies and in recreational activities, it is integral to the Yurok language and its oral tradition and truly represents the binding force of their community. Yurok use of the River developed over a long period of time as evidenced by the complexity of their religious ceremonies and practices. In aboriginal times, religious practices were integrated with fisheries management.

The Yurok have many traditional dances and ceremonies which they have long practiced along the banks of the Klamath and Trinity Rivers. The Yurok's ceremonial way-of-life has greatly suffered with the deterioration of the region's rivers. The Yurok have always depended on the Klamath and Trinity Rivers and the sustenance that their flows provide, they name themselves after the rivers and much of their universe is defined in terms of their physical relation to rivers. Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation routes, economic and sociological resources, indeed the Yurok identity, are all

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<sup>4</sup> A detailed report documenting the history and culture of the Yurok prepared by Sloan (2011) is included in Appendix B of the DOI (2011a) report

intricately woven into the ecosystems of the Klamath and Trinity Rivers. Yurok continue to live upon some of the forty-four village sites that line the Klamath and lower Trinity Rivers. These are places where Yurok have lived, fished, gathered, prayed and have been buried for countless centuries.

### **Yurok Cultural Practices**

#### **Fishing**

The Yurok have long practiced their traditional dances and ceremonies along the banks of the Klamath River. Consequently, deterioration of the Klamath River affects Yurok ceremonial and traditional practices. The lives of the Yurok people have always been intricately tied to the river. Historically, they depended on the river for sustenance, and much of their world was defined in terms of their physical relation to the river. Natural and cultural sites, daily and seasonal ceremonial practices, oral traditions, transportation routes, economic resources, social relationships, and the Yurok identity were all drawn from the river.

The Yurok base time and direction on the flows of the Klamath River as much as on the rising and setting of the sun, which can be obscured by the steep terrain, deep forests, and rainy conditions of the Klamath Basin. As one Yurok elder said, “Without this river we would not know who we are, where we’re from, or where we’re going.” Under natural conditions, the rates and sounds of the river’s flow tell the Yurok both the season and the time of day. The skill of the Yurok fisherman has always been measured by his ability to navigate the Klamath River in the dark, not by the stars or landmarks, but by correlating the location and swiftness of the current and back eddies of the river with the sounds that are unique to each bend and riffle. Moreover, the Yurok people are so attuned to the river that they have a name for each characteristic of the water’s movement. Even when Yuroks are away from the river, they remain acutely aware of their location in relation to it, always measuring direction by the river’s flow. For example, it is not uncommon to refer to the burners on a kitchen stove as upriver or downriver, depending on their position. One Yurok elder said, “The river flows like our blood. It is our veins and arteries.”

Many of the Yurok cultural sites on the Klamath and lower Trinity Rivers are traditional fishing spots owned by families. Fishing spots are locations where there are deep holes, significant back eddies, and ideal spots to set a net or erect a platform out over the river. Fishing spots can be given, inherited, loaned, leased, and bought and sold, and are central to the Yurok economy. Over time, as the rivers’ flows have changed, so have the locations of these cultural sites. To this day the Yurok continue to live in some of the village sites that line the Klamath and lower Trinity Rivers, where they still practice many of their traditions in places where the Yurok have lived, fished, gathered, prayed, and buried their dead for centuries.

The Yurok Tribe conducted subsistence fishing in 1987 through 1989. Since 1990, tribal commercial harvests have been marginal and have not provided a comfortable standard of livelihood as originally envisioned for the Yurok in the Hoopa Yurok Settlement Act. At

the same time, subsistence fishing has been severely limited. The decreased harvests have had a significant adverse impact on the tribe's economies and health, as described below.

### **Trade and Barter**

Fish are the Yurok Tribe's most valuable asset and a mainstay of their economy. Abundant fish allow Yurok to feed themselves and their families and to acquire products from outside their territory through trade. Fish was a trading commodity available to any enterprising man. A young man who diligently fished and successfully traded fish for other items could amass sufficient wealth to buy a boat, travel to collect all of the necessary items to fashion intricate ceremonial regalia, and to allow him to marry. Fish were the baseline resource that facilitated the acquisition of wealth and upward social mobility in Yurok culture.

### **Religious Practices**

First Salmon Ceremonies were initiated around April when fish first breeched the sandbar at the mouth of the Klamath River. The ceremony was conducted to celebrate the harvesting of fish and to pray for continuing prosperity and access to subsistence resources. Written and oral tradition indicates that prior to impacts on the fishery beginning with miners who arrived during the Gold Rush, salmon were entering the river in distinguishable waves throughout the year. The major run was traditionally that of the spring salmon. George R. Field, supervisor of the cannery of the Klamath Packers Association at the mouth of the Klamath, described the runs in 1930:

As the run of winter steelheads ceases, about March 30, spring Salmon begin to come. A few enter the Klamath in the later part of February, but the run really starts in March and slackens or almost entirely passes by the last of May. These fish average about 11 pounds in weight and are indistinguishable from those which come later, except that the eggs are always immature. These spring salmon may be caught in the smaller streams fed by melting snow at the headwaters of Salmon River during the month of May.

In early spring the first salmon to enter the Klamath River was traditionally speared and ritually eaten by Yurok medicine men, which signified the beginning of the fishing season. The beginning of fishing season also marked the construction of the fish dam at Cappell, located 33 miles from the mouth of the Klamath River. The fish dam that has not been constructed since 1913 was built by Yurok men under the supervision of a Yurok medicine man. Dam construction sanctified the taking, distribution, and consumption of salmon. All other ceremonies were scheduled only after the fish dam ceremony took place.

Salmon are ritually managed to ensure that Yurok are provided with fish and that enough fish spawn to maintain the fishery. Yurok maintain a general reverence for salmon; however, a strong belief prevails that without proper ceremony the salmon will not return in sufficient numbers. Regardless, the river is central to most Yurok ceremonies. There

are several rocks along the river etched with petroglyphs that provide instructions from the Creator to the Yurok people. One message is a warning that when the rivers stop flowing that will mark the end of the Yurok world. Accordingly, some elders have prophesied that the manipulation of flows by damming represents the beginning of the end for the Yurok.

The Brush Dance, intended as a communal focus around an ailing child, is held in many of the traditional village sites along the Klamath River. The ceremony requires the proper river setting and the availability of river resources. As a Brush Dance unfolds over a four-day period, the participants celebrate the wealth that the riverine environment provides. Baskets made of plant materials collected at the water's edge are used to hold food and ceremonial medicine. Acorns are cooked in the baskets and converted into a nourishing mush using hot rocks gathered from specific river bars. Regalia used by dancers is constructed from various plant and animal products that the riverine environment provides. Ceremonial hosts are expected to feed visitors salmon, and to fail in providing such traditional food to guests is considered an insult.

Beginning with the California Gold Rush and the appearance of large numbers of Euroamericans in traditional Karuk territory, Yurok traditional cultural practices began to decline; however, during the 1970s and 1980s Yurok cultural practices were revitalized. Tribal elders began to teach young people traditional Yurok practices and ceremonies. The Jump Dance was conducted in Pecwan in 1984, a War Dance was held in the late 1980s, communities came together to support the revival of Brush Dances, and in 2000 the White Deerskin Dance was held for the first time in many years at Weitchpec (DOI 2011a, 2011b).

### **Oral Traditions**

The anthropologist Alfred Kroeber traveled throughout Yurok territory in the early 1900s interviewing Yurok people and documenting the tribe's riverine way of life. Kroeber (1976) presents 169 Yurok stories, of which 77 make direct reference to the Klamath River. Among the stories are tales and information regarding construction of fish dams, locations and origins of ceremonies held along the river, bad places in the river, locations where the first salmon was created, what one must do with salmon caught at certain locations, how the river came to flow the way it does, and death passage on the river. It is evident from transcriptions of Yurok stories that the Klamath River is an integral part of their way of life and a basis of their tradition and culture. These stories highlight a healthy and vibrant river ecosystem.

The use of the Yurok language dramatically decreased when non-Indians settled in the Yurok territory, and by the early 1980s it was near extinction. When the Yurok Tribe began to operate as a formal tribal government in 1988, the Yurok created a language revitalization program. The use of old records helped new language learners, but hearing fluent speakers was the most effective way for young people to acquire the language (DOI 2011a, 2011b).

### **Yurok Potentially Affected Trust Resources**

In a government-to-government consultation meeting concerning Yurok trust resources affected by current dam operations held on September 28, 2010, the Yurok Tribe asserted the following as Yurok trust resources: water, fish, land, wildlife, minerals, and timber. The Yurok Tribe asserted that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Tribe and its membership. The Yurok further assert that the federal government has other trust responsibilities to the Yurok in the areas of social welfare, education, and health. For example, Yurok believe that limited access to water, aquatic, and terrestrial resources has restricted the ability of Yurok to practice of some of their most important traditions. This includes freely fishing the once-prolific semi-annual salmon runs and participating in the cycle of ceremonies initiated concurrently. In the past, the Yurok were not inclined to leave their territory; currently, several factors, including an inability to meet subsistence needs from the fishery and a perception that the rivers are dirty, prompt younger tribal members to leave the area to find work (DOI 2011a, 2011b).

The Yurok tribal chairperson, when asked if such trust resources were affected by the current dam operations, responded “Yes” and went on to relate that the Yurok understand that their resources are intricately interconnected to multiple ecosystems. The Yurok World Renewal Ceremonies, recently completed at the time of the meeting, were provided as an example of how Yurok understand and pray for the integrity of such ecosystems. Table 13.12-4 identifies trust resources and rights associated with the Yurok Tribe. The United States does not necessarily agree that all of the above resources are in trust (and therefore form the basis of a trust relationship), but the resources are important to the Yurok (and thus to the United States) for their traditional and ceremonial use.

### **Yurok Health Impacts**

Secondary effects of the Klamath River dams on the Yurok Tribe include emotional and physical conditions such as increased obesity, diabetes, and heart disease due to loss of traditional salmon diet, and depression and alienation that can result in suicide (DOI 2011a, 2011b).

**Table 13.12-4. Effects of Current Dam Operations on Yurok Tribe Trust Resources and Rights**

Trust Resource/Right	Effects
Water resources	Altered flows
	Altered water temperature regime
	Reduced bedload sediment transfer
	Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants
	Diminished aesthetics
	Algae clogged fishing nets
	Human exposure to toxic water while conducting cultural activities
	Diminished opportunity for traditional bathing
Aquatic resources	Loss of habitat
	Less suitable water temperature regime
	Reduced bedload transfer
	Increased potential for disease/parasites
	Reduced population size
	Diminished livelihood
	Loss of traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity among tribal members
	Depression, alienation, and possible suicide
	Tribal members leaving ancestral territory
	Lost opportunities for transmitting traditional knowledge
Terrestrial resources	Reduced food availability
	Loss of riparian habitat
	Diminished plant availability for cultural practices and related benefits
	Loss of opportunity for inter-generational traditional knowledge transmission

Source: DOI 2011a, 2011b

**Effects Determinations**

**Alternative 1: No Action/No Project - Yurok and Damming of the River**

*Continued impoundment of water could affect tribal trust resources.* The damming of the river has resulted in changes in the flows of the water and the resources it offers to the tribe, along with myriad losses to tradition and culture (USFWS et. al. 1999). Despite significant degradation of the river ecosystem of the Klamath region through the latter 19th and first half of the 20th centuries, the Yurok persisted in their traditional reliance on the river and its resources. Although it became increasingly difficult, the tribe continued to practice its ceremonies and religions and gathered vegetation for baskets, food, medicines, and other purposes. As much as possible, Klamath River fish caught by the Yurok tribal membership continued to be an important component of the tribe’s diets. Indeed, many of today’s older Yurok grew up with a strong physical connection to the river and a great appreciation for the traditions and ways of life of their ancestors.

The presence of the dams on the upper reaches of the Klamath River has brought about changes in Yurok culture. Sites for fishing and traditional use have become clogged with debris and algae, and fish populations have declined. Observers report that when tribal members try to use their traditional fishing nets, they fill with algae, which is a sign of an unhealthy river.

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath basin have significantly decreased over the last several decades. Timber extraction in the basin has slowly become controlled by better regulations at the federal and state levels to the point where timber extraction is now better characterized as forest management.

However, the current operations of the four Klamath River dams significantly affect the trust resources of, and other resources traditionally used by the Yurok Tribe and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

**Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)**

*Removal of the Four Facilities could affect tribal trust resources.* Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the KBRA would be implemented, the East and West Side Facilities would be decommissioned, and the Yreka water supply pipeline would be installed. Implementation of the Proposed Action, including the KHSAs and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

**KBRA**

The KBRA has several programs that could result in impacts/effects to trust resources and other traditional resources used by the Yurok. Specific KBRA programs potentially affecting trust resources and other traditional resources include the Tribal Fisheries and Conservation Management Program. Other KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources; these programs' effects are discussed in Sections 3.2, 3.3, and 3.5 of this EIS/EIR.

*Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources.* As the original stewards of the natural resources of the Klamath Basin the Yurok hold a special position in the Basin and have interests in and a traditional relationship to the Basin ecosystem and its fisheries. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribe in developing their capacity to participate in resource management activities within the Basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The timing of and specific locations where these resource management actions could be undertaken is not certain but the improvements they are anticipated to support in trust resources would contribute to the effects of hydroelectric facility removal. Implementation of the Tribal Fisheries and Conservation Management Program would generate beneficial effects to trust resources and other traditionally used resources. Implementation of specific plans and projects associated with the Tribal Fisheries and

Conservation Management Program will require future environmental compliance as appropriate.

**Alternative 3: Partial Facilities Removal of Four Dams**

*Partial facilities removal could affect tribal trust resources.* Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSAs and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

**Alternative 4: Fish Passage at Four Dams**

*Fish passage at four dams could affect tribal trust resources.* Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not fully resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

**Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

*Fish passage at two dams and facilities removal of two dams could affect tribal trust resources.* Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Yurok Tribe (Table 3.12-4), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

**3.12.3.4 Resighini Rancheria**

**Resighini Rancheria History**

The Resighini Rancheria is in Del Norte County, California, and encompasses 239 acres. The Resighini Rancheria is several miles inland from the mouth of the Klamath River and rests on the southern banks of the river, completely surrounded by the Yurok Reservation. It is primarily settled by Yurok Indians affiliated with the Yurok Coast

Indian Community. A population of 36 was reported on rancheria lands in the 2000 U.S. Census.

Today the Resighini Rancheria employs a dozen people and operates a campground. A former casino and cafe received flood damage in the 1990s and are no longer operational. The tribe also operates a gravel-extraction enterprise along the course of a secondary channel to the Klamath River that runs through rancheria boundaries. Groundwater wells have been assessed and are slated for improvements that will lead to better water distribution throughout the rancheria in support of several residences and the campground and for irrigating agricultural lands. The tribe recently purchased off-rancheria and adjacent fee lands totaling 196 acres. This additional acreage is mostly riparian habitat along the mainstem of the Klamath River and includes the old Waukel Flat Indian Agent site.

### **Resighini Rancheria Cultural Practices**

#### **Fishing, Trade and Barter, Religious Practices, and Oral Traditions**

The Indians of the Resighini Rancheria are Yurok people; consequently they share their cultural practices and values with the general culture described for the Yurok Tribe. Resighini tribal members recently participated in the Weitchpec Jump and Deerskin ceremonies.

The original “Merin” proposal to create the Resighini Rancheria described the tract of land as “agricultural” with conditions that are “ideal for farming or dairying.” However, the value of the land as agricultural was directly connected to the loss of the traditional fisheries. In past years, commercial and subsistence fishing was a primary means of economic and subsistence support for the Yurok along the Klamath River. However, with the closure and restrictions on tribal fishing, the Yurok lost this means of support. While the “fish wars” and accompanying litigation of the 1970s and 1980s reinstated Yurok fishing rights and the Hoopa-Yurok Settlement Act further confirmed that the Yurok Tribe had fishing rights, Rancheria members were left out of that settlement.

### **Resighini Rancheria Potentially Affected Trust Resources**

In a government-to-government consultation meeting concerning Resighini Rancheria trust resources affected by current dam operations held on September 29, 2010, the Resighini Rancheria asserted the following as Rancheria trust resources: gravel (minerals); water as it relates to groundwater for domestic, agricultural, and recreational (campground) uses; riparian plants; wetlands; fish; land; and wildlife. The Resighini Rancheria asserted that the United States has a trust responsibility to protect such resources and ensure that such resources are managed for the beneficial use of the Rancheria and its membership. The Rancheria further asserted that the federal government has trust responsibilities to the Rancheria in the areas of social welfare, education, and health. The United States does not necessarily agree that all of the above resources are trust resources (and therefore form the basis of a trust relationship) but the resources are important to the Rancheria (and thus to the United States) for their traditional ceremonial use. Table 3.12-5 identifies Resighini Rancheria Trust Resources and rights and resources traditionally used by Rancheria members.

**Table 3.12-5. Effects of Current Dam Operations on Trust Resources and Rights and Resources Traditionally Used by the Resighini Rancheria**

Trust Resource/Right	Other Resources Traditionally Used By The Tribes	Effects
Water resources (groundwater)		Indeterminate groundwater quality
	Water resources (instream)	Altered flows Altered water temperature regime Reduced bedload sediment transfer Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants Diminished aesthetics Algae clogged fishnets Human exposure to toxic water while conducting cultural activities Diminished opportunity for traditional bathing
	Aquatic resources	Loss of habitat Less suitable water temperature regime Reduced bedload transfer Increased potential for disease/parasites Reduced population size Less traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity Tribal members leaving reservation Fewer opportunities for transmitting traditional knowledge Increase in invasive species (Asian clams)
Terrestrial Resources		Real property: erosion and flooding Mineral: less gravel replacement
	Terrestrial resources	Reduced food availability Reduced riparian habitat Diminished plant availability for cultural practices and related benefits Loss of opportunity for inter-generational traditional knowledge transmission

Source: DOI 2011a, 2011b

Any Klamath River salmonid fishing rights and concomitant water rights to which the Resighini Rancheria may be entitled have not yet been determined. The United States does not currently recognize a Rancheria right to a fishery and the Rancheria does not currently have an instream water right. Regardless, the general health and well being and cultural values of the members of the Rancheria are affected by a lack of fish in the local economy and overall water quality. The lack of fish in the local economy also has secondary effects on general tribal health and cultural well being. The Rancheria tribal council person, when asked during consultation if such resources were affected by the current dam operations, responded, “Yes” and went on to relate that water quality has

declined, erosion of lands occurs at a higher rate, replenishment of gravel extraction beds has diminished, and fish returns are low. In addition, as a tribe that lives alongside the river, their aesthetic quality of life has diminished. The Rancheria people are at risk when they bathe in the river, tourists are less interested in visiting the Klamath River and staying in the campground, and in an area with fewer available fish, tribal members are likely to consume fewer traditional food resources. This has led to related impacts on tribal health such as higher rates of obesity, diabetes, heart disease, and stroke (DOI 2011a, 2011b).

The Yurok of the Resighini Rancheria bathe in the river and use its water for daily and ritualistic purposes. Because of their reliance on the river for so many aspects of their lives, they are concerned about the quality of its water. The Klamath Hydroelectric Project has effects on water quality and related environmental issues, such as watershed health, riparian habitats, erosion, sediment, turbidity, sources of pollution and temperature changes, algae blooms, low dissolved oxygen, high pH, and un-ionized ammonia. The cumulative effects may result in health problems, not just for the people who live on the Rancheria, but also for the tourists who come and camp in the area every year, and for people who use the water for business purposes or who work for those businesses.

A 1975 Resighini Rancheria Water Resources Investigation Report states that samples were not taken of the water in the abandoned well. It also states that coliform was found in a sample taken from a stream running through the Rancheria. A second report completed by the Bureau of Reclamation (Reclamation) in 2010 to document an Environmental Assessment of the Resighini Rancheria's Water Resources states: "The Rancheria is in need of an additional source of dependable drinking water to reduce potential health risks associated with their current operation." Later, the same document states: "Hydrogeologic information is currently not available for water-bearing formation, groundwater level trends, and groundwater storage for the Lower Klamath River Valley groundwater basin."

### **Resighini Rancheria Health Impacts**

Secondary effects of the Klamath River dams on the people of the Resighini Rancheria include emotional and physical health effects such as increased obesity, diabetes, heart disease due to loss of the traditional salmon diet, and depression, alienation, and suicide. Additionally, the tribal members experience a loss of opportunity for inter-generational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation for opportunities elsewhere (DOI 2011a, 2011b).

### **Effects Determinations**

#### **Alternative 1: No Action/No Project - Resighini Rancheria and Damming of the River**

*Continued impoundment of water could affect tribal trust resources.* The Klamath River dams have significantly reduced the ability of tribal members to engage in traditional and contemporary subsistence and religious practices. The availability and rights to

traditional foods and basket-making materials have been affected by the presence of the dams. The dams have altered the natural flows of the river, which has affected the formation of the sand spit in terms of sand buildup and the ability of the river to clear a path through the spit to the ocean. As a result of altered functions, including increased sand build up coupled with seasonal low flows, the Rancheria has experienced more fall flooding of its lands.

The Rancheria members have noticed an invasion of clams (identified generally as “Asian clams”) and wonder how that might alter the ecosystem. The tribe is not sure whether invasive species can be directly attributed to the dams, but does know that the clams have migrated from upriver to downriver. Although new species are introduced into the ecosystem with unknown consequences to Rancheria members, the Rancheria has also witnessed the demise of traditional species such as the spring run of Chinook and the near extinction of the Klamath population of eulachon. The demise of these populations is generally attributed to poor Klamath River water quality (DOI 2011a, 2011b).

Many historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin. Mining activities in the Klamath basin have significantly decreased over the last several decades. Timber extraction in the basin has slowly become controlled by better regulations at the federal and state levels to the point where timber extraction is now better characterized as forest management, as noted above.

However, the current operations of the four Klamath River dams significantly affect the trust resources of the Resighini Rancheria and, by extension, their cultural values, and their continued operation under the No Action/No Project Alternative would result in no change from existing conditions.

**Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)**

*Removal of the Four Facilities could affect tribal trust resources.* Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the Yreka water supply pipeline would be installed, and the KBRA would be implemented. KBRA programs would have effects on trust resources of aquatic resources, water quality, and terrestrial resources, which are discussed Sections 3.2, 3.3, and 3.5 of this EIS/EIR. Implementation of the Proposed Action, including the KHSAs and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5).

**Alternative 3: Partial Facilities Removal of Four Dams**

*Partial facilities removal could affect tribal trust resources.* Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam

would be transferred to the DOI, the East and West Side Facilities would be decommissioned, the KBRA would be implemented, and the Yreka water supply pipeline would be installed. Implementation of the Partial Facilities Removal of Four Dams Alternative, including the KHSAs and KBRA, would, in the long-term benefit the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5). Actions addressing these issues are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

**Alternative 4: Fish Passage at Four Dams**

*Fish passage at four dams could affect tribal trust resources.* Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Four Dams Alternative would benefit fish populations. However, implementation of this alternative would not resolve the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5). Under the Fish Passage at Four Dams Alternative issues related to water, aquatic, and terrestrial resources related to trust resources and rights would persist.

**Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

*Fish passage at two dams and facilities removal of two dams could affect tribal trust resources.* Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented. Implementation of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would address the water, aquatic, and terrestrial resources issues related to trust resources and rights identified by the Resighini Rancheria (Table 3.12-5), but not to the same degree as the Proposed Action or Partial Facilities Removal of Four Dams Alternatives. Actions addressing issues related to water, aquatic, and terrestrial resources are presented in Sections 3.2, 3.3, 3.4, and 3.5 of this EIS/EIR.

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### 3.13 Cultural and Historic Resources

This section discusses the Proposed Action and alternatives' potential effects on cultural resources, historic properties, and historical resources. United States Department of the Interior (DOI) elected to utilize the National Environmental Policy Act (NEPA) process to meet the requirements of Section 106 of the National Historic Preservation Act (NHPA) as allowed under 36 CFR Section 800.8(c). DOI defines the undertaking, for purposes of Section 106 of the NHPA, as the removal of the four PacifiCorp dams which may be a result of the Secretarial Determination. The proposed undertaking has the potential to affect historic properties triggering compliance with Section 106 of the NHPA. The analysis and consultations concerning any effects of the Proposed Action and alternatives on historic properties will be integrated into the NEPA review and documentation pursuant to the criteria identified in 36 CFR Section 800.8(c)(1)-(4). The following section also incorporates the compliance requirements of the California Environmental Quality Act (CEQA).

#### 3.13.1 Area of Analysis

The area of analysis for cultural and historic resources includes the area of potential effects (APE) for the Proposed Action (removal of the four dams and facilities) as this represents the largest APE of all alternatives and is inclusive of all APEs for each of the other alternatives. The APE is defined as the entire 263 mile length of the Klamath River from Upper Klamath Lake to the Pacific Ocean and a 0.5-mile-wide corridor surrounding the river, all four dams and associated facilities, and each of the four reservoirs.

#### 3.13.2 Regulatory Framework

The following definitions are common terms used to discuss the regulatory requirements and treatment of cultural resources:

**Cultural Landscape** is a geographic area, including both cultural and natural resources, associated with an historic event, activity, or person or exhibiting other cultural or aesthetic values. (Birnbaum 1994). An ethnographic landscape, one type of cultural landscape, is described as a landscape containing a variety of natural and cultural resources that associated people define as heritage resources. (Birnbaum 1994). Cultural landscapes may be evaluated for eligibility following the criteria 36 CFR Section 60.4.

**Cultural resource** is a term used to describe several different types of properties, both made/modified by people and natural: prehistoric and historical archaeological sites; architectural properties such as buildings, bridges, and infrastructure; and resources of traditional or historic importance to Indian tribes and other cultural groups.

**Historic properties** is a term defined in 36 CFR Section 800, the implementing regulations for Section 106 of the NHPA, as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places (National Register), including artifacts, records, and material remains related to such a property. The term includes properties of traditional religious and cultural importance (Traditional Cultural Properties or Cultural Landscapes) to an Indian tribe or other cultural group that also meet the National Register criteria for listing found at 36 CFR Section 60.4.

**Historical resource** is a CEQA term that includes buildings, sites, structures, objects, or districts, each of which may have historical, prehistoric, architectural, archaeological, cultural, or scientific importance, and is eligible for listing or is listed in the California Register of Historical Resources (California Register).

**Historic District** is a significant concentration, linkage, or continuity of sites, buildings, or structures united historically or aesthetically by plan or physical development. A Historic District derives its importance from being a unified entity, even though it is often composed of a wide variety of resources. The identity of a District results from the interrelationship of its resources, which can convey a visual sense of the overall historic environment or be an arrangement of historically or functionally related properties. A District can include sites, structures, and features that, on their own, lack individual distinction, but are significant as a group. A District will have an identified theme and time period of significance.

**Programmatic Agreements** are negotiated agreements between federal agencies, the Advisory Council on Historic Preservation (ACHP), and State Historical Preservation Officers (SHPOs), in consultation with other interested parties, that govern the implementation of a particular program or the resolution of adverse effects from certain complex project situations or multiple undertakings, as defined in 36 CFR Section 800.14. Programmatic Agreements may be used when effects on properties are similar and repetitive or are multi-state; when effects on historic properties cannot be fully determined prior to approval of an undertaking; when nonfederal parties are delegated major decision making responsibilities; and for dealing with the potential adverse effects of complex projects or multiple undertakings.

**Traditional Cultural Property (TCP)** is defined as a property eligible for inclusion in the National Register “because of its association with cultural practices or beliefs of a living community that (a) are noted in that community’s history, and (b) are important in maintaining the continuity of the community (Parker and King 1998).”

### **3.13.2.1 National Historic Preservation Act of 1966, as amended in 1992**

The NHPA is the primary federal legislation governing preservation of cultural and historical resources in the United States. The NHPA established a national historic preservation program which encourages the identification and protection of cultural resources. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties listed in or eligible for the National Register of Historic Places and afford the ACHP a reasonable opportunity to comment on such undertakings (16 USC Section 470f). The ACHP promulgated the Section 106 implementing regulations, found at 36 CFR Part 800, which sets forth the Section 106 process, including consultation requirements.

**Compliance with Section 106 of the NHPA** As allowed under the Section 106 regulations, DOI has elected to integrate compliance with Section 106 through the NEPA process pursuant to 36 CFR Section 800.8(c)(1)-(4). This integrated approach satisfies the regulatory steps of the Section 106 process by using the NEPA process and the documentation required for the preparation of an Environmental Impact Statement (EIS)/ Record of Decision (ROD) to evaluate and resolve an undertaking's potential adverse effects on historic properties. The regulations identify specific requirements that the federal agency must meet through the NEPA process and documentation in lieu of the Section 106 process set forth in 36 CFR Sections 800.3 through 800.6. These standards, and a description of how DOI will meet those standards, are described below.

Initiation of the Section 106 Process: The definition of the federal undertaking is an important step in the initiation of the Section 106 process. In this case, the proposed undertaking is the potential removal of the four lower PacifiCorp dams. The proposed undertaking and the alternatives being analyzed in this EIS/ Environmental Impact Report (EIR) are limited to only the selection of an approach involving partial or full dam removal and the installation of fish passages. The specific details of how the proposed undertaking or the alternatives might be implemented are not fully known at this time and cannot be fully analyzed in this EIS/EIR, nor will a decision through the EIS/EIR authorize the removal of dams without additional compliance with NEPA and other federal environmental laws, including Section 106 of the NHPA. Future decisions will evaluate how to implement the Proposed Action or other selected alternative.

Use of the NEPA Process In Lieu of the Section 106 Procedures Set Forth in 36 CFR Sections 800.3 through 800.6: The regulations for Section 106 permit federal agencies to integrate Section 106 compliance with the NEPA process (36 CFR Section 800.8). Due to the scope and scale of this undertaking, DOI has chosen to utilize this provision in order to reduce redundancies when complying with both laws; provide the broadest possible opportunities and greatest convenience for the public to review and consult on DOI's proposed actions; and ensure that concerns pertaining to historic properties are fully integrated into the EIS and the ROD.

The Section 106 regulations clearly state that integrating the Section 106 compliance process with NEPA does not waive federal agency obligations under either law. While the regulations do permit the DOI to take advantage of the NEPA process, the Agency

must still adhere to the fundamental direction for compliance with Section 106. The following summarizes the DOI's actions to comply with these provisions (36 CFR Sections 800.8(c)(1) through 800.8(c)(4)).

Notifications: A federal agency must disclose its intent to integrate the Section 106 process with the NEPA process to the appropriate SHPOs and the ACHP prior to the review. DOI notified the ACHP and the California SHPO and Oregon SHPO, of its intent to implement the Section 106 regulations through the NEPA process by letter dated June 24, 2011.

Identifying consulting parties pursuant to 36 CFR Section 800.3(f): The public involvement process for NEPA has been extensive and sustained. It has included outreach and invitations to consult to other federal agencies, state and local governments, nongovernmental organizations, and the public. In addition, DOI has separately notified the ACHP, California SHPO, Oregon SHPO, six federally recognized Indian tribes, two Indian organizations, and other interested parties.

Identify Historic Properties and Assess the Effects: For purposes of the proposed action to remove the four lower PacifiCorps dams (and for the evaluation of alternatives), DOI established as the APE the entire 263 miles of the Klamath River and a 0.5 mile corridor around it. The effort to identify and assess effects reflects DOI's consideration of the project alternatives and is commensurate with the assessment of other environmental factors. The identification of and potential effect on some historic properties cannot be fully determined prior to approval of either the proposed undertaking or an alternative evaluated in this EIS/EIR. Future decisions regarding implementation of the selected alternative will further develop the APE and identify cultural and historic properties that may be affected by future actions such as road construction or improvements and reservoir drawdown.

DOI identified known historic properties listed or eligible for the National Register, such as the Klamath Hydroelectric Facilities, and also the types of historic properties likely to occur within this area through records searches at the North Central Information Center at California State University, Chico; the North Coastal Information Center, Klamath, California; the Oregon Office of Historic Preservation; the Klamath National Forest; a sacred lands search conducted by the California Native American Heritage Commission; and a review of archaeological, ethnographic, and historic information. DOI also sought information from the SHPOs, Indian tribes, Indian organizations, and the public regarding information about historic resources through the scoping process for the EIS/EIR and the initiation of consultations under Section 106 of the NHPA. This data is presented in Section 3.13.3. The potential effects of the proposed undertaking and the alternatives are discussed in Section 3.13.4.

Consult Regarding the Effects of the Undertaking with Tribes that May Attach Religious and Cultural Significance to Affected Historic Properties: Tribal consultation for Section 106 was initiated via letter dated October 19, 2010. Tribal consultation is ongoing.

Involve the Public in accordance with the Agency’s Published NEPA Procedures: The public has been involved in the scoping process for this EIS/EIR and will be provided an opportunity to review and comment on this EIS/EIR during the public review period.

Develop, in Consultation with Consulting Parties, Alternatives and Proposed Measures that Might Avoid, Minimize, or Mitigate Any Adverse Effects of the Undertaking on Historic Properties: Selection of one of the proposed alternatives, other than the No Action Alternative, would be the first part of a multi-tiered decision-making process. The Proposed Action and the alternatives being evaluated in this EIS/EIR will require additional environmental compliance prior to initiation of ground disturbing activities. Section 106 consultation was initiated with ACHP, SHPOs, and other consulting parties, and will be ongoing through a final decision and any future agency decisions. DOI identified known historic properties and methods to further identify and evaluate historic properties. DOI has also sought information from Indian tribes regarding the identification of areas with religious or cultural importance, and this section discusses the potential effect to such resources. Measures to avoid, minimize or mitigate adverse effects are also evaluated in this section. These measures would be offered as binding commitments for future decisions, and will help to coordinate future development through those decisions. The mitigation measures also serve as a program of action to avoid, minimize, or mitigate the effects on historic properties associated with the selected alternative.

Review of Environmental Documents: DOI will submit the Draft EIS/EIR for review and comments to the SHPOs, Tribal Historical Preservation Officers (THPOs), ACHP, Indian tribes, Indian organizations, and other parties identified as interested parties.

Approval of the Undertaking: The measures to avoid, minimize, or mitigate potential adverse effects associated with the Proposed Action or the selected alternative will be incorporated into the Record of Decision and represent a binding commitment as the selected alternative is carried out.

#### **3.13.2.2 Native American Graves Protection and Repatriation Act (NAGPRA)**

Section 3 of NAGPRA applies to Indian human remains and other cultural items found on federal lands and tribal lands, and addresses the treatment and disposition of those remains and items in consultation with relevant tribe(s) (see Appendix D of NAGPRA). Any Indian human remains or other cultural items found on federal land or tribal land affected by the Proposed Action and alternatives would be subject to the procedures under NAGPRA.

#### **3.13.2.3 California Environmental Quality Act**

For the purpose of this Klamath Facilities Removal EIS/EIR, California public agencies must consider the effects of their actions on both “historical resources” and “unique archaeological resources.” Pursuant to Public Resources Code (PRC) Section 21084.1, a “project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment.” Section

21083.2 requires agencies to determine whether proposed projects would have effects on “unique archaeological resources.”

“Historical resource” is a term with a defined statutory meaning (PRC, Section 21084.1 and State CEQA Guidelines, Section 15064.5 [a], [b]). The term embraces any resource listed in or determined to be eligible for listing in the California Register. The California Register includes resources listed in or formally determined to be eligible for listing in the National Register, as well as some California State Landmarks and Points of Historical Interest.

Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified in a local historical resources inventory may be eligible for listing in the California Register and are presumed to be historically or culturally significant for purposes of CEQA unless a preponderance of evidence indicates otherwise (PRC, Section 21084.1 and California Code of Regulations, Title 14, Section 4850).

In addition to assessing whether historical resources potentially affected by a proposed project are listed in the California Register or have been identified as historically or culturally significant in a survey process, lead agencies have a responsibility to evaluate them against the California Register criteria prior to making a finding as to a proposed project’s impacts on historical resources (PRC, Section 21084.1 and California Code of Regulations, Section 15064.5 [a][3]). Under California Code of Regulations (CCR), Title 14, Chapter 3, Section 15064.5 (a)(3) a historical resource is defined as any object, building, structure, site, area, place, record, or manuscript that meets the following criteria:

- a) Is historically or archeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political or cultural annals of California.
- b) Meets any of the following criteria:
  - (A) Is associated with events that have made a significant contribution to the broad patterns of California’s history and cultural heritage.
  - (B) Is associated with the lives of persons important in our past.
  - (C) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
  - (D) Has yielded, or may be likely to yield, information important in prehistory or history.

Archaeological resources may also qualify as “historical resources” and PRC 5024 requires consultation with the Office of Historic Preservation when a project may affect historical resources located on state-owned land.

For historic structures, CEQA Guidelines Section 15064.5, subdivision (b)(3), indicates that a project that follows the Secretary of the Interior’s *Standards for the Treatment of*

*Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*, or the Secretary of the Interior’s *Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* (1995) shall be considered as mitigating impacts to a less-than-significant level.

CEQA addresses impacts, potentially significant and significant impacts, to historical resources. Historical resources are properties that are either listed on or determined eligible for inclusion on the California Register and significant impacts are defined at CCR Section 15382 as: “...a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic and aesthetic significance. An economic or social change by itself shall not be considered a significant effect on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant.”

As noted above, CEQA also requires lead agencies to consider whether projects will affect “unique archaeological resources.” PRC Section 21083.2, subdivision (g), states that “‘unique archaeological resources’ means an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- 1) Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.
- 2) Has a special and particular quality such as being the oldest of its type or the best available example of its type.
- 3) Is directly associated with a scientifically recognized, important prehistoric or historic event or person.”

Treatment options under PRC Section 21083.2 include activities that preserve such resources in place in an undisturbed state. Other acceptable methods of mitigation under PRC Section 21083.2 include excavation and curation or study in place without excavation and curation (if the study finds that the artifacts would not meet one or more of the criteria for defining a “unique archaeological resource”).

In addition, California law protects Indian human remains and associated cultural items regardless of their antiquity and provides for the sensitive treatment and disposition of those remains. Section 7050.5(b) of the California Health and Safety Code specifies protocol when human remains are discovered. The code states:

In the event of discovery or recognition of any human remains in any location other than a dedicated cemetery, there shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent remains until the coroner of the county in which the human remains are discovered has determined, in accordance with Chapter 10 (commencing with Section 27460) of Part 3 of Division 2 of Title 3 of the Government Code, that the remains are not subject to the provisions of Section 27492 of the Government Code or

any other related provisions of law concerning investigation of the circumstances, manner and cause of death, and the recommendations concerning treatment and disposition of the human remains have been made to the person responsible for the excavation, or to his or her authorized representative, in the manner provided in Section 5097.98 of the Public Resources Code.

California Health and Safety Code at Sections 8010-8011 established the California NAGPRA 2001. The state repatriation policy is consistent with and facilitates implementation of the federal NAGPRA. The California act strives to ensure that all California Indian human remains and cultural items are treated with dignity and respect by encouraging voluntary disclosure and return of remains and cultural items by publicly funded agencies and museums in California. The act also provides a mechanism for aiding California Indian tribes, including non-federally recognized tribes, in filing repatriation claims and obtaining responses to those claims.

CCR Section 15064.5, subdivision (e), requires that excavation activities be stopped whenever human remains are uncovered and that the county coroner be called in to assess the remains. If the county coroner determines that the remains are those of Indian tribes, the Native American Heritage Commission must be contacted within 24 hours. At that time, the lead agency must consult with the appropriate Indian tribes, if any, as identified by the Native American Heritage Commission. CCR Section 15064.5 directs the lead agency, under certain circumstances, to develop an agreement with the Indian tribes for the treatment and disposition of the remains.

In addition to the mitigation provisions pertaining to the accidental discovery of human remains, the State CEQA Guidelines also require that a lead agency make provisions for the accidental discovery of historical or archaeological resources, generally. Pursuant to CCR Section 15064.5, subdivision (f), these provisions should include “an immediate evaluation of the find by a qualified archaeologist. If the find is determined to be an historical or unique archaeological resource, contingency funding and a time allotment sufficient to allow for implementation of avoidance measures or appropriate mitigation should be available. Work could continue on other parts of the building site while historical or unique archaeological resource mitigation takes place.”

Burials would be subject to federal NAGPRA on federal land and Indian land, California state burial laws in California, and Oregon state burial laws in Oregon.

### **3.13.3 Existing Conditions/ Affected Environment**

The presence of historic properties (or historical resources under CEQA) within the APE for each alternative was identified by conducting background and archival research and consulting with parties with knowledge of the area to identify known resources. In addition, through archival and background research, consultations, and knowledge of known resources, the types of historic properties likely present in inaccessible areas (primarily areas currently inundated by the reservoirs) were identified.

Due to the nature of the action being proposed, potential effects on all historic properties cannot be fully determined prior to approval of either the Proposed Action or an alternative evaluated in this EIS/EIR. The identification and evaluation of certain resources, and the potential effects to those resources, can only be understood and addressed as particular details of how to carry out the selected alternative are developed. One particular example is historic properties and cultural resources that are thought to be currently under water that could be exposed during reservoir draw down, as a direct result of dam removal. Another example is the construction or modifications to related facilities, roads, or temporary systems that may be necessary to implement the selected alternative, which will only be known when DOI develops particular details for accomplishing the proposed alternative. As specific details are developed through designs and plans to implement the selected alternative, the designated federal officials will conduct additional steps to identify and evaluate historic properties and alternatives to avoid, minimize, or mitigate adverse effects, in consultation with the consulting parties, in accordance with 36 CFR Part 800 and the stipulations identified in this EIS/EIR.

### **3.13.3.1 Regional Prehistory and Ethnography**

The cultural resources area of analysis includes four culture areas; the Columbia Plateau, Great Basin, California, and Northwest Coast. These culture areas have unique histories and are occupied by different Indian tribes that exhibit diverse traits and ecological adaptations. The cultural resources analysis will focus on The Klamath Tribes, Shasta, Karuk, Hoopa, and Yurok that occupy the territory along and adjacent to the Klamath River. These tribes have a long history of occupation of the area and tribal beliefs identify that the groups have occupied the area for time immemorial.

#### **Columbia Plateau and Great Basin Culture Areas** **Prehistory**

The upper Klamath River and Klamath Lakes area exhibit a blend of cultural traits from the Columbia Plateau and Great Basin culture areas. The chronology of the area may be organized into the Paleoarchaic, Early Archaic, Middle Archaic, Late Archaic, and Late Prehistoric periods.

#### **Paleoarchaic (14,000 to 7,000 Before Present [BP])**

During the Paleoarchaic period, the Klamath Basin was occupied by hunter-gatherers that tended to focus on hunting large game animals, but also supplemented their diet with fish, birds, and plant resources. These groups were seasonally mobile and generally small in size (Ames et al. 1998). Two of the oldest sites in the region are Paisley Cave, which is dated at 14,200 BP (Balter 2008) and Fort Rock Cave, which is dated between 13,200 and 10,200 BP (Aikens and Jenkins 1994). The oldest site in the upper Klamath River area is the Klamath Shoal midden site, 35KL21, which yielded a date of 7,700 BP.

#### **Early Archaic (7,000 to 4,500 BP)**

Most of the archaeological evidence for early human occupation in the Klamath River Canyon dates to the beginning of the Early Archaic period (Mack 1983 and 1991). Semi-subterranean house pits first appear in the Plateau region during this period suggesting

that some people were adopting a less mobile lifestyle. Typical artifacts associated with the Early Archaic include large stemmed, lanceolate, or leaf-shaped projectile points, knives, graters, scrapers, and some cobble and ground stone tools (e.g., abraders or grinding slabs, mortars, mullers, and stone bowls).

#### Middle Archaic (4,500 to 2,500 BP)

The Middle Archaic period is characterized by an increase in the exploitation of riverine and marsh environments and food resources such as salmon and various plant roots/tubers. There was also an increase in the use of milling stones and pestles at sites during this period. Typical Middle Archaic artifacts include broad-necked, corner-notched, and side-notched projectile points, many types of ground stone tools, bone and antler tools (e.g., chisels and wedges), and specialized fishing gear (e.g., bone harpoon barbs and net sinkers).

#### Late Archaic/Late Prehistoric (2,500 to 200 BP)

Several major cultural changes occurred during the Late Period, including: the widespread appearance of pit houses; a shift to a heavy reliance on fishing; the use of storage pits for salmon; camas exploitation; the development of seasonal land use patterns (i.e., use of “winter villages”); the appearance of the bow as evidenced by the presence of small corner- and side-notched projectile points at sites; and the appearance of Olivella shell beads. Extensive trade networks became important across the region by as early as 1,500 years ago, as suggested by tools made from obsidian sources 110 to 120 miles away and the presence of beads made from marine shells.

### **Ethnography**

The Klamath Tribes were constituted as a result of the Klamath Treaty of 1864, and includes the Klamath, Modoc, and Yahooskin Band of Snake Indians. Prior to their placement on a shared reservation, these groups utilized overlapping resource areas in the Klamath Basin, but were necessarily friendly with one another. When these groups were forcefully placed on the same reservation, they began to become more integrated. The Klamath and Modoc people occupy the entire upper Klamath Basin and adjacent interior drainages to the east, living in close association with the marsh and riverine resources of this area. The Klamath and Modoc tribes were the only populations residing in the Upper Klamath Basin prior to Euro-American contact, but they participated in salmon fishing and social gatherings along the Klamath River at least as far downstream as Seiad Valley in California. The Yahooskin principally occupy lands east of the Klamath Basin, but did participate in resource harvests, including salmon harvests, with Klamath and Modoc on the Sprague River and other Klamath River tributaries. The discussion of The Klamath Tribes will focus on the Klamath and Modoc because of their close proximity to the APE.

Stern (1998) summarizes ethnographic information regarding the Klamath Tribe collected by Barrett (1910), Spier (1930), and Berreman (1937). Deur (2011) also presents a summary of the ethnography of the Klamath Tribes and their relationship to the Klamath River. The Klamath and Modoc are members of the Plateau Penutian language family and they speak dialects of a single language (Stern 1998). Klamath ancestral territory stretches from the southern boundary of the Deschutes River watershed

in the north to Shovel Creek, which is along the Klamath River south of the Oregon and California border and from the Cascade Mountains in the west to the escarpment of Winter Rim in the east (Stern 1998). This area encompasses the Sprague River and Sycan Rivers, Sycan Marsh, Klamath Lake, and Klamath Marsh (Spier 1930; Berreman 1937). Modoc ancestral territory extends from Mount Shasta in the south to an area near the current California and Oregon border in the north and from the eastern slope of the Cascade Range near Mount Shasta to the area around Goose Lake in the east (Ray 1963). This area encompassed Lower Klamath Lake and Tule Lake.

Klamath and Modoc were both organized in villages that collectively owned productive fishing or other resource (e.g., seed or other plants) gathering areas. Influential heads of households, supported by extended families, assumed leadership roles in the villages (Stern 1998). Villages included various types of structures including semi-subterranean winter lodges for families and extended families. The Klamath and Modoc rebuilt their winter lodges in the fall. Spier (1930) identified five geographic subdivisions of winter villages:

- Klamath Marsh-Williamson River group on the southern margin of Klamath Marsh and the Lower Williamson and Sprague rivers (about 34 villages, plus four to five villages on the upper Sprague and Sycan rivers).
- Agency Lake group on Agency Lake and the northern arm of Klamath Lake (one village and one hamlet).
- Lower Williamson River group close to the mouth of Williamson River (about seven villages).
- Pelican Bay group that includes the Pelican Bay district on the west side of Klamath Lake, Four Mile Creek, and the marsh north of the lake (about eight villages).
- Klamath Falls group: along Klamath Lake south of Modoc Point (about 14 villages).

The permanent winter villages were never totally abandoned during the year. Each group of villages maintained one or more places for cremation of the dead. The ashes of cremated individuals were covered with soil and rocks. Individuals dying away from home might be interred under piles of rocks or cremated and returned to the cremation ground. Particular sweat houses, said to have been built by the legendary *Kemu'kumps*, and a hot spring were used to cleanse mourners.

Fish is the primary resource for the Klamath and Modoc; consequently settlements clustered near rivers and streams. Runs of fish began in the early spring and lasted into the fall (Spier 1930). Men, with some assistance from women, fished throughout the year from the banks of rivers or streams or from canoes using long-handled dip nets, spears, harpoons, and hook-and-line. During parts of the year, fish drives were also used to harvest fish. Members of the tribe would drive fish toward individuals dragging triangular nets on A-frames or purse nets through the water either on foot or from a canoe. Gill nets drawn between canoes and traps were also used to acquire fish. In

addition, stone barriers were constructed on some streams to restrict fish passage and facilitate fishing.

Klamath and Modoc typically left their winter villages in early spring to begin a seasonal round of harvest activities. Spring activities began with harvesting fish from the run of large suckers that took place in Upper Klamath Lake in March. Fish were dried on the branches of pine saplings and sometimes pounded into a meal and bagged for storage. As the spring sucker run subsided, Klamath and Modoc women turned their attention to digging ipos (*Carum oregonum*) roots, gathering waterfowl eggs, and scraping the cambium layers of young ponderosa pines for food. By late spring, women dug camas bulbs in wet meadows, baking them in earth ovens and sun-drying them for storage while men hunted waterfowl and other animals.

Summer was the season when women harvested wocas, the nutritious seeds of the yellow pond lily, at Klamath Marsh, Sycan Marsh, Tule Lake, Lower Klamath Lake, and other water bodies. Wocas were an important food resource and shaman conducted a ceremony at the beginning of the harvest. The seeds were processed for soup and flour. Women also collected cattail roots for drying and grinding into meal. During the summer months men hunted waterfowl and a variety of small mammals.

In fall, Klamath and Modoc gathered chokecherries, serviceberries, Klamath plums, pine nuts, blackberries, and gooseberries. Klamath and Modoc eventually moved into the high country of the western Cascades to harvest huckleberries. Women dried the berries before fires, while men hunted deer and elk and trapped furbearing mammals. Deer hunting methods included stalking and driving the animals into the lakes, rivers, or confined spaces where they could be clubbed by women in canoes or shot with bows and arrows. Whitefish were also harvested in the fall primarily by the use of dip-nets.

Klamath and Modoc sought power by visiting places where they believed that sacred beings resided and sought to gain their power through ritualized activities. Klamath and Modoc parents sent boys and girls on a power quest when they reached puberty. Fathers and mourning kinsmen sometimes sought power at the birth of a child or death of a wife or child (Stern 1998). Seekers of power often sought specific competence such as luck in hunting or fishing, war, love-making, gambling, foot-racing, or curing. Seekers of power went alone into the mountains for 5 days to fast, pile rocks, wrestle with trees, run, perhaps take sweat baths, and climb hills. Power might come in the form of a dream or a visit by a spirit, which would be followed by the seeker waking with blood in his mouth or nose and a personalized spirit song in his ears.

Shamans, mourners, and gamblers also sought power by swimming in deep river eddies. During the day, the seeker sweated and fasted, waiting in the brush until nightfall. At that time the power seeker went to the river and dove to the bottom in search of a spirit. The seeker did not appear to be frightened even if he saw something moving under the water. Similar to other power seeking events, it is reported that sometimes a seeker surfaced from the bottom of the river unconscious, with blood flowing from his mouth and/or nose (Spier 1930).

Shamans performed important ceremonies in midwinter gatherings, first-fruit rites for wocas gathering, and other occasions. They also cured illnesses and provided spiritual and practical support during warfare. Novice shamans received their initiation as a group at midwinter ceremonies. Helpers worked with shamans over a 5-day period during the ceremonies to call spirits, interpret spirit messages, and lead the audience in singing sacred songs.

Euroamerican expansion into Klamath and Modoc territory had a dramatic effect on their traditional cultural practices. Regardless, The Klamath Tribes exhibited considerable and well-documented persistence in their ceremonial and social traditions, particularly as they related to site-specific and resource-specific traditions. However, in 1954 Congress terminated the reservation and its trust relationship with The Klamath Tribes. The Klamath Tribes retained some rights to resources, but a majority of the tribal members withdrew from the tribe and received a portion of the tribal holdings. The trust account created for the rest of the members was later liquidated. In addition, in 1974 the federal government condemned thousands of forest acres that had been part of the Klamath Reservation so that the forest land could be added to the Winema National Forest (Klamath Tribes 2003).

The Klamath Tribes accomplished restoration of federal recognition in 1986 and began to rebuild their tribal government, economy, and community. Currently, the tribal Culture and Heritage Department is working to protect, preserve, and enhance traditional cultural values (Klamath Tribes 2003). The Klamath Tribes are also pursuing a variety of economic enterprises through their Economic Self-Sufficiency Plan.

### **Northern Interior California Culture Area**

#### **Prehistory**

Previous archaeological investigations near the area of analysis were conducted in response to hydroelectric developments and highway construction projects beginning in the 1940s. The more recent investigations of Basgall and Hildebrandt (1989) and Cleland (1997a, 1997b) are the most relevant to this analysis because it is likely that the subsistence and settlement patterns they identify are similar to the patterns along the Klamath River in California.

Basgall and Hildebrandt (1989) propose a three-phase cultural chronology for the northern Sacramento River Canyon that includes the Pollard Flat Phase (2,700–5,300 BP), the Vollmers Phase (1,700–4,500 BP), and the Mosquito Creek Phase (1,900 BP to contact). The Pollard Phase appears to represent a forager population that occupied residential base camps for extended periods of time, and is characterized by relatively large projectile points, ground stone tools, anvils, mauls, and net weights. The Vollmers Phase represents populations that were more mobile than those of the previous phase, while still maintaining residential camps, and are characterized by medium size projectile points, ground stone tools, anvils, mauls, and net weights. The Mosquito Creek Phase populations consisted of small groups that practiced a pattern of seasonal transhumance, and are characterized by small projectile points, ground stone tools, and the absence of hand stones, milling stones, hammer stones, anvils, mauls, and net weights.

Cleland's (1997a, 1997b) chronology for the Lake Britton area is divided into six periods spanning 7,000 years. The six periods include: Paleo-Indian (prior to 7,500 BP); Early Archaic-A (5,000–7,500 BP); Early Archaic-B (3,900–5,000 BP); Middle Archaic-A (3,000–3,900 BP); Middle Archaic-B (2,000–3,000 BP); Late Archaic (1,000–2,000 BP); and Emergent (150–1,000 BP).

The Paleo-Indian Period is poorly represented and indicates sporadic use of the area. The Early Archaic-A Period reflects an intensification of use of the area. Sites associated with this period are usually on mid-slope terraces and tend to be situated some distance from the Pit River. The Early Archaic-B Period reflects increased occupation of the area. Sites still tend to be situated on terraces and benches above the Pit River, but freshwater mussel shells appear at sites suggesting the exploitation of riverine resources.

The Middle Archaic-A Period is highlighted by a continued increase in the intensity of use of the area and a diversification of the overall settlement pattern. Occupation of the higher terraces above the Pit River continues, but habitation sites also occur closer to the river. The diversified settlement pattern of the Middle Archaic-A Period continues during the Middle Archaic-B Period, but there is increased occupation of sites near the Pit River. The Late Archaic-A Period is characterized by an increase of more riverine sites. This pattern continues into the Emergent-A Period during which occupation of riverine sites intensifies.

### **Ethnography**

Silver (1978) summarizes ethnographic information regarding Shasta collected by Dixon (1907), Voegelin (1942), and Holt (1946). Shasta territory extended north to a point about 20 miles north of Ashland, Oregon, including the Rogue River; south to Mt. Shasta; west to Seiad Valley on the Klamath River, southwest to New River; and east to Beswick (Silver 1978). Shasta groups are members of the Hokan language family.

There are several groups of Shasta that exhibit different cultural traits. Information presented here focuses on the Klamath River Shasta, called the Wiruhikwairuka or Kammatwa (Daniels 2003). Shasta were organized into autonomous tribelets consisting of extended family groups that occupied a group of villages. The family was the basic social unit of the Shasta, with the village being the political and economic unit. Each village had a chief, whose position was usually hereditary, to provide leadership and organize important social, political, and economic events (Silver 1978). Shamans conducted a variety of ceremonies in villages, and Shasta considered Mount Shasta to be sacred ground that was used for healing, blessing, and ceremonies. Mount Shasta is a significant part of Shasta traditions and ceremonialism.

Shasta along the Klamath River tended to build their winter villages near the river. Villages had recognized territories with areas for each family, including fishing places with fish weirs along the Klamath. Hunting territories also were held privately over the long term, in contrast to tobacco-growing plots and acorn-gathering trees, which were claimed only for brief periods. Typical villages consisted of brush shelters, bark houses, sweathouses, assembly houses, and winter houses (Silver 1978).

During the spring and summer, Shasta established temporary hunting and gathering camps in the foothills and mountains to exploit seasonally available resources in those ecological zones. Shasta relied on a subsistence pattern emphasizing gathering, hunting, and fishing, and exploited a variety of plant and animal resources as they became seasonally available. For example, resources used by the Shasta included deer, brown bear, rabbit, a variety of small mammals, fish, birds, insects, acorns, buckeye, pine nuts, manzanita berries, and a variety of other plants. Acorns were a staple of the Shasta diet. Regardless of the variety of resources available to the Shasta, the primary components of their diet were deer, Chinook salmon, and acorns (Dixon 1907; Silver 1978).

Individual hunters and communal hunting parties hunted deer using bows and arrows, snares, dogs, and drives (e.g., driving deer over cliffs). Waterfowl and quail were taken using nets, snares, and traps (Moratto 1984). Spring and fall salmon runs were important fishing times for the Shasta. Fishing techniques included using set, dip, and long flat seine nets, basket traps, weirs, hook and line, and spears. In the spring Klamath River Shasta waited to catch salmon until a member of another Shasta group called the Kammatwa caught the first fish and performed a ritual. Klamath River Shasta could then catch and process the fish for storage but could not eat them until the Karuk performed the White Deerskin Dance ceremony. Salmon and trout were sun dried and stored in baskets for winter consumption (Silver 1978). Women and children also dove for mussels in the Klamath River during the spring.

Shasta traded pine nuts, obsidian blades, and juniper beads with their neighbors for obsidian from the Achumawi; pine nut necklaces from the Wintu; canoes from Karuk and Yurok; acorns, baskets, dentalia shells, haliotis shells, and other shells from the Karuk, Hoopa, and Yurok; and beads from Wintu (Silver 1978). Shasta also acted as a middleman for the Achumawi, who acquired dentalia shells from groups in the Columbia River area. In addition, Shasta occasionally attended Karuk, Hoopa, and Yurok dances.

Euroamerican settlement of the study area accelerated as a result of the Gold Rush. Conflicts between Indian tribes and Euroamericans resulted in the Rogue River Indian Wars of 1850-1857 that pushed Shasta from their traditional fishing, hunting, and village sites. A treaty in 1851 established a reservation in Scott Valley for Shasta, but conflict between Euroamericans and Shasta persisted. Consequently, in the 1870s Shasta welcomed cultural revivalist movements such as the Ghost Dance. From the 1870s through the 1940s most Shasta in the APE lived at the Frain Ranch or Bogus Tom Smith's Rancheria (Daniels 2003) and continued to practice their traditional subsistence activities. Currently, Shasta are attempting to preserve, protect, and maintain traditional cultural practices, including sites associated with those practices.

### **Northwest California Culture Area**

#### **Prehistory**

Fredrickson (1973) identified six patterns or modes of adaptation (i.e., Post, Borax Lake, Berkeley, Mendocino, Gunther, and Augustine Patterns) for northwest California and the North Coast Ranges and assigned them to six time periods: Paleo-Indian (10,000–6,000 B.C.); Lower, Middle, and Upper Archaic (6,000 B.C.–A.D. 500); and Upper and Lower

Emergent (A.D. 500–1800) periods. The patterns applicable to northwest California are the Post, Borax Lake, Mendocino, and Gunther.

The Post Pattern (12,000–8,000 BP) represents the earliest occupation of the area and is characterized by fluted, concave-base projectile points and crescents. Regardless, archaeological sites with well-defined assemblage of typical Post Pattern artifacts are not well represented in northwest California.

The Borax Lake Pattern (8,000–2,500 BP) represents a generalized hunting and gathering subsistence pattern. It is characterized by heavy, wide-stemmed points with indented bases, serrated bifaces, ovoid tools, hand stones, and milling slabs (Hildebrandt 2007). The Borax Lake Pattern is identified at sites across a wide variety of environments in Humboldt and Trinity Counties. For example, sites CA-HUM-567 and CA-HUM-367 are along Pilot Ridge and South Fork Mountain and site CA-TRI-1008 is along a river terrace adjacent to the Trinity River. Site CA-HUM-567 includes a house floor and post holes dated at 6,000 BP.

The Mendocino Pattern (5,000 BP–AD 500) appears to represent a hunting and gathering subsistence pattern that is well adapted to local environments and typically exploits seasonally available resources across different ecological zones. It is characterized by side-notched, corner-notched, and concave base dart points, hand stones, milling slabs, and in some cases small numbers of cobble mortar and pestles. The Mendocino Pattern is not clearly defined in northwestern California, but it has been identified at sites such as CA-DNO-11 at Point St. George, CA-DNO-1 and CA-DNO-26 along the Smith River, CA-HUM-351 in Humboldt Bay, and CA-HUM-538, -588, and -595 in the northern mountains of Humboldt County (Hildebrandt 2007).

The Gunther Pattern (Post A.D. 500) appears to be associated with the exploitation of marine and riverine resources. It is characterized by Gunther barbed projectile points, concave based points used for composite harpoons, spears, hooks ground and polished stone artifacts, flanged pestles, notched net sinkers, and steatite bowls. Sites representing the Gunther Pattern in Del Norte and Humboldt Counties that are associated with exploitation of marine mammals and fish include sites CA-DNO-11, CA-HUM-129, -118, and -67 (Hildebrandt 2007). The Gunther Pattern appears to represent the earliest evidence of subsistence patterns associated with the exploitation of marine mammals and fish that is typical of the Yurok, Hoopa, and Karuk that currently inhabit northwest California and the Klamath Basin.

## **Ethnography**

### **Karuk**

Bright (1978) summarizes ethnographic information regarding Karuk primarily from information presented by Gifford (1939a, 1939b, and 1940) and Kroeber and Barrett (1960). Karuk occupy territory west of the Shasta, which stretches along the middle part of the Klamath River near the western boundary of Siskiyou County from Seiad to Bluff Creek just west of Orleans (Bright 1978). Karuk are members of the Hokan language

family (Bright 1978). Karuk share similar cultural traits with the Yurok and Hoopa and regularly interact with each other.

Karuk were organized in villages with a relatively loose political structure. The acquisition of wealth is an important part of Karuk culture, and wealthy men assumed leadership roles because of their prestige. Villages varied in size and consisted of rectangular cedar plank houses and sweat houses. Karuk focused on the exploitation of fish and aquatic resources, but other terrestrial resources were also important supplements to their diet. Karuk also harvested acorns and hunted in upland areas around the Klamath River for deer, elk, birds, and fur bearing mammals. The hides of mammals were used for a variety of clothing and bird feathers and pelts were used for ceremonial regalia.

Plentiful fish resources facilitated the occupation of numerous villages along the Klamath and Salmon Rivers (i.e., Salter [2003] reports that 100 villages existed along the two rivers). The villages were in advantageous locations on bends of the Klamath River and bluffs above it, such as near the mouths of Camp Creek (Tishaniik), the Salmon River (Mashuashav), and Clear Creek (Inam).

Karuk tools reflect their emphasis on the acquisition of fish and other aquatic resources and include harpoons, nets, and hooks. Facilities constructed to harvest fish include weirs, dams, and fishing platforms. Karuk also constructed canoes from hollowed out logs for fishing and transportation along the Klamath River and its tributaries. Transportation along the river and streams was essential to Karuk ceremonial activity. Indeed, Karuk traditions state that the Klamath River was created to facilitate their interaction with Yurok and Hoopa and with salmon.

The political and social organization and material cultural of the Karuk are important topics, but their religious and ceremonial practices highlight their relationship to the Klamath River and its associated resources. Of particular importance are world renewal ceremonies and ceremonies for bountiful harvests of fish and other resources (Bright 1978). World renewal ceremonies include the White Deerskin and Jump ceremonies at which the earth and the creator are honored for providing food and facilitating the prosperity of the tribes. These ceremonies were and continue to be conducted at sites along the Klamath River such as Panaminik (Drucker 1936). Ceremonies to insure harvests of fish include the First Fish, First Salmon, and Fish Dam ceremonies. Other ceremonies related to world renewal and curing are the Boat Dance and the Brush Dance. Karuk, Hoopa, and Yurok regularly attend each other's ceremonies and the ceremonies are conducted for the benefit of all the groups.

The White Deerskin and Jump ceremonies honor the earth and the creator for providing food resources and maintaining the tribes. The White Deerskin ceremony is held from late August into September, depending on the river and its waters. The Jump ceremony is conducted after the conclusion of the White Deerskin ceremony and is also held for the “good” of the world. Both the White Deerskin and the Jump ceremonies depend on a healthy Klamath River system for fish, basket materials, and bathing. The First Fish ceremony is conducted in spring and the Fish Dam ceremony is conducted to in mid-

summer to celebrate the harvesting of fish and to pray for continuing prosperity and access to subsistence resources, primarily fish resources. The Boat ceremony forms part of the White Deerskin ceremony, celebrating the flows and health of the rivers. The Brush Dance is held to cure the sick, particularly children.

As noted above, Euroamerican settlement in the area of analysis accelerated as a result of the Gold Rush. Conflicts between Indian tribes and Euroamericans were commonplace across Karuk territory. Consequently, Karuk welcomed cultural revivalist movements in the 1870s such as the Ghost Dance, but traditional cultural practices and numbers of Karuk continued to decline. Regardless, the Karuk persisted even though they do not have a reservation, and contemporary Karuk continue to practice their traditional activities and are actively engaged in programs related to improving the health of the Klamath River and its fishery.

### Yurok

Pilling (1978) summarizes ethnographic information regarding Yurok collected by Waterman (1920), Waterman and Kroeber (1934), and others. Sloan (2004, 2011) also presents a summary of the ethnography of the Yurok and the relationship to the tribe to the Klamath River. Yurok are members of the Algonquian language family. Yurok ancestral territory extends along the Pacific coast of California from Crescent City in the north to Trinidad in the south and along the Klamath River from the coast to a point near the confluence of the Klamath and Trinity Rivers and the town of Weitchpec (Pilling 1978). The Yurok life, language, ceremonies, society, and economy are linked with the Klamath River. There are Yurok stories that reinforce the Yurok belief that the River was created in a distinct way in order to provide Yurok people with the best of worlds (Sloan 2004, 2011). Yurok refer to the river as *HeL kik a wroi* or “watercourse coming from way back in the mountains”. Contemporary Yurok often refer to the Klamath River as the “Yurok Highway” emphasizing its comparison to a blood vessel that provides the main flow of sustenance. Indeed, Karuk, Yurok, and Hoopa share similar cultural traits and traditional stories state that the Klamath River was created to facilitate their interaction with each other and with salmon.

Yurok were organized into villages and districts with a relatively loose political structure (Pilling 1978). The acquisition of wealth is an important part of Karuk culture, and wealthy men assumed leadership roles in the village, district, and family. Villages varied in size and consisted of rectangular cedar or redwood plank houses and sweat houses. Pilling (1978) cites 44 villages, 97 fishing spots, 82 significant cultural places (e.g., places used for ceremonies, gathering, and hunting), and 41 rocks of cultural significance along the Klamath River.

Yurok focused on the exploitation of fish and aquatic resources, but other terrestrial resources were also important supplements to their diet. Yurok harvested acorns and hunted in upland areas around the Klamath and Trinity River for deer, elk, birds, and fur bearing mammals. The hides of mammals were used for a variety of clothing and bird feathers and pelts were used for ceremonial regalia.

Yurok tools reflect their emphasis on the acquisition of fish and other aquatic resources and include harpoons, nets, and hooks. Facilities constructed to harvest fish include weirs, dams, and fishing platforms. Yurok also constructed canoes for fishing and transportation along the Klamath and Trinity Rivers and their tributaries. Transportation along the rivers and streams was essential to Yurok ceremonial activity.

One of the most important aspects of Yurok technology was the river- and ocean-going canoe or yoch, which were carved from selected redwood trees (Sloan 2004, 2011). The Yurok ocean-going canoe was from 30 to 40 feet in length, 6 to 8 feet in width and 3 feet deep. It could haul up to five tons of cargo (e.g., seal carcasses) and was customarily paddled by 5 to 20 paddlers and an oarsman who steered the boat from the back. There are historic accounts of expeditions traveling 180 miles along the coast (Sloan 2004, 2011). A typical river canoe measured 16 to 20 feet in length and 3 to 4 feet in width. River canoes were customarily paddled and/or pushed with a long pole. Yurok technology and facilities do not only serve utilitarian functions, but also include ceremonial aspects of Yurok culture. For example, facilities, such as fish weirs, were created specifically to signify the time of sacred ceremonies (e.g., the Deerskin and Jump ceremonies).

Fishing places along the Klamath River were owned by individuals, families, or groups of individuals. Fishing places were borrowed, leased, inherited, or bought and sold (Sloan 2004, 2011). Some ownership rights at fishing places depended on species of fish caught at the site, while others depended on the water level (i.e., individuals owned the right to fish at a place if the river was below or above a certain level). Yurok still recognize this traditional form of resource management and use of the river. Families and individuals continue to use and own rights to fishing places on the Klamath River.

Like the Karuk, the religious and ceremonial practices highlight the Yurok's relationship to the Klamath River and its associated resources. Of particular importance were the Jump, Deerskin, Boat, and Brush ceremonies. The Jump and Deerskin ceremonies were held in late fall to give thanks for food resources abundance collected during the year and to insure a continued abundance of food resources for the next year (Sloan 2004, 2011).

Affluent individuals and religious leaders conducted most ceremonies, and wealthy individuals were expected to feed salmon to everyone attending the ceremonies. The Boat Ceremony was part of the Deerskin Ceremony. In this ceremony, several boats filled with participants traveled down the Klamath River. The participants thanked the river for continuing to flow and provide resources. The Brush Ceremony unfolded over a four-day period and highlighted the importance of Klamath River resources to Yurok. For example, baskets made of plant materials collected at the water's edge were used to hold food and ceremonial medicine; acorns were cooked in the baskets using hot rocks gathered at specific river bars; ceremonial regalia was made from various plant and animals that live along the river; ceremonial bathing was performed; and participants listened to the sounds made by the Klamath River.

The social and ceremonial significance of the Klamath River is evident in and reinforced by Yurok traditions. For example, there are at least 77 Yurok stories that make direct reference to the Klamath River (Sloan 2004, 2011). These Yurok stories reinforce the belief that the Klamath River was created to provide Yurok with a very good place to live.

Spanish explorers and vessels traveling from the Philippines may have interacted with Yurok along the coast in the late 1700s. Other explorers such as Peter Skene Odgen and Jedediah Smith certainly encountered Yurok along the Klamath River in the early 1800s. Regardless, Euroamerican settlement and use of Yurok territory did not begin until after the discovery of gold in California. As a result of the discovery of gold in the Trinity River, gold prospectors inundated the region affecting Yurok traditional culture (Pilling 1978).

In 1851 a “Treaty of Peace and Friendship” was signed between the United States Government and the Klamath River Indians, but the United States Congress did not ratify this treaty. Subsequently, on November 16, 1855, the Klamath River Reserve, also known as the Klamath Indian Reservation, was established by Executive Order. The Order designated the reservation lands from the mouth of the Klamath River, one mile on each side extending approximately 20 miles upriver to Tectah Creek (Sloan 2004, 2011).

Escalating conflict between Yurok and Euroamericans during the 1860s and 1870s over encroachment onto the Klamath Indian Reserve resulted in the gradual displacement of Lower Klamath Indians further upriver (Sloan 2004, 2011). Euroamericans on the reserve resisted attempts to remove them, including eviction in 1879 by the United States Army (Sloan 2004, 2011). After decades of struggle to regain their traditional homelands, the Yurok Tribe was re-organized and was granted its own reservation in 1988. As a result of the 1988 Hoopa-Yurok Settlement Act (PL-100-580), the Yurok Indian Reservation was established.

The Yurok Tribe is the largest tribe in California, with over 4,500 enrolled tribal members and over 200 tribal government employees. The Yurok Tribe is actively pursuing economic development and resource management both on the reservation and Yurok ancestral lands, including a fisheries program.

### Hoopa

Wallace (1978) summarizes ethnographic information regarding Hoopa primarily collected by Goddard (1903). Hoopa are members of the Athabascan language family. Hoopa ancestral territory is centered in Hoopa Valley and the area surrounding the Trinity River near its confluence with the Klamath River. Hoopa, Karuk, and Yurok share similar cultural traits and regularly interact with each other.

Hoopa were organized in villages with a relatively loose political structure. Villages typically consisted of family groups (Wallace 1978). Villages varied in size and consisted of rectangular cedar plank houses. Hoopa focused on the exploitation of fish and aquatic resources, but other terrestrial resources were also important supplements to

their diet. Hoopa also harvested acorns and hunted in upland areas around the Trinity and Klamath River for deer, elk, birds, and fur bearing mammals. The hides of mammals were used for a variety of clothing and bird feathers and pelts were used for ceremonial regalia.

Hoopa tools reflect their emphasis on the acquisition of fish and other aquatic resources and include harpoons, nets, and hooks. Facilities constructed to harvest fish include weirs and dams. Hoopa used canoes for fishing and transportation along the Trinity and Klamath Rivers, but obtained their canoes from the Yurok. Transportation along the river and streams was essential to Hoopa ceremonial activity. Indeed, Hoopa believe that the Klamath River was created to facilitate their interaction with Yurok and Hoopa and with salmon.

Like the Karuk and the Yurok, the Hoopa's religious and ceremonial practices highlight their relationship to the Klamath and Trinity Rivers and their associated resources. Of particular importance are world renewal ceremonies and ceremonies for bountiful harvests of fish and other resources (Wallace 1978). World renewal ceremonies include the White Deerskin and Jump ceremonies at which the earth and the creator are honored for providing food and facilitating the prosperity of the tribes. Ceremonies to ensure harvests of fish and acorns include the First Salmon ceremony and Acorn Feast (Wallace 1978). Hoopa, Karuk, and Yurok regularly attend each other's ceremonies and the ceremonies are conducted for the benefit of all the groups.

Euroamerican settlement of the APE accelerated as a result of the Gold Rush, resulting in the establishment of the Hoopa Valley Reservation in 1864. President Harrison expanded the existing Hoopa Valley Indian Reservation in 1891 to include lands within one mile on either side of the Klamath River from the Pacific Ocean to the Hoopa Valley (Salter 2003). This area included the Klamath Indian Reserve. The 1988 Hoopa-Yurok Settlement Act (PL-100-580) established the Yurok Indian Reservation (Salter 2003).

The culture of Karuk, Hoopa, and Yurok is closely related to the Klamath and Trinity Rivers. These tribes subsist wholly or in large part on the resources acquired from the river, most of their sacred sites are located along it, and their cultural traditions are related to it (Bright 1978; Pilling 1978; and Wallace 1978). Contemporary Hoopa practice their traditional activities and are actively engaged in programs related to improving the health of the Klamath River and its fishery.

### **3.13.3.2 Historic Context**

Before the influx of Euroamericans that began in the 1840s, the APE was settled primarily by Indian tribes (as described in Section 3.13.3.1). Euroamerican exploration of the Klamath Basin began in the early 19th century. Jedediah Strong Smith and Peter Skene Ogden explored current Siskiyou and Klamath County in 1826 and 1827 for beaver, and in 1829 a party of Hudson Bay Company trappers and explorers, led by Alexander Roderick McLeod, also passed through the area (Klamath Hydroelectric Project [KHP] 2004). The fur trade ended in the mid-1840s. Largely, the area remained

sparsely occupied by Euroamericans until the late 1800s, when mining and logging attracted settlers to the area.

The discovery of gold at Sutter's Mill in Coloma in 1848 was the catalyst that caused a dramatic alteration of both Indian tribes and Euroamerican cultural patterns in California. A flood of Euroamericans entered the region once news of the discovery of gold spread. Initially, the Euroamerican population grew slowly, but soon exploded as the presence of large deposits of gold was confirmed. The population of California quickly swelled from an estimated 4,000 Euroamericans in 1848 to 500,000 in 1850 (Bancroft 1888). The discovery of gold and the large influx of Euroamerican immigrants had a positive effect on the growth and economic development of California, but a negative effect on Indian cultures. The discovery of gold in California marked the beginning of a relatively rapid decline of both Indian populations and culture. Euroamericans displaced Indian tribes from their traditional territory, discouraged the use of traditional languages and the practice of religious ceremonies, and Euroamerican economic pursuits (e.g., gold mining, logging, ranching, and farming) limited the practice of traditional Indian subsistence activities.

Gold was discovered by Abraham Thompson and his party just north of the present-day location of Yreka in 1851 (Hoover et al. 2002). Known as "Thompson's Dry Diggins", the population quickly exploded to 2,000 miners, and the town of Shasta Plains was established (Hoover et al. 2002). The town primarily included tents and brush shanties, but also included a saloon built out of shakes and canvas by Sam Lockhart. The first permanent house in the town was built by D. H. Lowry and his wife, who is credited with being the first white woman in Siskiyou County.

Euroamerican settlement in the Klamath River watershed continued to grow through the 1850s due to the completion of roads such as the Southern Emigrant Road, also known as the Applegate Trail, in 1846 (KHP 2004). These roads brought prospectors to the region and helped to establish communities such as Henley (Cottonwood), Gottville, Happy Camp, and Somes Bar. Fertile soil and plentiful water sources provided opportunities for homesteading and the private development of agriculture and ranching by unsuccessful prospectors, particularly in the area around current Upper Klamath Lake. The expansion of agricultural activities in southeastern Oregon resulted in execution of treaties with The Klamath Tribes and the relocation of groups of Indians in the area (KHP 2004).

Logging began in the Klamath Basin in the 1860s and sustained logging enterprises appeared in the 1880s (KHP 2004). Early companies were generally small, family-run operations managed by ranching families trying to supplement their income. In 1867, President Ulysses S. Grant signed legislation to create a land-grant subsidy for the construction of the Oregon & California Railroad (O&C) (KHP 2004). The grant allowed the O&C Railroad Company to select off-numbered sections from the public domain for the construction of the railroad. In 1887, the O&C Railroad Company claimed "lieu" lands on the Pekegama Plateau as compensation for other lands that had already been claimed by homesteader or military and wagon road companies. Title to these lieu lands were immediately (and illegally) transferred to the Pokegama Sugar Pine

Lumber Company (PSPLC). To move the logs from the Pokegama Plateau, the PSPLC built a log chute on the rim of the Klamath River Canyon and the first railroad in Klamath County (Gavin 2003). During this period, larger scale logging companies such as Pokegama Sugar Pine Lumber Company and Klamath River Lumber and Improvement Company were established on the north rim of the Klamath River Canyon.

The end of the nineteenth and beginning of the twentieth century witnessed an ongoing and growing immigration of Euroamericans into the area, which was facilitated by the construction of the of the railroad through the region. The railroad provided a reliable means of transportation in the area and stimulated regional cultural and economic development. In addition to improving transportation, a railroad grade constructed at the northern end of Lower Klamath Lake functioned as a dike that facilitated drainage of wetlands for agriculture and control of the flow of water from the Klamath River.

The Oregon & California Railroad constructed in 1877 was the first railway through the region (KHP 2004). It extended from Siskiyou County, California, to Jackson County, Oregon, and facilitated travel and the transport of goods between Sacramento and Portland. Subsequently, the Southern Pacific Railroad Company acquired the Oregon & California Railroad, and by 1909 agricultural and lumber products of the Klamath Basin could be distributed to a nationwide market.

The first hydroelectric development in the Klamath Basin was established in 1891 in the Shasta River Canyon below Yreka Creek to provide electricity to Yreka (KHP 2004). Four years later, in 1895, the Klamath Falls Light & Water Company built a power plant along the banks of the Link River and soon thereafter began power generation for the town of Klamath Falls (KHP 2004). The first decade of the 20th century brought a number of mergers and reorganizations of power companies in the APE. The California-Oregon Power Company (Copco) was one of the companies that emerged from this period of reorganization (KHP 2004). The Bureau of Reclamation's Klamath Project was developed by the DOI to supply farmers with irrigation water and farmland in the Klamath Basin.

Copco proposed to develop hydroelectric power facilities along the Klamath River. Residents in the Klamath Falls area were divided over Copco's proposal to dam and generate power on the river. Farmers feared the depletion of precious irrigation water while other businesses saw Copco operations as an addition to the local economy. Regardless, with the increasing power needs of both irrigation and lumber mills and a huge influx of military personnel stationed at Medford and Klamath Falls, it was only a matter of time before additional power generation facilities were needed in the area. Envisioned in 1911, the Klamath Hydroelectric Project was built in phases through 1962 (see Kramer [2003a, 2003b] for a detailed history of the Klamath Hydroelectric Project). Klamath Hydroelectric Project facilities were constructed by Copco beginning with Copco 1 (1918), followed by Copco 2 (1925), and reconstruction of the old East Side facility in 1924. After World War II, regional population growth prompted a new round of hydroelectric power expansion highlighted by Copco's Big Bend project in 1958 and the construction of the Iron Gate facilities in 1962. While the Iron Gate facilities were

still under construction, Copco merged with Pacific Power & Light, currently PacifiCorp. PacifiCorp currently owns and operates the Klamath Hydroelectric Project.

The development of the Klamath Hydroelectric Project played a significant role in the area's economic development, both as part of a regionally significant, locally owned and operated private utility and through the role that increased electrical capacity played in the expansion of the timber, agriculture, and recreation industries during the first six decades of the 20th century. The Klamath Hydroelectric Project dams and associated facilities are recommended as eligible for inclusion on the National Register as the Klamath Hydroelectric Historic District (KHHD) under criterion a for its association with the industrial and economic development of southern Oregon and northern California from 1903-1962 (see Table 3.13.1 below) (Kramer 2003a, 2003b; Cardno Entrix 2010).

### **3.13.3.3 Known Cultural and Historic Resources in the APE**

Record searches and archival research were conducted for the vicinity of the APE. Previously, 191 cultural resources surveys were conducted covering 30,746 acres (approximately 36 percent of the APE) and 681 sites were identified (Cardno Entrix 2010). Most of the surveys were conducted around Upper and Lower Klamath Lakes and on Yurok lands. The majority of the sites within the APE are prehistoric sites associated with Indian occupation and use of the area. These sites include small lithic scatters, traditional fishing sites, ceremonial sites, and large village sites. The historic sites within the APE are mostly related to the development of agriculture and hydroelectric power.

Sixty-eight sites in the APE are recommended eligible for inclusion on the National Register. The Klamath Hydroelectric Project dams and other associated facilities also are recommended eligible for inclusion on the National Register as a historic district (Kramer 2003a, 2003b and Cardno Entrix 2010). Table 13.13-1 identifies key features of the hydroelectric system and their eligibility recommendation.

The review of ethnographic information for the study area identified TCPs and other culturally sensitive sites along and near the Klamath River. The TCPs and other sites include villages at traditional salmon fishing sites, villages associated with secondary resource procurement areas, ceremonial sites, and burial sites (cf., Daniels 2003; Deur 2004, 2011; Kreober and Barrett 1960; Sloan 2004, 2011; and Waterman 1920). Deur (2004, 2011) identified 11 TCPs along the Klamath River and Theodoratus et al. (1990) identified 3 sites along the river between J.C. Boyle Dam and Scott River that have "cultural value" to The Klamath Tribes. Daniels (2003) identified 47 ethnographic sites (e.g., habitation, hunting, fishing, gathering, and spiritual/ceremonial sites) along the Klamath River and at least 5 village sites submerged by the formation of Copco 1 Reservoir that have cultural value to the Shasta. Theodoratus et al. (1990) also identified 24 sites along the Klamath River between J.C. Boyle Dam and Scott River that have "cultural value" to Shasta. Additionally, the Bureau of Land Management (BLM) has previously identified a culturally significant area along the Upper Klamath River for a proposed National Register District.

**Table 3.13-1. Klamath Hydroelectric Facilities Historic District  
 National Register Eligibility Recommendation**

<b>J.C. Boyle</b>	
Dam	Historic Contributing
Communications Building	Non-Contributing
Fire Protection Building	Non-Contributing
Red Barn	Non-Contributing
Maintenance Shop	Non-Contributing
Water Conveyance Features	Potentially Contributing
Steel Pipe	Historic Contributing
Flume Headgate	Non-Contributing
Open Flume/Concrete	Historic Contributing
Headgate	Historic Contributing
Forebay/Spillgates	Historic Contributing
Spillway House	Historic Contributing
Tunnel	Historic Contributing
Penstocks	Historic Contributing
Powerhouse	Historic Contributing
Substation	Historic Contributing
Armco Warehouse	Historic Contributing
<b>Copco 1</b>	
Dam	Historic Contributing
Gatehouse 1	Historic Contributing
Gatehouse 2	Historic Contributing
Gate Hoist System/Rails	Historic Contributing
Double Penstock	Historic Contributing
Single Penstock	Historic Contributing
Powerhouse	Historic Contributing
<b>Copco 2</b>	
Dam	Historic Contributing
Water Conveyance Features	Potentially Contributing
Headgate	Historic Contributing
Tunnel Intake	Historic Contributing
Concrete-lined Tunnel	Historic Contributing
Wood Stave Pipeline	Historic Contributing
Concrete Tunnel	Historic Contributing
Steel Penstocks	Historic Contributing
Timber Cribbing	Historic Contributing
Coffer Dam	Historic Contributing
Powerhouse	Historic Contributing
<b>Iron Gate</b>	
Dam	Historic Contributing
Spillway	Historic Contributing
Diversion Tunnel	Historic Contributing
Water Conveyance System	Historic Contributing
Water Way/Trash Racks	Historic Contributing
Pipeline	Historic Contributing
Penstock	Historic Contributing
Powerhouse	Historic Contributing
Dam Fisheries Facilities	Historic Contributing
Holding Tanks	Historic Contributing

Gates (2003) and King (2004) identify the entire length of the Klamath River as a “riverscape,” which they identify as a type of cultural or ethnographic landscape, because of the relationship between the Klamath Tribes, Shasta, Karuk, Hoopa, and Yurok and the river and its resources. Gates (2003) and King (2004) recommended the Klamath River as eligible for inclusion on the National Register as a riverscape and/or ethnographic landscape. The Klamath River is certainly sensitive to the Klamath Tribes, Shasta, Karuk, Hoopa, and Yurok and is an integral part of their traditional cultural practices, but its eligibility for inclusion on the National Register as a riverscape and/or ethnographic landscape requires formal review and concurrence by the Oregon and California SHPOs. The riverscape and/or ethnographic landscape reports and eligibility determination have not been submitted to the Oregon and California SHPOs for review and concurrence regarding their eligibility determination.

At least one site is known to have human remains exposed from erosion in the Upper Klamath River area. Actions by a federal agency resulted in the reburial of the exposed remains and temporary stabilization of the river bank. Previous studies, surveys, and federal actions, combined with ethnographic studies, indicates that there is a high probability for the presence of additional sites in unsurveyed areas, as well as, in currently submerged settings.

Based on the previously identified sites and ethnographic literature reviews, sites identified at each reservoir include primarily the historic dams and associated facilities and structures and prehistoric/ethnohistoric villages, fishing locations, and ceremonial sites. At the JC Boyle Reservoir, ten prehistoric sites have been identified along the shoreline. At the Copco Reservoir, eleven prehistoric sites and five ethnographic village sites have been identified along the shoreline and within the reservoir. At Iron Gate Reservoir, twelve prehistoric sites and five ethnographic village sites have been identified along the shoreline and within the reservoir. Additional sites may be inundated and/or covered with sediment. Depending on the selected alternative for this EIS/EIR, further identification efforts would need to be taken to identify these sites.

### **3.13.4 Environmental Consequences**

#### ***3.13.4.1 Effects/Impacts Determination Methods***

Cultural resources investigations (e.g., records searches and reviews of archaeological, ethnographic, and historic information) resulted in the identification of 681 sites, one historic district, several TCPs, and one potential ethnographic landscape within the APE. Identified sites will be treated as potentially eligible for the National Register and California Registers for the analyses of potential effects/impacts for this EIS/EIR. In addition, certain site types likely to be identified in previously unsurveyed areas, including inundated areas, will be considered potentially eligible for potential effects/impacts analyses.

The cultural resources section of this document considers potential effects/impacts from implementation of the Proposed Action and alternatives on these sites, which include prehistoric and historic sites, buildings/structures, cultural (ethnographic) landscapes, and

TCPs. The findings of effects/impacts to cultural resources within the APE are based on criteria presented in 36 CFR Section 800.5 and in CEQA, as described in 3.13.2 Regulatory Framework. Through consultation (see Chapter 7), DOI has developed measures to avoid, minimize or mitigate adverse effects to historic properties and historical resources, including known effects and those effects for which DOI cannot fully understand at this time. Many of these measures would be offered as binding commitments in the ROD, and will help to coordinate future development through these decisions.

Additionally, due to the nature of the action being proposed, potential effects on all historic properties or historical resources cannot be fully determined prior to approval of either the Proposed Action or an alternative evaluated in this EIS/EIR. The identification and evaluation of certain resources, and the potential effects to those resources, can only be understood and addressed as particular details of how to carry out the selected alternative are developed. To address this uncertainty, DOI through consultation (see Chapter 7), is proposing measures that the designated federal officials must follow as specific details are evaluated through future decisions that are required before the selected alternative in this EIS/EIR can be implemented. These measures, which are identified below, will be incorporated as binding stipulations in the ROD for this EIS/EIR. Further, DOI will also seek to develop additional measures through consultation with the ACHP, the SHPOs, THPOs, Indian tribes, and other interested parties as part of the continuing NEPA process.

Under CEQA, potentially significant or significant impacts to historical resources may be mitigated to a less than significant level. If impacts cannot be mitigated or if implementation of mitigation would not reduce an impact to a less than significant level, the impacts are identified as significant and unavoidable.

#### **3.13.4.2 Significance Criteria**

The significance criteria used to assess effects/impacts to cultural resources (e.g., historic properties and historical resources) as a result of implementing the Proposed Action and alternatives include both federal and California state criteria.

Cultural resource effects/impacts would be adverse and/or significant if implementation of the Proposed Action and alternatives result in any of the following:

- Under NHPA Section 106, “an adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association (36 CFR Section 800.5(a)(1)).”
- Under CEQA, a substantial adverse change in the significance of an archaeological resource or an historical resource is defined as physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource is materially impaired, as defined in PRC Section 21083.2 and CCR 15064.5; or

- Disturbance of any human remains, including those interred outside of formal cemeteries.

### **3.13.4.3 Effects Determinations**

#### **Alternative 1: No Action/No Project Alternative**

Under the No Action/No Project Alternative, none of the actions under consideration would be implemented. The Klamath Hydroelectric Project would continue operations under the terms of an annual license until a long term license is finalized. Annual licenses would not include the actions associated with the Klamath Hydroelectric Settlement Agreement (KHSAs) and Klamath Basin Restoration Agreement (KBRA).

*Under the No Action/No Project Alternative current effects/impacts on historic properties/ historical resources, other cultural resources, and human remains will continue to occur.* Under the No Action/No Project Alternative, the Klamath Hydroelectric Project on the Klamath River would continue to operate. The Klamath Hydroelectric Project introduced artificial water fluctuations that have resulted in erosion along the lower terraces. Over the life of the Klamath Hydroelectric Project, cultural resources have been impacted by these changing water levels. Known impacts include exposing cultural materials to the public, sometimes leading to looting and illegal excavation of these sites. These circumstances are known to have exposed human remains at least one site. Actions by a federal agency resulted in the reburial of the exposed remains and temporary stabilization of the river bank. Concerns regarding artificial fluctuating water levels and exposing cultural remains in the APE continue to be a concern of federal agencies and Indian tribes.

There are known ongoing effects/impacts on cultural resources due to operation of the Klamath Hydroelectric Project. **Therefore, the No Action Alternative would result in no change from existing conditions and effects/impacts on historic properties and/or historical resources in the APE.**

#### **Alternative 2: Full Facilities Removal of Four Dams Alternative (the Proposed Action)**

Under the Proposed Action, four dams and their associated hydroelectric facilities along the Klamath River would be removed. Keno Dam would be transferred to the DOI, the KBRA would be implemented, and the Yreka water supply pipeline would be installed.

*The Proposed Action would result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD, which is considered eligible for inclusion on the National Register and California Register.* The Proposed Action would include removal of four dams, their associated hydroelectric facilities, and other facilities along the Klamath River. These facilities contribute to the KHHD, which is considered eligible for inclusion on the National Register and the California Register due to its role in early development of electricity and economy of the southern Oregon and northern California regions. Removal of the four dams and all associated facilities under the Proposed Action would adversely affect each dam's eligibility for inclusion on the National Register and the

California Register and the overall integrity of the KHHD because a large portion of this district would be removed.

**Under this action adverse effects, as described in Section 106, to the dams and the KHHD cannot be avoided and will need to be mitigated.** Mitigation will likely include thorough documentation of the four dams and their associated facilities to Historic American Building Survey (HABS)/Historic American Engineering Record (HAER)/Historic American Landscape Survey (HALS) levels or the equivalent. Removal of the dams and facilities may also impact as yet unidentified buried cultural resources, particularly ethnographic villages. Additional efforts to identify and evaluate historic properties/historical resources would be conducted. Possible avoidance and/or minimization of effects/impacts to other currently unidentified historic properties/historical resources would be identified through consultations as appropriate.

Under CEQA, for the purpose of this EIS/EIR, mitigation measures that include HABS/HAER documentation could be implemented for the removal of dams under the Proposed Action, but implementation of mitigation measures would not reduce impacts to historical resources to a less than significant level. **For the purpose of this EIS/EIR, under CEQA, the Proposed Action would be a significant and unavoidable impact to historical resources.**

**Under NEPA/CEQA, for the purpose of this EIS/EIR, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would be implemented. Impacts to the KHHD would remain significant and unavoidable.**

*Reservoir drawdown associated with the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.* The Proposed Action includes a drawdown of the reservoirs at the Four Facilities. The dam removal and reservoir drawdown would result in a reduction of water levels in the existing reservoirs; temporarily increase flows along the Klamath River; and expand the limits of the 100 year floodplain by 1 percent (see Section 3.6, Flood Hydrology, for specific data related to stream flow and flooding data). Ethnographic records identify village sites, including burials, located along the previous riverbanks prior to dam construction and subsequent inundation. The dam removal and reservoir drawdown could affect 32 known sites located along the current shores of the reservoirs, ten ethnographic village sites, an unknown number of sites that may be submerged in the reservoirs and human remains that may be isolated or associated with those sites. Ethnographic records identify village sites, including burials, located along the previous riverbanks prior to dam construction and subsequent inundation. Also, several hundred sites along and near the Klamath River downstream from the dams and reservoirs may be exposed or damaged from temporary increase in flows during reservoir drawdowns.

The riverscape, a potentially eligible or significant cultural landscape, includes villages, hunting, gathering, fishing, and spiritual locations on terraces and benches along the river, as well as the river itself and its natural resources. The overall riverscape/cultural

landscape would likely benefit from dam removal by restoring the river more closely to its original setting and facilitating the practice of important Indian traditional customs, ceremonies, and economic activities. However, sites associated with it could be adversely affected through erosion, exposure, and vandalism. Increased flows along the Klamath River could undercut, erode, or flood sites along or near the banks of the river, affecting elements of the potentially significant cultural landscape.

**Under this action adverse effects, as described in Section 106, could occur to historic properties as a result of reservoir drawdowns. These effects will need to be mitigated.** Drawdown of the reservoirs and the flushing of sediment will likely expose submerged sites around and under the reservoirs. Additional cultural resources surveys and monitoring of the drawdown zone would be conducted as land is exposed. Avoidance, minimization, and mitigation measures would be identified through consultations as appropriate. A cultural resources management plan is likely to be developed, through consultations, to manage and protect endangered and exposed cultural resources.

**Under CEQA, for the purpose of this EIS/EIR implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to any historical resources to less than significant.**

*Installation of the Yreka Water Supply Pipeline could affect/impact archaeological and historic sites that are eligible for inclusion on the National Register or California Register.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and will have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline will either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Bridge just downstream of Iron Gate Dam. The pipeline itself may be a historic property or historical resource and would need to be evaluated for eligibility. Ground disturbance required for either method of relocating the pipeline could result in the discovery of historic and/or archaeologically significant sites. The construction of footing to support the pipe bridge and the trenching and rerouting of the pipeline to reach Lakeview Bridge could uncover previously unknown sites. **Under this action adverse effects, as described in Section 106, could occur to historic properties as a result of installation of the Yreka water supply pipeline. These effects will need to be mitigated.** Measures to identify historic properties/historical resources and to avoid, minimize, or mitigate and resolve adverse effects would be identified through consultations, as appropriate.

**Under CEQA, for the purpose of this EIS/EIR implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to any historical resources to less than significant.**

*Construction activities including use of haul roads and disposal sites for demolition debris under the Proposed Action could affect/impact archaeological and historic sites,*

*TCPs, and cultural landscapes that are eligible for inclusion on the National Register or California Register.* Ground disturbing activities associated with construction activities will likely have both direct and indirect effects/impacts on historic properties/historical resources. The debris from the demolition of the dams and facilities would be hauled to disposal sites. Modifications of the proposed haul roads and use of disposal sites could affect/impact sites (including 17 sites previously identified during earlier survey coverage of the roads and the KHHD) that are located along the haul roads and/or at the disposal sites. **Under this action adverse effects, as described in Section 106, could occur to historic properties as a result of construction of haul roads and disposal sites. These effects will need to be mitigated.** As future plans are developed for construction activities, modifications to haul roads, and identification of actual locations of disposal sites and associated staging/construction, additional identification and evaluation of historic properties/historical resources would be conducted. Measures to avoid, minimize, or mitigate and resolve adverse effects would be identified through consultations, as appropriate.

**Under CEQA, for the purpose of this EIS/EIR implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to any historical resources to less than significant.**

*Removal of the recreational facilities after reservoir drawdown may affect archaeological or historic sites that could be eligible for inclusion on the National Register or California Register or human remains.* Recreation facilities, such as campgrounds and boat ramps, currently located along the reservoir banks will need to be relocated down slope to be near the new river bed once the reservoir is removed. These facilities are not eligible for the National Register or California Register, and were not known to impact archaeological sites when they were built. Additional ground disturbance from removal of these facilities may affect/impact previously unidentified historic properties/historical resources. **Under this action adverse effects, as described in Section 106, could occur to historic properties as a result of removal and relocation of recreational facilities. These effects will need to be mitigated.** Further identification and evaluation of historic properties/historical resources would be conducted. Measures to avoid, minimize, or mitigate and resolve adverse effects would be identified through consultations, as appropriate.

**Under CEQA, for the purpose of this EIS/EIR implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to any historical resources to less than significant.**

#### **Keno Transfer**

*The Transfer of Keno Dam to the DOI could have adverse effects to historic properties or historic resources.* The KHSA calls for transferring ownership and operation of Keno Dam from PacifiCorp to DOI. Upon transfer of privately owned facilities into federal ownership, cultural resources and historic properties are then subject to federal historic and cultural resources management laws. **Under Section 106 and CEQA, this action would not cause an effect/impact to historic properties or historical resources. The**

**transfer would likely be a beneficial effect because the facilities would be subject to federal regulation.**

### **East and West Side Facilities**

*The decommissioning of the East and West Side Facilities could have adverse effects on historic resources or historic properties.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna.

Decommissioning does not typically involve deconstruction of the facilities. Instead, buildings and equipment that are too large to easily remove or are fixed in place are usually fenced to prevent entry. Any deconstruction and removal of facilities would be analyzed in future environmental analyses. **The decommissioning of the East and West Side Facility will have less than significant effects on historical resources or historic properties.**

### **KBRA**

The KBRA has several programs that could result in impacts/effects to cultural and historic resources that are eligible for inclusion on the National Register and/or California Register. These resources include archaeological and historic sites, TCPs, cultural landscapes, and possibly Indian human remains. Specific KBRA programs potentially affecting cultural and historic resources include:

- Phases 1 and 2 Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration Project
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction
- Klamath Tribes Interim Fishing Site
- Mazama Forest Project

*Implementation of the Phase 1 and 2 Fisheries Restoration Plans, the Fisheries Reintroduction and Management Plan, the Wood River Wetland Restoration Project, the On-Project Plan, the Water Use Retirement Program, and the Fish Entrainment Reduction program, could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.* Actions associated with the Fisheries Restoration Plans in the floodplain and river channel include: floodplain rehabilitation, large woody debris replacement, fish passage correction, cattle exclusion (fencing), riparian vegetation planting, mechanical thinning of upland areas to mimic natural forest conditions, fire treatment to mimic natural forest conditions, purchase of conservation easements/land, road decommissioning, gravel augmentation, and treatment of fine sediment sources. The fisheries restoration actions are designed to improve

aquatic and riparian habitat and potential changes in river hydraulics are intended to improve the habitats' ability to support river fisheries. These restoration actions would not occur at the same locations as construction activities for the hydroelectric facility removal. KBRA construction activities would not contribute to potential cultural and historic resource effects of facility removal actions. **Implementation of the KBRA programs listed above include ground disturbing activities that are likely to have a significant impact on cultural and historic resources that are eligible for inclusion on the National Register and/or California Register. Studies will be conducted to identify cultural resources and measures to reduce significant impacts to those resources. Implementation of specific plans and projects associated with Phase 1 and 2 Fisheries Restoration will require future environmental compliance as appropriate.**

**Under CEQA/NEPA, for the purpose of this EIS/EIR, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would be implemented, but the impact would remain significant and unavoidable.**

*Establishment of the Klamath Tribes Interim Fishing Site could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and possibly Indian human remains. Actions associated with the Klamath Tribes Interim Fishing Site include establishment of an interim fishing site for Klamath Tribal members between Iron Gate Dam and Interstate - 5. The location and timing of this project reduces the potential for any negative cultural and historic resource impacts generated by establishment of the Klamath Tribes Interim Fishing Site from contributing to the effects of the hydroelectric facility removal actions. Although negative short-term effects could occur, implementation of construction-related best management practices (BMPs) would occur. **Establishment of the Klamath Tribes Interim Fishing Site is likely to include ground disturbing activities that could have a significant impact on cultural and historic resources that are eligible for inclusion on the National Register. Studies will be conducted to identify cultural resources and measures to reduce significant impacts to those resources. Implementation of specific plans associated with the establishment of the Klamath Tribes Interim Fishing Site will require future environmental compliance as appropriate.***

**Under CEQA/NEPA, for the purpose of this EIS/EIR, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would be implemented and would reduce any impact of the Klamath Tribes Interim Fishing Site to a less than significant level.**

*Implementation of the Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and possibly Indian human remains. Actions associated with the Mazama Forest Project include the purchase and management of 90,000 acres of timberland on former reservation land owned by the Klamath Tribe. The 90,000 acres identified in the Mazama Forest Project are likely to include cultural and historic resources that are eligible for inclusion on the National Register. Forest management actions at the Mazama Forest would not be in the same location as the*

hydroelectric facility removal actions and there would be no negative cultural and historic resource impacts generated by these restoration actions that would contribute to the effects of facility removal actions. **While the Klamath Tribes Forest Management Plan has been developed, the specific location of management actions within the Mazama Forest have not been identified. It is assumed however that implementation of this plan is likely to have a significant impact on cultural and historic resources that are eligible for inclusion on the National Register and/or California Register. Studies will be conducted to identify cultural resources and reduce significant impacts to these resources. Implementation of specific plans and projects associated with the Mazama Forest Project will require future environmental compliance as appropriate.**

**Under CEQA/NEPA, for the purpose of this EIS/EIR, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would be implemented and would reduce any impact of the Mazama Forest Project to a less than significant level.**

#### **Finding of Effects Under NHPA Section 106**

Under the Proposed Action for NHPA, adverse effects to known historic properties (including the KHHD) cannot be avoided. In addition, adverse effects to as yet unidentified or unevaluated historic properties expected to be identified during future identification efforts may result from this alternative. The adverse effects will need to be minimized or mitigated. Additional consultations and identification and evaluation efforts will be conducted under consultations with ACHP, SHPOs, THPOs, Indian Tribes, and other interested parties, per 36 CFR Part 800. Measures to avoid, minimize, or mitigate and resolve adverse effects, identified through consultations, will likely result in agreement documents per 36 CFR Part 800 for implementation of this alternative. **Under NHPA Section 106, the Proposed Action will have an adverse effect to historic properties.**

#### **Alternative 3: Partial Facilities Removal of Four Dams Alternative**

Under the Partial Facilities Removal of Four Dams Alternative, four dams and their associated hydroelectric facilities would be partially removed to provide for volitional fish passage. Keno Dam would be transferred to the DOI, the KBRA would be implemented, and the Yreka water supply pipeline would be installed

*The Partial Facilities Removal of Four Dams Alternative would result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam and on the KHHD considered eligible for inclusion on the National Register and California Register. The Partial Facilities Removal of Four Dams Alternative would include removal of portions of the four dams, their associated hydroelectric facilities, and f other facilities along the Klamath River. These facilities contribute to the KHHD, which is presumed eligible for inclusion on the National Register and the California Register due to its role in early development of electricity and economy of the southern Oregon and northern California regions. Partial removal of the four dams would adversely affect each dam's eligibility and possibly the overall integrity of the KHHD.*

Potential effects/impacts to cultural and historic resources under the Partial Facilities Removal of Four Dams Alternative, including draw downs of reservoirs; the Keno Transfer; the East and West Side Facility decommissioning; relocation of the Yreka Water Supply Line; construction activities; removal of recreational facilities; and transfer of Keno Dam would be the same as those identified for the Proposed Action/Full Facilities Removal of Four Dams Alternative.

### **KBRA**

The KBRA has several programs that could result in impacts/effects to cultural and historic resources that are eligible for inclusion on the National Register and/or California Register. These resources include archaeological and historic sites, TCPs, cultural landscapes, and possibly Indian human remains. Specific KBRA programs potentially affecting cultural and historic resources include:

- Phases 1 and 2 Fisheries Restoration Plans
- Mazama Forest Project
- Klamath Tribes Interim Fishing Site
- Fisheries Reintroduction and Management Plan – Phases I and II – Oregon
- Wood River Wetland Restoration Project
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction

Potential effects/impacts to cultural and historic resources associated with the Partial Facilities Removal of Four Dams Alternative are the same as identified for the Proposed Action.

### **Finding of Effects Under NHPA Section 106**

Under the Partial Removal of Four Dams Alternative for NHPA, adverse effects to known historic properties (including the KHHD) cannot be avoided. Under this alternative effects would be the same as those identified for the Proposed Action/Full Facilities Removal of Four Dams Alternative.

### **Alternative 4: Fish Passage at Four Dams Alternative**

Under the Fish Passage at Four Dams Alternative operation of the existing dams and hydroelectric facilities would continue along the Klamath River and fish passage facilities would be constructed at the four dams. Keno Dam would not be transferred to DOI and the KBRA would not be implemented.

*The Fish Passage at Four Dams Alternative could affect/impact the four dams and the KHHD, other historic properties/historical resources, TCPs, cultural landscapes, or human burials. The Fish Passage at Four Dams Alternative would continue operation of the existing dams and hydroelectric facilities along the Klamath River and could continue to affect historic properties/ historical resources. Construction of fish passages could require modifications to the four dams and/or their associated facilities, resulting in*

effects/impacts to the KHHD. Construction activities required for the fish passages may affect/impact as yet unidentified historic properties/historical resources. **Under this action adverse effects, as described in Section 106, to the dams and the KHHD would occur and will need to be mitigated.** Further identification and evaluation of historic properties/historical resources would be conducted. Measures to avoid, minimize, or mitigate and resolve adverse effects would be identified through consultations, as appropriate.

**Under CEQA/NEPA, for the purpose of this EIS/EIR this would be a significant impact to historical resources. Implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to any historical resources to less than significant.**

#### **Finding of Effects Under NHPA Section 106**

Under the Fish Passage at Four Dams Alternative for NHPA, adverse effects to known historic properties (including the KHHD) would likely occur. In addition, adverse effects to as yet unidentified or unevaluated properties may result from this alternative. The adverse effects will need to be minimized or mitigated. Additional consultations and identification and evaluation efforts will be conducted under consultations with ACHP, SHPOs, THPOs, Indian Tribes, and other interested parties, per 36 CFR Part 800. Measures to avoid, minimize, or mitigate and resolve adverse effects, identified through consultations, will likely result in agreement documents per 36 CFR Part 800 for implementation of this alternative. **Under NHPA Section 106, the Fish Passages at Four Dams will have an adverse effect to historic properties.**

#### **Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative**

Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, two dams, their associated hydroelectric facilities, and fish hatchery facilities along the Klamath River would be removed and fish passage facilities would be constructed at two dams. Under this alternative, Keno Dam would not be transferred to the DOI and the KBRA would not be implemented.

*The Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would result in direct effects/impacts to Copco 1 Dam and Iron Gate Dam and on the KHHD considered eligible for inclusion on the National Register and California Register. The Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would include removal of two dams, their associated hydroelectric facilities, and other facilities along the Klamath River. Installation of fish passages at JC Boyle Dam and Copco 2 Dam may affect/impact those dams and their associated facilities. These facilities contribute to the KHHD, which is presumed eligible for inclusion on the National Register and the California Register due to its role in early development of electricity and economy of the southern Oregon and northern California regions. The removal of two dams and facilities would adversely affect each dam's eligibility and possibly the overall integrity of the KHHD.*

**Under this action adverse effects, as described in Section 106, to the dams and the KHHD cannot be avoided and will need to be mitigated.** Mitigation will likely include thorough documentation of the four dams and their associated facilities to HABS/HAER/HALS levels or similar. Removal of the dams and facilities and construction of fish passages may also impact as yet unidentified buried cultural resources, particularly ethnographic villages. Additional efforts to identify and evaluate historic properties/historical resources would be conducted. Possible avoidance, minimization, and mitigation measures to other currently unidentified historic properties/historical resources would be identified through consultations as appropriate.

Under CEQA, for the purpose of this EIS/EIR, mitigation measures that include HABS/HAER documentation could be implemented, but implementation of mitigation measures would not reduce impacts to historical resources to a less than significant level. **For the purpose of this EIS/EIR, under CEQA/NEPA, the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would be a significant and unavoidable impact to historical resources.**

*Reservoir drawdown associated with the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.* The Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative includes a drawdown of the reservoirs behind Copco 1 and Iron Gate dams. The dam removal and reservoir drawdown would result in a reduction of water levels in the existing reservoirs and temporarily increase flows along the Klamath River. Ethnographic records identify village sites, including burials, located along the previous riverbanks prior to dam construction and subsequent inundation. The dam removal and reservoir drawdown could affect 23 known sites located along the current shores of the reservoirs, ten ethnographic village sites, an unknown number of sites that may be submerged in the reservoirs and human remains that may be isolated or associated with those sites. Ethnographic records identify village sites, including burials, located along the previous riverbanks prior to dam construction and subsequent inundation. Also, several hundred sites along and near the Klamath River downstream from the dams and reservoirs may be exposed or damaged from temporary increase in flows during reservoir drawdowns.

The riverscape, a potentially eligible or significant cultural landscape, includes villages, hunting, gathering, fishing, and spiritual locations on terraces and benches along the river, as well as the river itself and its natural resources. The overall riverscape/cultural landscape would likely benefit from dam removal by restoring the river more closely to its original setting and facilitating the practice of important Indian traditional customs, ceremonies, and economic activities. However, sites associated with it could be adversely affected through erosion, exposure, and vandalism. Increased flows along the Klamath River could undercut, erode, or flood sites along or near the banks of the river, affecting elements of the potentially significant cultural landscape.

**Under this action adverse effects, as described in Section 106, could occur to historic properties as a result of reservoir drawdowns. These effects will need to be mitigated.** Drawdown of the reservoirs and the flushing of sediment will likely expose submerged sites around and under the reservoirs. Additional cultural resources surveys and monitoring of the drawdown zone would be conducted as land is exposed. Avoidance, minimization, and mitigation measures would be identified through consultations as appropriate. A cultural resources management plan is likely to be developed, through consultations, to manage and protect endangered and exposed cultural resources.

**Under CEQA/NEPA, for the purpose of this EIS/EIR implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to any historical resources to less than significant.**

Potential effects/impacts to cultural and historic resources under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative, including draw downs of reservoirs; construction activities; and removal of recreational facilities would be the same as those identified for the Proposed Action/Full Facilities Removal of Four Dams Alternative.

#### **Finding of Effects Under NHPA Section 106**

Under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative for NHPA, adverse effects to known historic properties (including the KHHD) cannot be avoided. In addition, adverse effects to as yet unidentified or unevaluated properties may result from this alternative. The adverse effects will need to be minimized or mitigated. Additional consultations and identification and evaluation efforts will be conducted under consultations with ACHP, SHPOs, THPOs, Indian Tribes, and other interested parties, per 36 CFR Part 800. Measures to avoid, minimize, or mitigate and resolve adverse effects, identified through consultations, will likely result in agreement documents per 36 CFR Part 800 for implementation of this alternative. **Under NHPA Section 106, the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative will have an adverse effect to historic properties.**

#### ***3.13.4.4 Mitigation Measures***

##### **Mitigation Measure by Consequences Summary**

Implementation of the Proposed Action and alternatives will each have an adverse effect on historic properties under Section 106 of the NHPA. Mitigation measures CHR-1 to CHR-4 identify actions to avoid, minimize or mitigate adverse effects following the process in 36 CFR Section 800.8(c)(1)(v).

Under CEQA, most of the impacts to historical resources could be mitigated to a less than significant impact for the purpose of this EIS/EIR by implementing all four mitigation measures. However, impacts to the four dams and the KHHD cannot be mitigated to less than a significant and unavoidable impact for the purpose of this EIS/EIR.

Mitigation Measure CHR-1: Update the Klamath Hydroelectric Project Request for Determination of Eligibility (Kramer 2003) to include Iron Gate as a historic property and to identify contributing elements to the KHHD; and

- Continue consultations under Section 106 of the NHPA with ACHP, SHPOs, THPOs, and other interested parties to reach a consensus on the eligibility determination; and
- Enter into an agreement document (Memorandum of Agreement or Programmatic Agreement) under Section 106 of the NHPA with ACHP, SHPOs, THPOs, and other consulting parties for the resolution of adverse effects; and
- Document the four dams to HABS/HAER/HALS standards or equivalent; and
- Identify additional mitigation measures in the agreement document, including a public outreach or education component.

Mitigation Measure CHR-2: Continue consultations under Section 106 of the NHPA with ACHP, SHPOs, THPOs, Indian tribes, and other interested parties to identify and evaluate cultural resources for eligibility for listing on the National Register and/or California Register; and

- Continue identification and evaluation of historic properties/historical resources for unevaluated cultural resources, unsurveyed areas, and inundated zones; and
- Continue consultations under Section 106 of the NHPA with ACHP, SHPOs, THPOs, Indian tribes and other interested parties to identify alternatives to avoid, minimize, or mitigate adverse effects to historic properties; and
- Enter into an agreement document (Memorandum of Agreement or Programmatic Agreement) under Section 106 of the NHPA with ACHP, SHPOs, THPOs, and other consulting parties for the avoidance, minimization, and mitigation of adverse effects, and the resolution of adverse effects (including excavation as appropriate and a public outreach component); and
- Prepare a Monitoring Plan to identify historic properties/historical resources exposed during implementation of the selected alternative; and
- Prepare and implement an Inadvertent Discovery Plan for unanticipated discoveries of historic properties/historical resources and Indian human remains; and
- Prepare and implement a Cultural Resources Management Plan to address the management and protection of historic properties/historical resources and significant cultural resources; and
- Respect and maintain the confidentiality of sensitive information following 36 CFR Section 800.11(c) and the Archaeological Resources Protection Act of 1979 (16 USC 470hh).

Mitigation Measure CHR-3: Continue consultations under Section 106 of the NHPA with ACHP, SHPOs, THPOs, Indian tribes and other interested parties to identify and evaluate TCPs and cultural landscapes for eligibility for listing on the National Register and/or California Register; and

- Follow the steps in CHR-2 for identification and evaluation, alternatives to avoid, minimize, or mitigate, and resolution of adverse effects; and

- Respect and maintain the confidentiality of sensitive information following 36 CFR Section 800.11(c) and the Archaeological Resources Protection Act of 1979 (16 USC Section 470hh).

**Mitigation Measure CHR-4:**

- Consult with Indian Tribes and other Indian organizations on identification, treatment, disposition, and management of Indian human remains exposed and/or impacted by the selected alternative;
- Prepare and implement a Plan of Action to manage and treat Indian human remains, following NAGPRA on federal and Indian tribal lands and California and Oregon state burial laws on appropriate state lands;
- Prepare and implement an Inadvertent Discovery Plan for unanticipated discoveries of historic properties/historical resources and Indian human remains;
- Consult on discoveries of historic properties/historical resources in association with Indian human remains as identified in Mitigation Measure CHR-2.

**Effectiveness of Mitigation in Reducing Effects/Impacts**

Under NHPA Section 106, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would be effective at addressing adverse effects to historic properties as a result of implementing the Proposed Action or other alternatives. Under CEQA, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would be effective at reducing most impacts to historical resources as a result of implementing the Proposed Action or other alternatives to less than significant. However, the mitigation measures would not be effective at reducing impacts on the four dams and the KHHD that is recommended eligible for inclusion on the California Register. The Proposed Action and other alternatives would have a significant and unavoidable impact on the Klamath River dams and KHHD. Mitigation measures could be implemented for the removal of dams under the Proposed Action, but implementation of the measures would not reduce impacts to these historical resources to less than significant.

**Agency Responsible for Mitigation Implementation**

The Dam Removal Entity or Hydropower Licensee, and state agencies would be responsible for implementing Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4. It is anticipated that a mix of federal and state agencies would be responsible for implementing the mitigation measures because implementation of the Proposed Action and alternatives requires the involvement of various federal and state permitting, licensing, and funding agencies.

**Remaining Significant Impacts**

Under CEQA, Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would address most impacts on historical resources associated with the Proposed Action and alternatives. However, the mitigation measures presented in this EIR/EIS would not reduce impacts on the four Klamath River dams and the KHHD that is recommended eligible for inclusion on the California Register to less than significant. Under the Proposed Action and other alternatives impacts to the four Klamath River dams and the KHHD would be significant and unavoidable.

### **Mitigation Measures Associated with Other Resource Areas**

Several other resources areas include mitigation measures to address construction related effects/impacts associated with implementation of the Proposed Action or other alternatives. These mitigation measures include Rec-1 (relocation of recreational facilities at reservoirs); H-2 (flood-proof structures); GW-1 (deepen or replace affected wells); WRWS-1 (modify or screen affected water intakes); PHS-4 (repair damaged roads); PHS-5 (construct water storage tanks for firefighting); TR-6 (assess and improve roads to carry construction loads); and TR-7 (assess and improve bridges to carry construction loads). These mitigation measures could affect/impact historic properties/historical resources, other cultural resources, and Indian human remains.

**Under NHPA Section 106 actions associated with implementing mitigation measures associated with other resource areas could cause adverse effects to historic properties. Adverse effects to historic properties that are a result of these mitigation measures can be resolved through implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4. Under CEQA, actions associated with implementing mitigation measures associated with other resource areas could result in significant impacts to historical resources. Implementation of Mitigation Measures CHR-1, CHR-2, CHR-3, and CHR-4 would reduce impacts to historical resources as a result of these mitigation measures to less than significant.**

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### **3.14 Land Use, Agricultural and Forest Resources**

This section analyzes the land use, agricultural, and forest resources impacts of the Proposed Action and alternatives. For the land use analysis, the section describes current land use types, planned uses, and land ownership and management in the area of analysis, described below. For the agricultural and forest resources analyses, the section focuses on the direct changes to land uses that would occur as a result of removal of the J.C. Boyle Dam, Copco 1 and Copco 2 Dams, and Iron Gate Dam (the Four Facilities) as described in the Klamath Hydroelectric Settlement Agreement (KHSA) and alternatives. The Four Facilities are in the Lower Klamath Basin below Keno Dam, also owned by PacifiCorp. The indirect impacts on agricultural and forest uses that may occur from changes in the water distribution in the region from implementation of the Klamath Basin Restoration Agreement (KBRA) are also described. KBRA actions are primarily focused on the Upper Klamath Basin, but also include actions in the Lower Klamath Basin.

This section does not address the potential effects of removal of the Four Facilities on property values and changes in property tax revenues. See Section 3.15, Socioeconomics, for potential effects on property values. Additionally, removal of the dams would alter the flood regime for the portion of the river downstream of Iron Gate Dam. However, flooding issues are not relevant to land use. Changes in flood risk are described in Section 3.6, Flood Hydrology.

The public scoping process identified several questions that will not be addressed in the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR). For instance, the public asked about establishing new property lines when reservoirs and the river channel reconfigure. Property line adjustments are not relevant to the EIS/EIR analysis and are not described in the KHSA (KHSA Section 7.6.4). The EIS/EIR does describe potential changes in land use that would occur if the dams were removed.

Participants in the scoping process also sought information regarding whether property owners would have first right to purchase property between the current reservoir shoreline and the newly established river channel boundary. The KHSA details that the PacifiCorp lands currently inundated by the existing reservoirs will be transferred to the State of Oregon or the State of California, as applicable, or to a designated third party transferee, to be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access (KHSA Section 7.6.4). This EIS/EIR includes an analysis of all potential property transfers outlined in the KHSA.

### **3.14.1 Area of Analysis**

For this analysis, the land use area was defined as lands encompassed by the Federal Energy Regulatory Commission (FERC) boundary identified in the FERC EIS (2007), surrounding lands that could be affected by implementation of the KHSA and private lands adjacent to the reservoirs and the Klamath River downstream of the reservoirs to the estuary that would be affected by the removal of the dams and loss of the reservoirs.

The Four Facilities that would be removed under the Proposed Action are in two counties, Siskiyou in California and Klamath in Oregon, and are not within any incorporated cities. The area of analysis for the KHSA is shown in Figure 3.14-1. The area of analysis includes the areas adjacent to the Four Facilities. The City of Yreka is included because its water supply facilities would be affected by the Proposed Action. In addition, lands downstream of the Iron Gate Dam that may be subject to flooding with or without the dams were identified (see Appendix J for revised 100 year floodplain maps).

To account for the effects of KBRA implementation, the area of analysis includes the agricultural lands that receive water from the Bureau of Reclamation's (Reclamation) Klamath Project in Klamath, Siskiyou, and Modoc Counties, and two of the wildlife refuges in the Klamath Basin National Wildlife Refuge System, the Tule Lake National Wildlife Refuge (NWR) and the Lower Klamath NWR (Figure 3.14-2). These areas are all within the Upper Klamath Basin above Keno Dam. Reclamation's Klamath Project contains approximately 200,000 acres of farmland and 35,000 acres of wetlands in the three counties along the California-Oregon border. Of the 200,000 acres of irrigable land in the project, water deliveries are typically made to between 180,000 – 196,000 acres each year, depending on available water supplies (Personal Communication, Mike Green, March 23, 2011). Section 1.2.4 describes Reclamation's Klamath Project in more detail. Agricultural areas in the Lower Klamath Basin, downstream of Keno Dam, do not receive water from Reclamation's Klamath Project.

#### **3.14.1.1 Klamath County, Oregon**

Klamath County is in south central Oregon. The county is bordered on the south by California, on the east by Lake County, on the north by Deschutes County, and on the west by Jackson and Douglas Counties. The county, Oregon's fourth largest, has 6,135 square miles (Klamath County 2010a). Klamath County is home to about 66,380 people, with about 20,000 of those people residing in the city limits of Klamath Falls (U.S. Census Bureau 2000, U.S. Census Bureau 2000–2008). Approximately 73 percent of the County is managed by federal and state agencies, including United States Fish and Wildlife Service (USFWS), National Park Service (NPS), the Bureau of Land Management (BLM), and the Oregon Department of State Lands (ODSL).

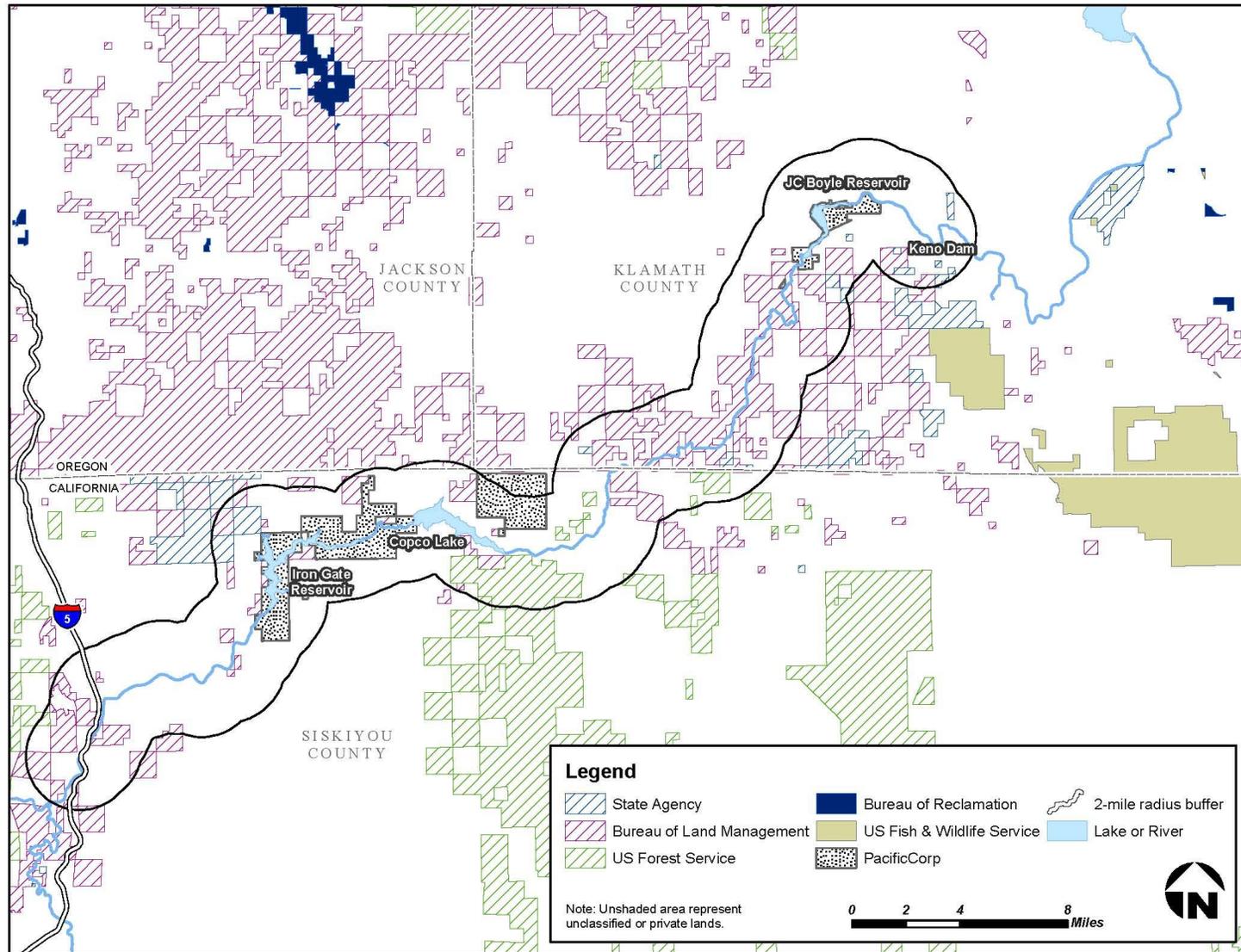


Figure 3.14-1. Area of Analysis for the Land Use Effects of the KHSAs

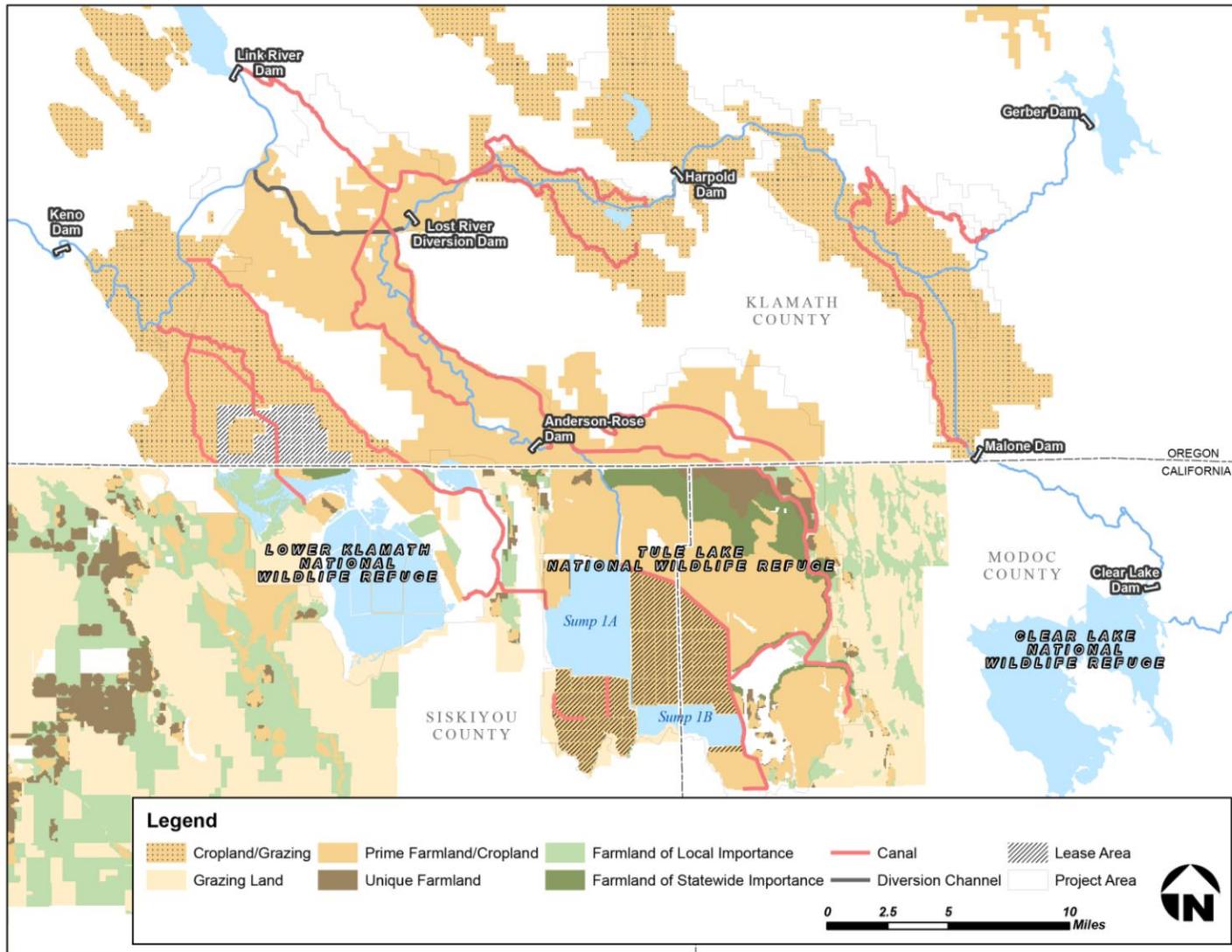


Figure 3.14-2. National Wildlife Refuges and Agricultural Designations in and around the Reclamation's Klamath Project

### **3.14.1.2 Siskiyou County, California**

Siskiyou County is in inland northern California, adjacent to the Oregon border. It is the fifth largest county in the state and has an area of approximately 6,340 square miles with a population of 44,328 (U.S. Census Bureau 2000–2008). More than 60 percent of the County is managed by federal and state agencies, including the United States Forest Service (USFS), BLM, the USFWS, and California Department of Fish and Game (CDFG). These lands are maintained in various National Forests, Parks, Wilderness Areas, National Grasslands, NWRs, other public lands and State Wildlife Areas (Siskiyou County 2010).

### **3.14.1.3 Modoc County**

Modoc County is just east of Siskiyou County in the northeastern corner of California, where it borders Oregon to the north and Nevada to the east. The county is 4,203 square miles and has approximately 9,100 residents (Modoc County 2011). Almost 70 percent of the county is federally owned in the Modoc National Forest, the Modoc and Tule Lake National Wildlife Refuges, and BLM lands managed out of the Alturas Field Office (Modoc County 2011). Approximately 29 percent of the county is in private ownership, with the remaining one percent split between state lands (.7 percent), County owned property (.04 percent), City properties (.03 percent), and railroads and utility companies (.15 percent) (Modoc County 2011). Part of the Tule Lake NWR and Reclamation's Klamath Project is in western Modoc County (Figure 3.14-2).

### **3.14.1.4 Klamath Basin National Wildlife Refuge System**

The Tule Lake NWR and the Lower Klamath NWR are both managed for wildlife habitat and croplands. In 2009, the Lease Land Program leased 22,828 acres of the two refuges for crop production. Of this, 7,518 acres or approximately 33 percent were certified organic, up from 5,753 in 2006, and 1,584 acres were set aside for the walking wetland program, a long-term crop rotation program that alternates the land use between wetlands for wildlife uses and crops for agricultural leases (Department of the Interior [DOI] 2009a).

The Tule Lake NWR covers 39,116 acres, of which 15,000 acres are dedicated to agricultural leases, in addition to another 2,300 acres dedicated to cereal grains and alfalfa cooperatively managed by the USFWS and local farmers (USFWS 2009). The farmland produces barley, oats, wheat, onions, potatoes, and alfalfa. Barley, wheat, and oats cover most of the acreage and potatoes dominate the row crops (USFWS 2010).

The Lower Klamath NWR is 46,000 acres and straddles the California/Oregon border. Approximately 5,500 acres are leased to farmers through the Reclamation's Public Lease Lands program for cereal grain and grass hay production, and another 5,000–7,000 acres are farmed under a cooperative agreement between area farmers and the USFWS (Table 3.14-1) (USFWS 2010). The leasing and farming of the Tule Lake NWR and Lower Klamath NWR are governed by the Kuchel Act, which was signed into law in 1964. The law provides that Tule Lake NWR and Lower Klamath NWR would be set aside for wildlife habitat and leasing for agricultural use. Only 25 percent of the total land may be planted for row crops. The counties that contain the refuges are intended to receive

approximately 25 percent of the net revenues collected during each fiscal year from the leasing of the Federal lands in Reclamation's Klamath Project. This revenue is paid annually to the counties that contain the refuges (Klamath, Siskiyou, and Modoc) in lieu of property tax.

The Kuchel Act also mandates that 13,000 acres of surface water area be maintained in Sumps 1A and 1B (Figure 3.14-2), areas in the refuges that are used to collect agricultural runoff and provide habitat for migrating waterfowl (Personal Communication, Mike Green, March 23, 2011). In 1976, Congress amended the National Wildlife Refuge System Administration Act of 1966 and provided primary management responsibility to the USFWS. Following the passage of the amendment, Reclamation and the USFWS formed a cooperative agreement on the management of the public lease land. Essentially, Reclamation administers the agricultural leases on the refuge land and the USFWS manages wildlife and habitat, such as the water areas, buffer strips, wildlife use areas, and share crop land (Personal Communication, Mike Green, March 23, 2011).

**Table 3.14-1. Kuchel Act Lands in Reclamation's Klamath Project, 2009**

State	County	Refuge Area	Agricultural Acres	Marsh Acres	Total Acres
California	Modoc	Tule Lake	4,557	2,640.80	<b>7197.8</b>
		Lower Klamath	NA	NA	
	Siskiyou	Tule Lake	12,283.60	12,090.80	<b>24,374.40</b>
		Lower Klamath	9,529.70	28,664.50	<b>38,194.20</b>
Total Kuchel Acres, California			26,370.3	43,396.10	<b>69,766.40</b>
Oregon	Klamath	Lower Klamath	Not Provided	Not Provided	<b>6365.9</b>
Total Acreage subject to Kuchel Act					<b>76,132.3</b>

Source: Reclamation's Payment to Counties In-Lieu-of-Taxes Report. DOI 2010a.

### **3.14.1.5 Land Ownership**

The area at or near the Four Facilities includes lands owned by PacifiCorp, private owners, and managed by BLM, the State of Oregon, and Klamath County. USFS also manages several parcels outside the Klamath Hydroelectric Project (KHP) boundary near Copco 1 Reservoir.

#### **PacifiCorp Lands**

PacifiCorp owns approximately 11,000 acres in Klamath County and Siskiyou County that are not directly associated with its Klamath hydroelectric facilities, and that are generally not included within the existing FERC project boundary. The KHSA describes this property as Parcel A (see Figures 3.14-3 through 3.14-7). Implementation of the KHSA would have no effect on disposition of Parcel A lands, which would be disposed of by PacifiCorp subject to applicable Public Utility Commission approval requirements (KHSA Section 7.6).

PacifiCorp also owns approximately 8,000 acres in Klamath County and Siskiyou County that are associated with the KHP and/or included within the FERC project boundary. The

KHSA describes this property as Parcel B lands (see Figures 3.14-3 through 3.14-7). Of these lands, approximately 2,000 acres are currently inundated by the reservoirs.

According to the KHSA (Section 7.6.4), Parcel B lands would be transferred to the respective states (Oregon or California) or a designated third party, before facility removal. Lands owned by the state and federal government would not be subject to local zoning laws and regulations. The transferred lands would be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access. The KHSA provides an option that would invoke the “meet and confer” provisions to allow for other uses. The states have no detailed plans but indicate that the approximately 2,000 acres of inundated lands would be restored to natural conditions consistent with the intent of improving fisheries in the Klamath system. PacifiCorp also owns electric transmission and distribution facilities, which will remain under its ownership (KHSA Section 7.6.1), and are not analyzed further in the EIS/EIR.

The land around the Keno Development would be transferred from PacifiCorp to the United States to be managed by DOI based on terms agreed to by both parties (KHSA Section 7.5). For purposes of this analysis, the transfer agreement was assumed to be complete by March 31, 2012, which is the target date for reaching an agreement (KHSA Section 7.5.2).

In addition to the above categories of lands, the KHSA identifies three parcels (East Side/West Side generating facilities lands) that may be transferred to DOI, near Klamath Falls, Oregon upon decommissioning (KHSA Section 6.4.1.C).

#### **Ownership at or near the Four Facilities**

Land ownership at or near the Four Facilities (Figures 3.14-3 through 3.14-7) is as follows:

- Keno Dam
  - The shoreline of Keno Impoundment is primarily in private ownership, with some federal (managed by DOI) and state (Oregon) ownership, while the area near the dam is owned by PacifiCorp. The State of Oregon title extends upriver to approximately river mile 233 and includes the bed and banks of the river channel under Keno Dam and Keno Impoundment.
  - PacifiCorp and private entities own the lands along the Klamath River in the Keno Reach.
  
- J.C. Boyle Dam
  - PacifiCorp owns most of the land at J.C. Boyle Reservoir concentrated along the reservoir and at the dam. The FERC boundary encompasses a few acres of private property and large tracts of public and Oregon and California Railroad (O&C) land managed by the BLM including Topsy Campground and much of the land along the access road, power canal, tunnel, and bypass reach. The FERC boundary also encompasses state-owned land. The title of the State of

Oregon extends upriver and includes the beds and banks of the river channel located under J.C. Boyle Dam and J.C. Boyle Reservoir.

- Most of the land along the J.C. Boyle peaking reach of the Klamath River is public and O&C land managed by the BLM. It also includes some PacifiCorp and other private property. A small amount of National Forest land managed by the Klamath National Forest lies near the Klamath Hydroelectric Project.
- Copco 1 & 2 Dams
  - PacifiCorp owns the lands around the powerhouses, dams, and Copco 2 Reservoir, while most of the land surrounding Copco 1 Reservoir is privately owned. The BLM also manages some public land near Copco 1 Reservoir and Copco 2 Dam.
- Iron Gate Dam
  - PacifiCorp owns the land adjacent to the Iron Gate Dam, Fish Hatchery, and Powerhouse, as well as most of the land along the Iron Gate Reservoir shoreline and the nearby transmission line right-of-way. The Iron Gate Dam vicinity also includes a small amount of private land.

### **Downstream of Iron Gate**

The Klamath River passes through federally designated wilderness, National Forests, public land managed by the BLM, undeveloped private lands and rural tribal reservations for most of its course downstream of Iron Gate Dam. There are no incorporated cities or large developed areas in the watershed downstream of Klamath Falls. Within a one-quarter mile buffer of the Klamath River downstream from Iron Gate Dam to the Estuary, there are approximately 40,500 acres of open space and public lands, 15,600 acres of agricultural lands, 290 acres of residential uses (of various densities), 24 acres of tribal reservation lands, 2,478 acres of urban reserve, and 26 acres of commercial use. In addition, the entire Klamath River is designated a wild and scenic river downstream of Iron Gate.

### **3.14.2 Regulatory Framework**

Land use resources within the area of analysis are regulated by several federal, state, and local laws and policies, which are listed below.

#### **3.14.2.1 Federal Authorities and Regulations**

- Federal Land Policy and Management Act of 1976
- Oregon and California Revested Railroad Grant Lands Act of 1937
- Oregon Public Lands Transfer and Protection Act of 1998
- BLM Redding Resource Management Plan and Record of Decision (1993)
- BLM Klamath Falls Resource Area Resource Management Plan and Record of Decision and Rangeland Program Summary (1995a)
- BLM Medford District Resource Management Plan and Record of Decision (2008)
- Northwest Forest Plan (1994)

- Fremont National Forest Land and Resource Management Plan (1989)
- Winema National Forest Land and Resource Management Plans (1990)
- Six Rivers National Forest Land Management Plan (1995b)
- Kuchel Act of 1964
- Klamath Basin Compact of 1956
- Tribal Forest Protection Act of 2004
- National Wildlife Refuge System Administration Act of 1966

#### **3.14.2.2 State Authorities and Regulations**

- California Land Conservation Act of 1965 (Williamson Act)
- California's Farmland Mapping and Monitoring Program
- California Forest Practice Rules
- Oregon Exclusive Farm Use zoning program
- Oregon Forest zoning program
- Oregon Forest Practices Act

#### **3.14.2.3 Local Authorities and Regulations**

- Klamath Reservation Forest Management Plan (2008)
- Klamath County Land Use Code
- Klamath County Comprehensive Plan (2010b)
- Siskiyou County Land Development Code
- Siskiyou County General Plan (1980)
- Siskiyou County General Plan Land Use Policies (1997)
- Siskiyou County zoning ordinance
- Modoc County General Plan (1988)
- Modoc County zoning ordinance
- City of Yreka General Plan (2003)
- City of Yreka municipal code

### **3.14.3 Existing Conditions/Affected Environment**

#### **3.14.3.1 Land Use**

##### **Land Use Categories**

Major land use categories in the area of analysis are agriculture, open space, forestry, recreation, and rural communities (see Figures 3.14-3 through 3.14-7). The main urban areas are Klamath Falls and the City of Yreka. Most of the land in the area of analysis is devoted either to agriculture/grazing or to open space and conservation. A small portion is devoted to hydroelectric operations and recreation sites. Residential developments occur in and around the community of Keno and the Keno Recreation Area, and along portions of Copco 1 Reservoir.

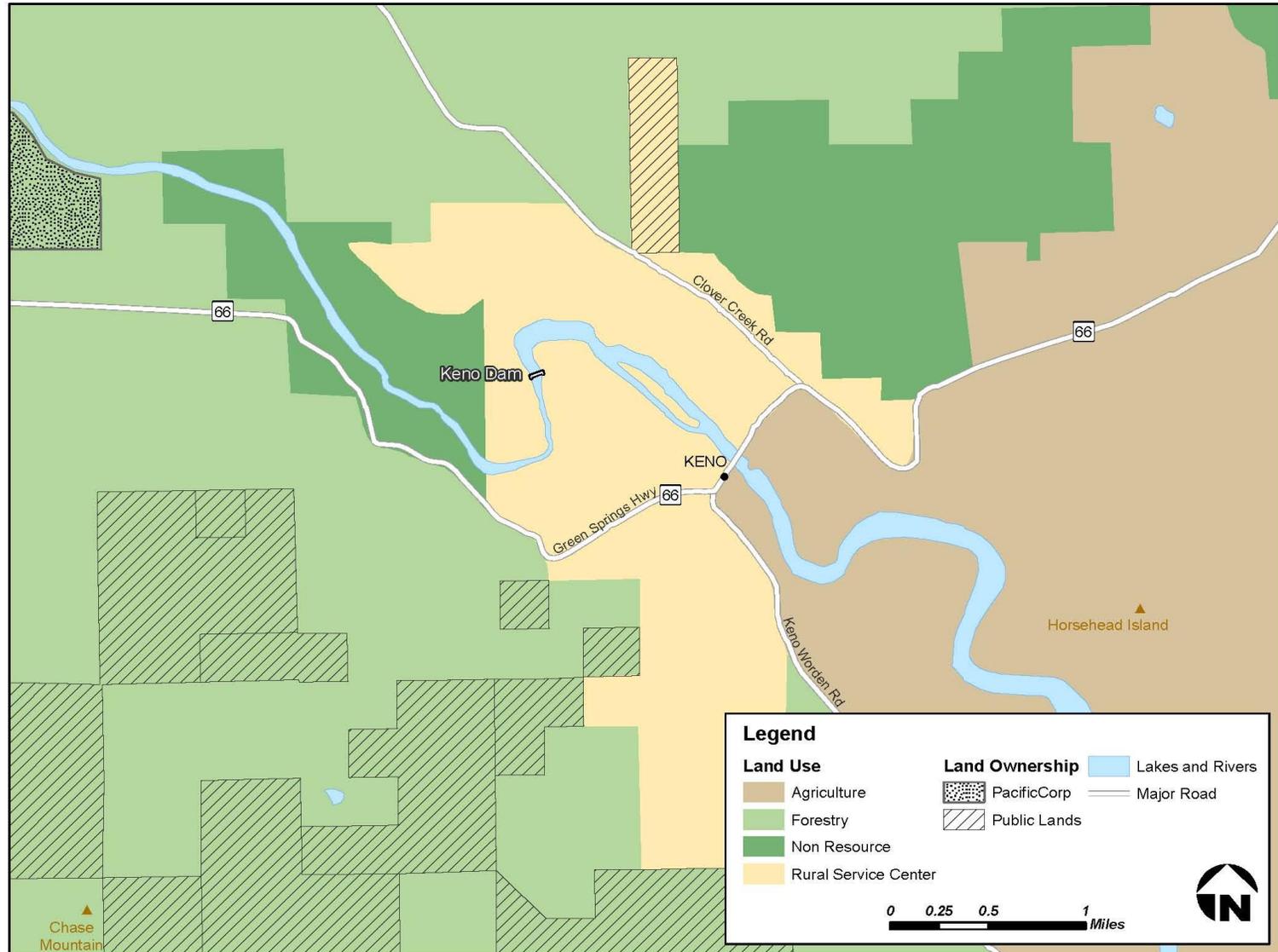


Figure 3.14-3. Land Use – Keno Dam

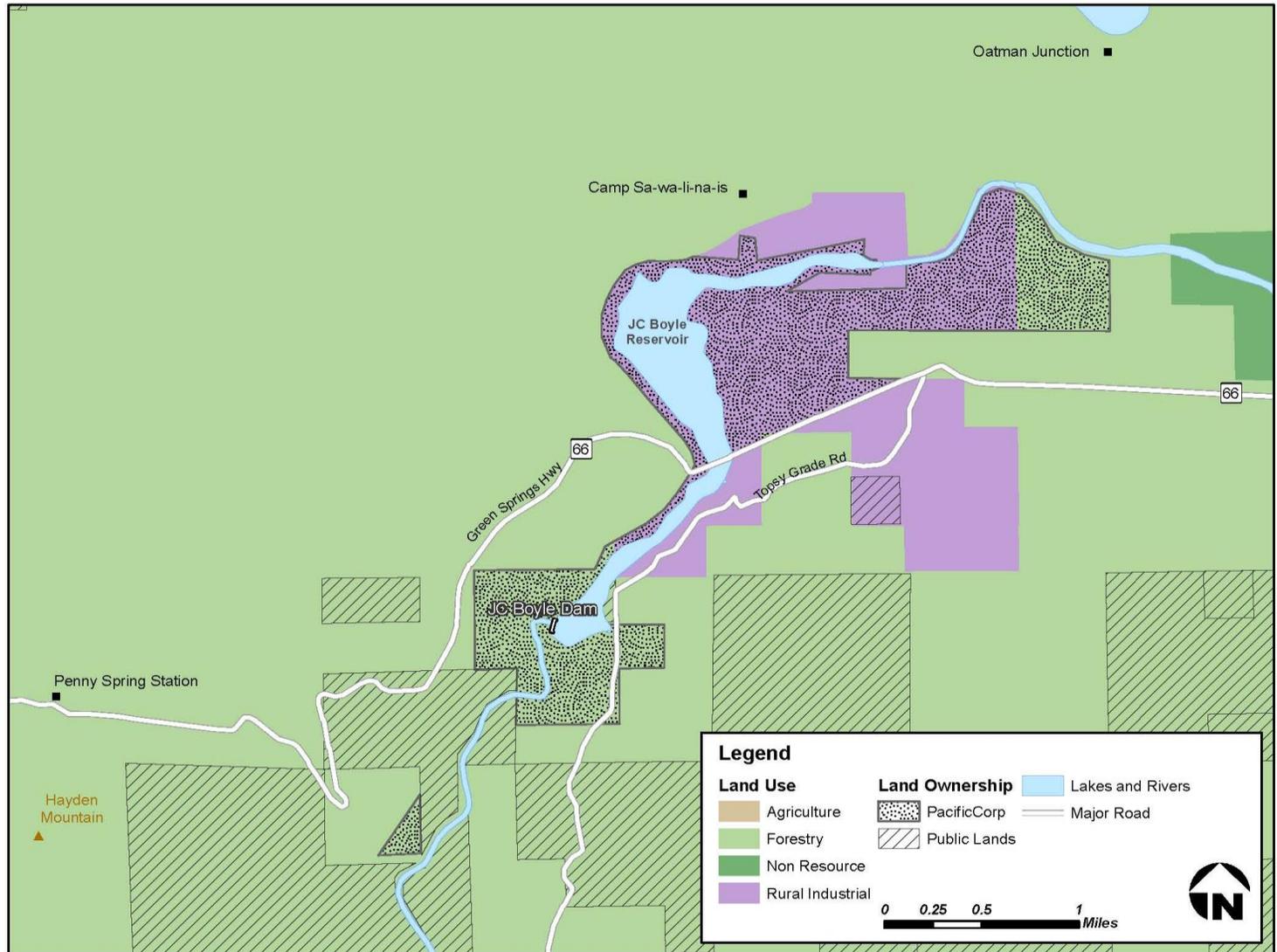


Figure 3.14-4. Land Use – J.C. Boyle Dam

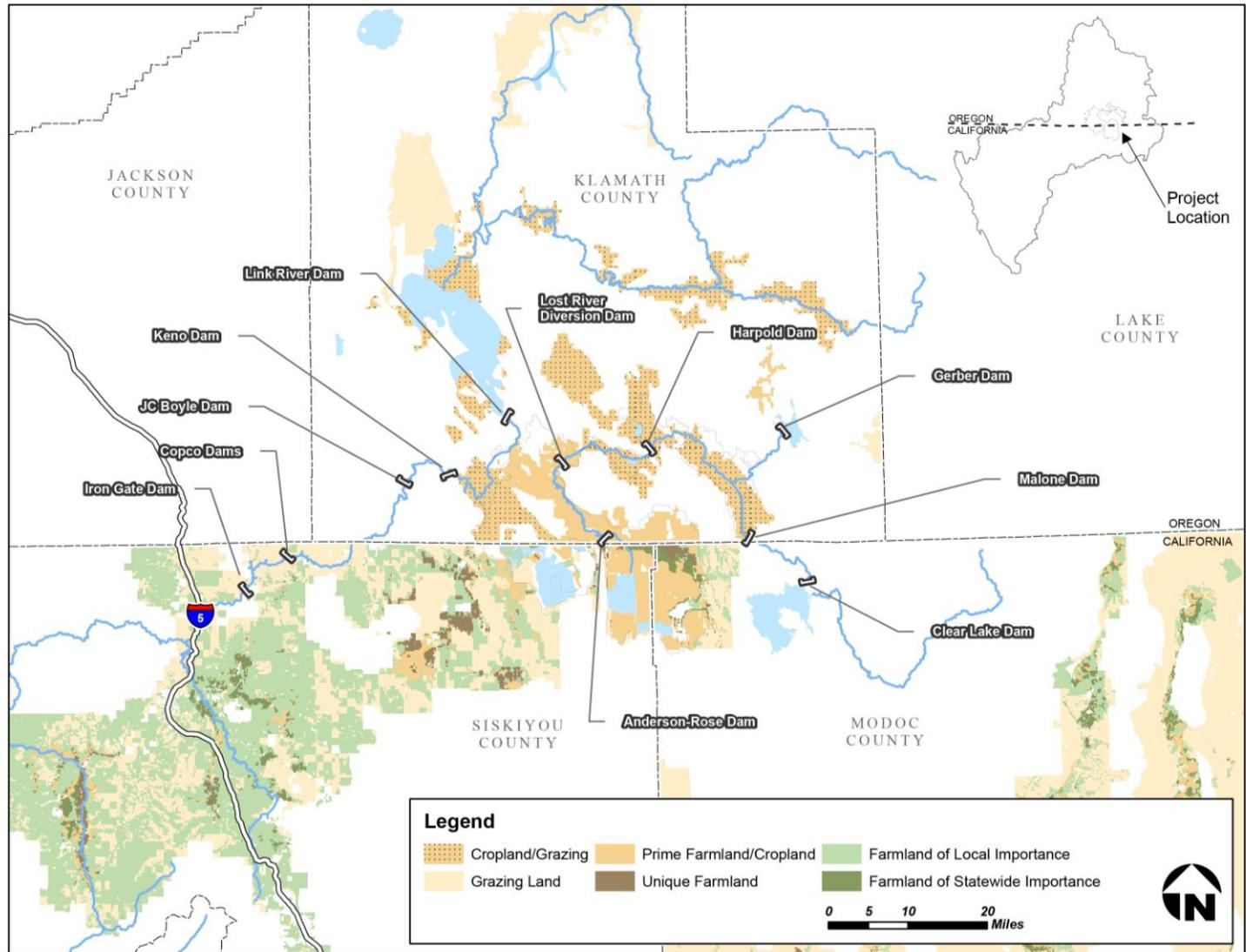


Figure 3.14-5. Upper Klamath Basin Agricultural Resources

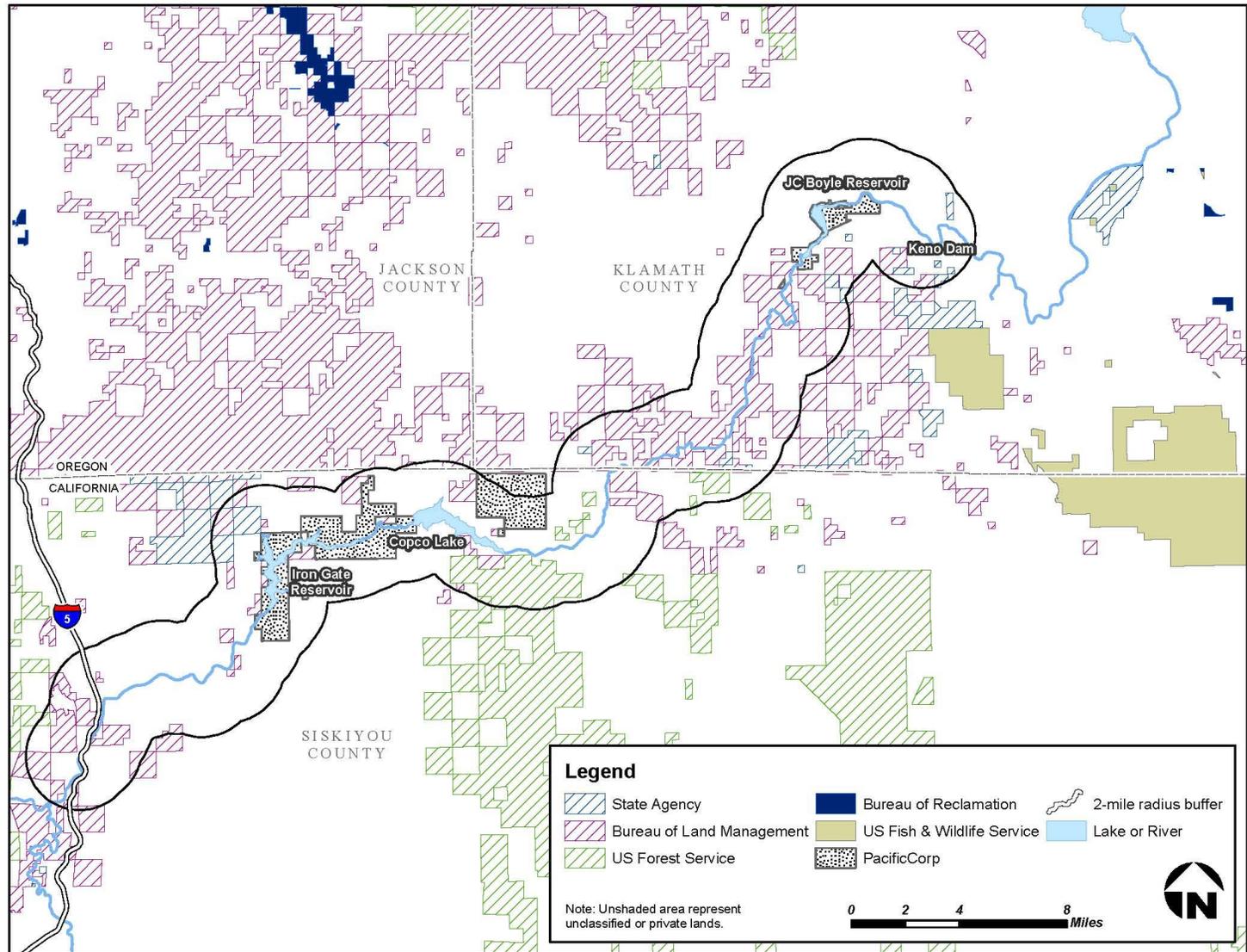


Figure 3.14-1. Area of Analysis for the Land Use Effects of the KHSAs

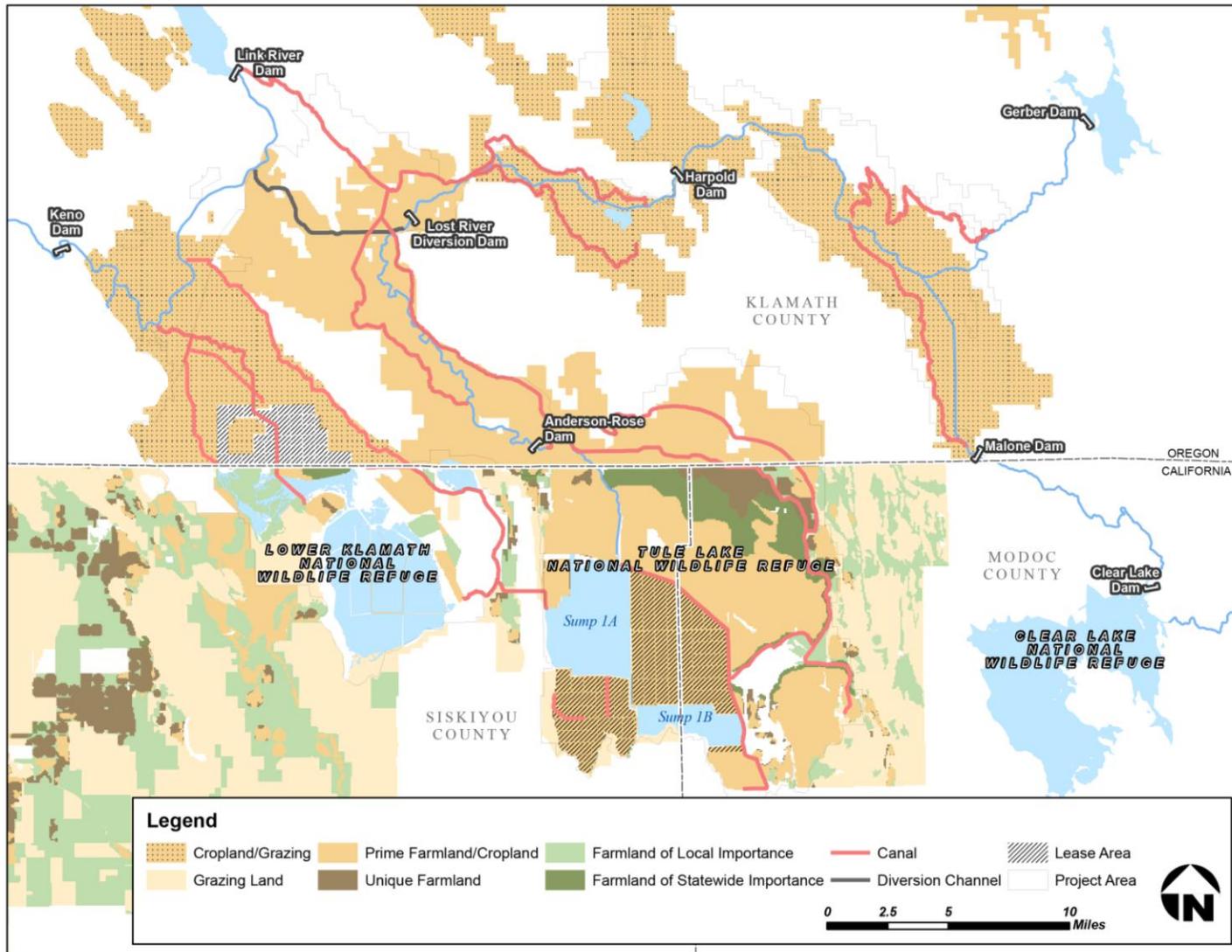


Figure 3.14-2. National Wildlife Refuges and Agricultural Designations in and around the Reclamation's Klamath Project

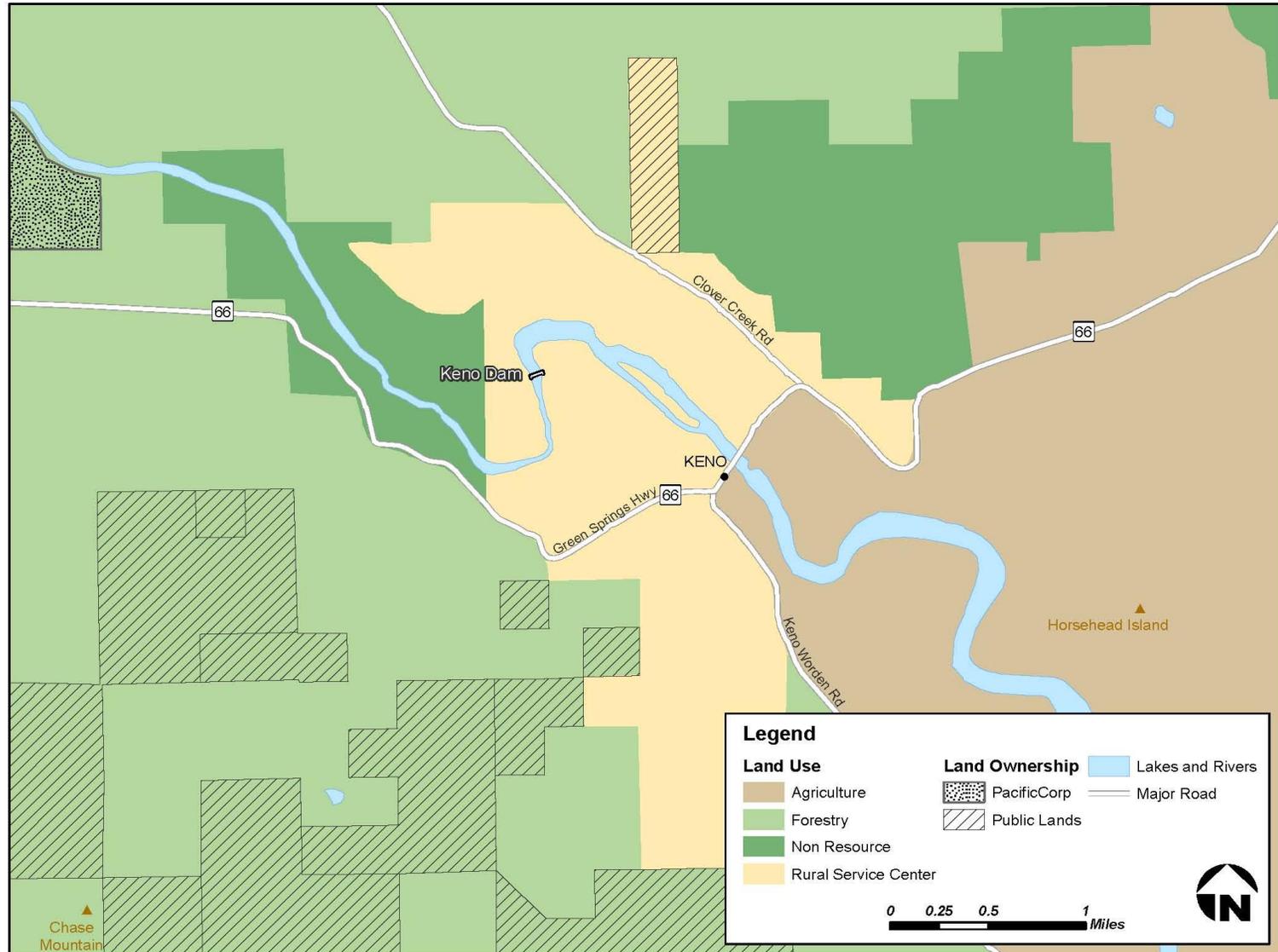


Figure 3.14-3. Land Use – Keno Dam

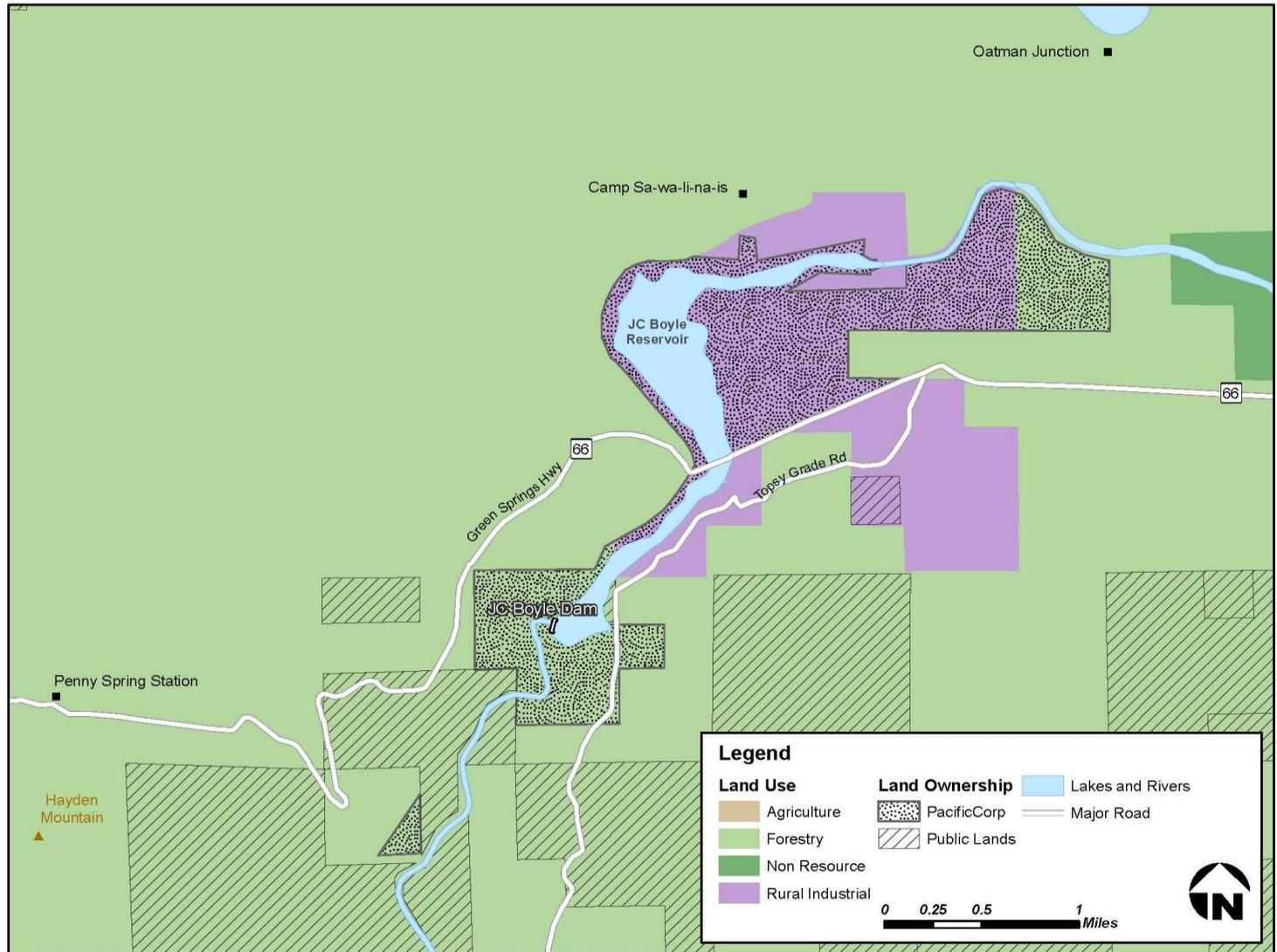


Figure 3.14-4. Land Use – J.C. Boyle Dam

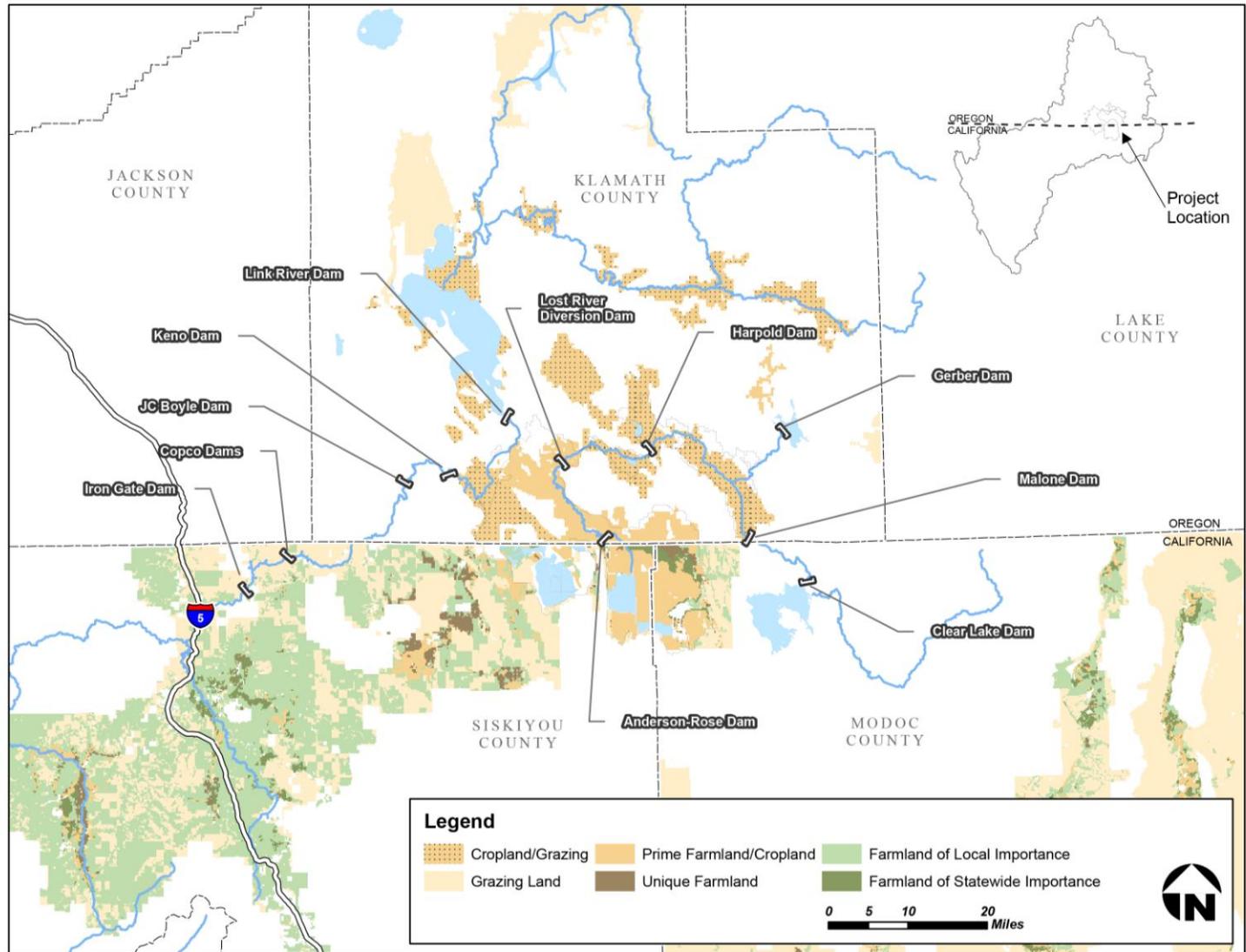


Figure 3.14-5. Upper Klamath Basin Agricultural Resources

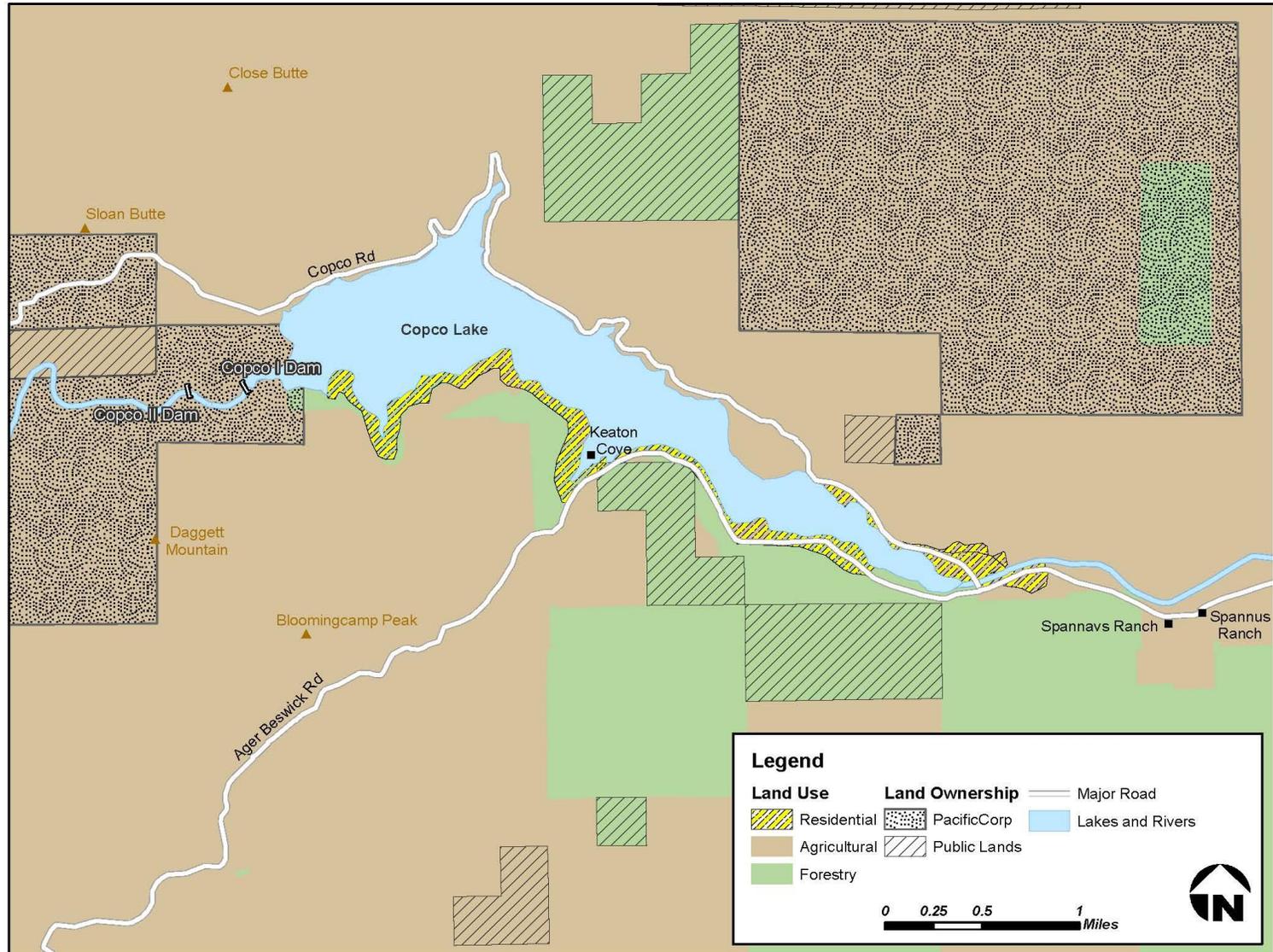


Figure 3.14-6. Land Use – Copco 1 and Copco 2 Dams

INTERNAL WORKING DOCUMENT - NOT FOR DISTRIBUTION

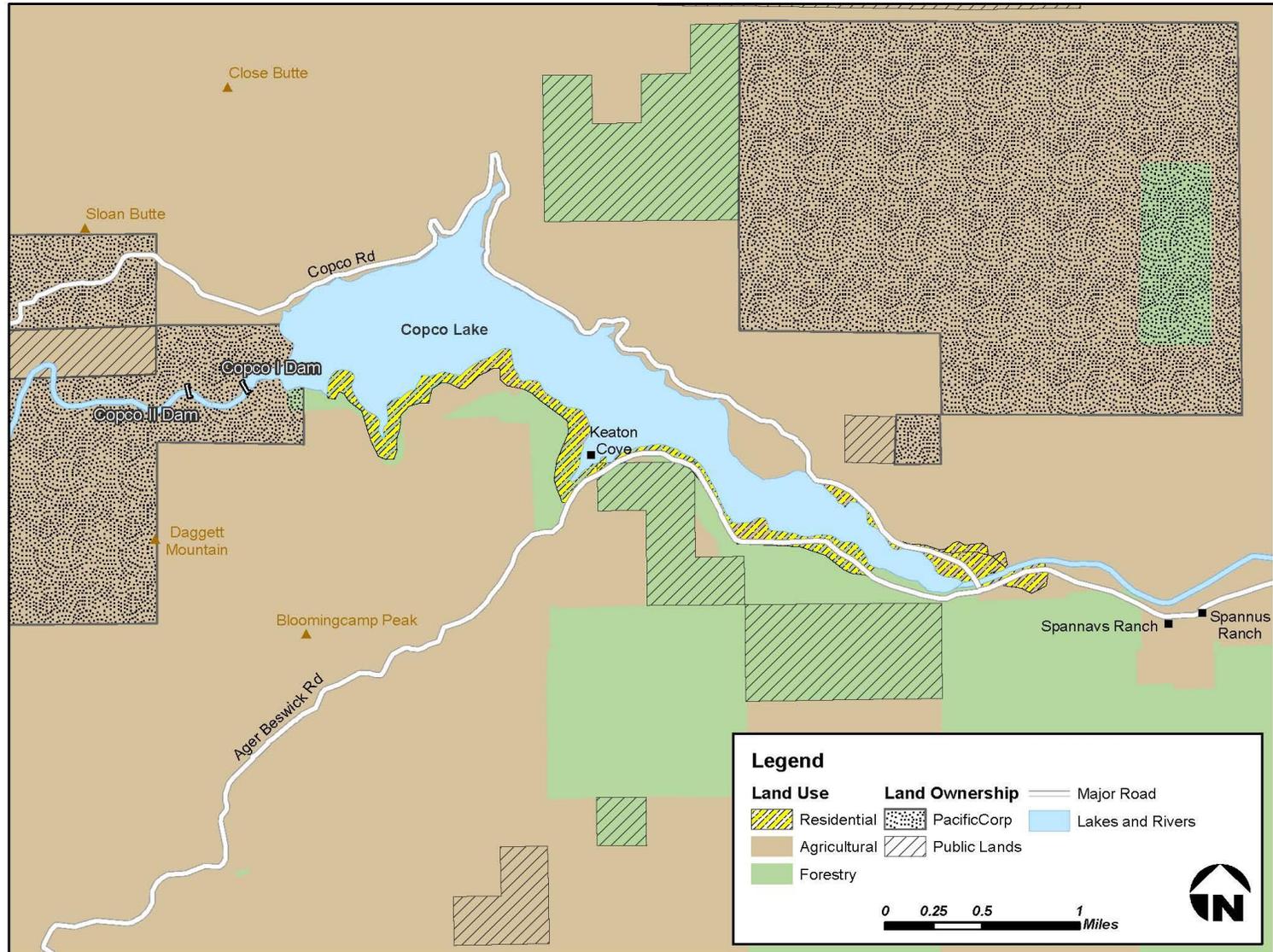


Figure 3.14-6. Land Use – Copco 1 and Copco 2 Dams

INTERNAL WORKING DOCUMENT - NOT FOR DISTRIBUTION

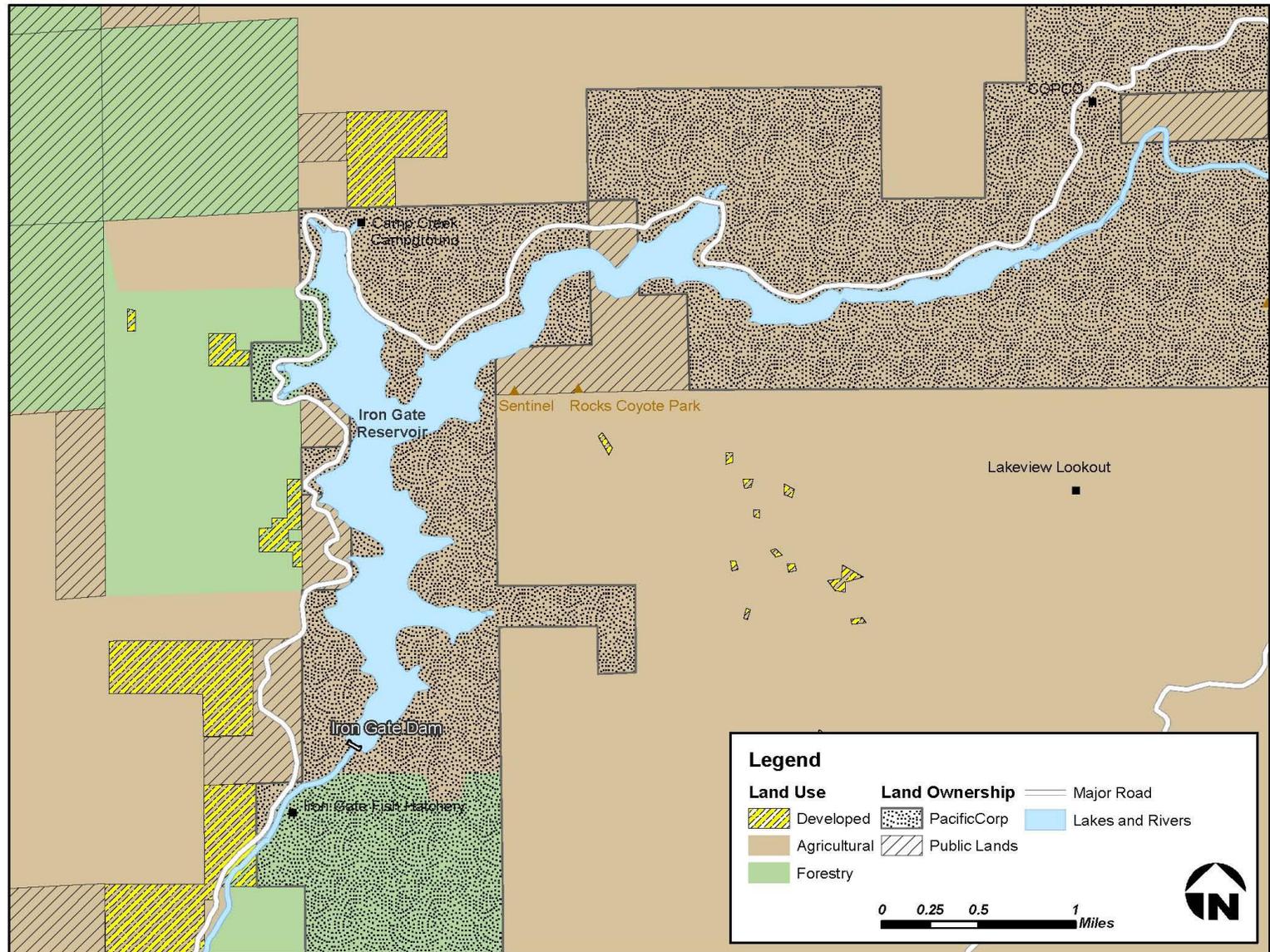


Figure 3.14-7. Land Use – Iron Gate Dam

### **Inundated Lands**

In Klamath County, lands currently inundated by J.C. Boyle Reservoir do not have land use designations or zoning, and would require a zoning change and plan amendment after the land is no longer inundated (Gallagher 2011). Lands currently inundated by the reservoirs in Siskiyou County have land use designations and zoning that correspond with the adjacent lands (generally agriculture). After the Proposed Action is complete, they would not require new land use designations or zoning because they run with the land and do not change with an ownership change until there is some action that triggers rezoning and land use amendment (Plucker 2011).

### **Open Space/Recreation/Public Lands**

Federal and state agencies own and/or manage public lands in the area of analysis. These include public and O&C lands owned by the United States and managed by BLM, National Forests and Grasslands owned by the United States and managed by USFS, wildlife refuges owned by the United States and managed by USFWS, and other publicly-accessible reservoirs and state lands. These areas are used for public recreation and open space, as well as forest and mineral resources. Additionally, DOI manages lands near the Keno Dam that are operated by PacifiCorp for public recreation. Other privately-owned recreation facilities (e.g., Recreational Vehicle parks) operate along the Klamath River downstream of Iron Gate Dam.

### **Residential**

In the area of analysis, there are residential developments in the city of Klamath Falls, in and around the community of Keno and the Keno Recreation Area, and along portions of Copco reservoir. These developments are mostly low-density rural residential (e.g., fewer than four units per acre).

### **Commercial/Industrial**

Besides the dam facilities themselves (zoned industrial), industrial/undeveloped and urban uses occur in the City of Klamath Falls near the East Side and West Side powerhouse developments. In addition, the Klamath Falls co-generation plant, the Collins Products lumber facility, and Jeld-Wen millwork plant are located outside city limits adjacent to Klamath River.

### **Rural Service Center**

Rural service centers are unincorporated areas that contain local commercial services to meet the needs of rural residents. These include general stores, limited commercial tourist oriented operations such as accommodations and restaurants, and campgrounds. These areas are located in the areas near the Keno Impoundment and Lake Ewauna.

### **Forest/Timber lands**

About 58,054 acres is designated forestry in the area of analysis as shown in Figures 3.14-3, 3.14-4, 3.14-6, and 3.14-7. These lands are owned by the United States and managed by the USFS, BLM, and private landowners for the purposes of timber harvests and other forest management practices.

### **Agriculture**

Agriculture is an important part of the economy for Klamath, Siskiyou, and Modoc counties. Hay, alfalfa, vegetables, nursery crops, livestock, and various grains are all grown in the three-county area that receives water from Reclamation's Klamath Project in the Upper Klamath Basin. The Agricultural Commissions of each California county prepare crop reports that focus on production at the county level, and Reclamation provides annual crop reports for Reclamation's Klamath Project. According to the California Water Plan's 2009 update, 55 percent of the Reclamation's Klamath Project is in Oregon, and the remaining 45 percent is in California (see Figure 3.14-5). There are no Williamson Act lands adjacent to the Four Facilities although there are Williamson Act lands in the Upper Klamath River Sub-basin. Most Williamson Act lands in the Lower Klamath Basin are in Shasta River Sub-basin and Scott River Sub-basin. In the Upper Klamath Basin, there are Williamson Act lands in the Butte and Lost River Sub-basins (see Figure 3.14-8, Williamson Act Lands in Project Vicinity).

Reclamation's Klamath Project provides water to agricultural lands and wetlands in the upper Klamath River and Lost River Sub-basins. A large percentage of the 35,000 wetland acres are in California, increasing the percentage of the project in California when included in the project total. Of the total land area in the Reclamation's Klamath Project, 45 percent are in California and 55 percent are in Oregon; however, only 34 percent of the agricultural land within the Reclamation's Klamath Project is located in California and 66 percent in Oregon (Personal Communication, Mike Green, March 23, 2011).

**Table 3.14-2. 2009 Irrigable Lands in Reclamation's Klamath Project by State**

<b>State</b>	<b>Acres Irrigated</b>	<b>Fallow or Idle</b>	<b>Total Irrigable</b>
<b>California</b>	65,321.30	6,313.80	71,635.10
<b>Oregon</b>	124,951.80	28,378	153,329.80
<b>Total</b>	190,273.10	34,691.80	224,964.90

*Source: Reclamation's Klamath Project 2009 Crop Report. DOI 2010b*

Water is captured in the Clear Lake and Gerber Reservoirs and the Lost River for the Lost River or Eastside portion of Reclamation's Klamath Project and in Upper Klamath Lake and the Klamath River for the Klamath or Westside portion of the project (see Figure 3.14-2). The drainage area of the entire project is approximately 5,700 square miles (DOI 2009b). See Chapter 1.2.4 for additional detail regarding Reclamation's Klamath Project.

Chapter 3 – Affected Environment/Environmental Consequences  
 3.14 Land Use, Agricultural and Forest Resources

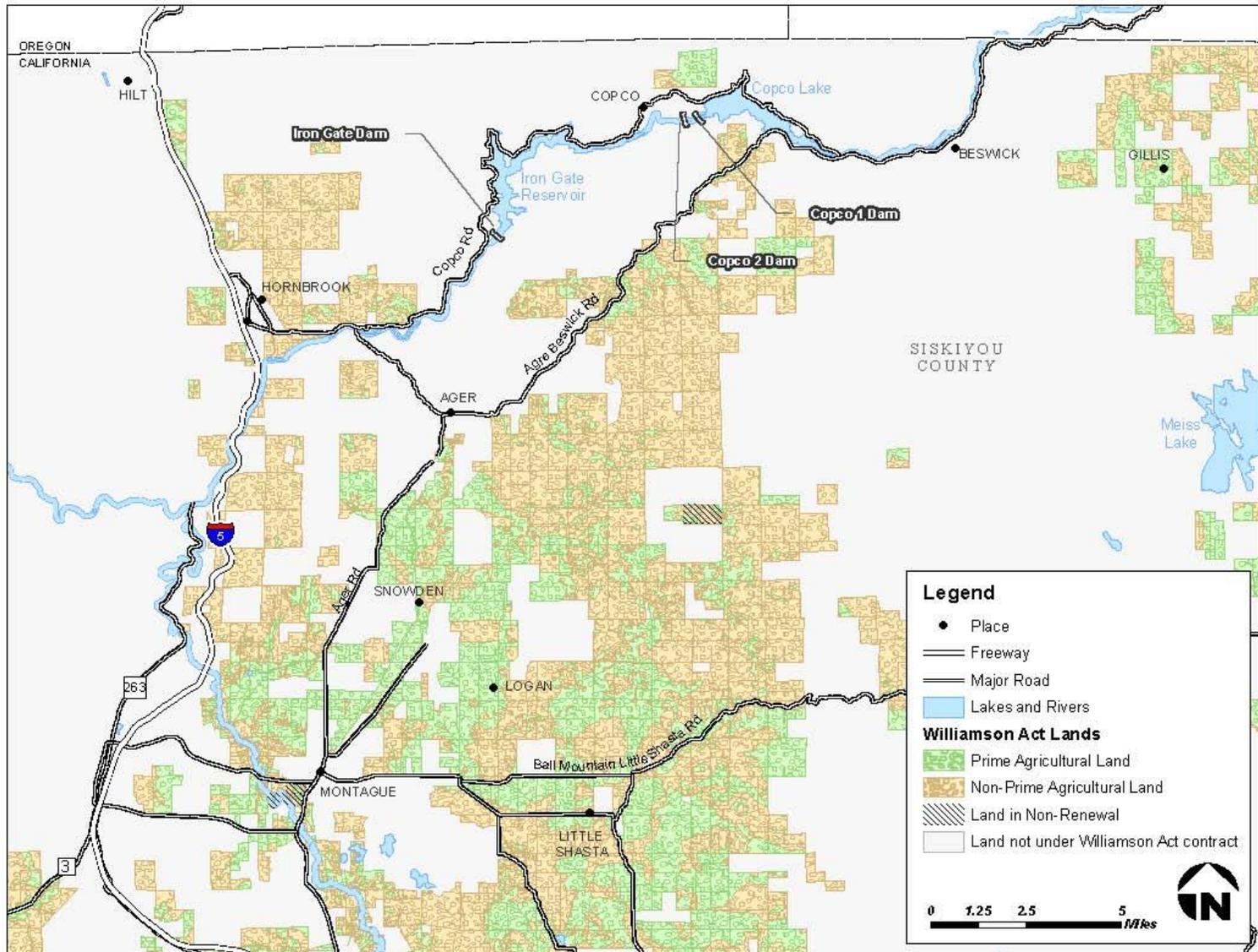


Figure 3.14-8. Williamson Act Lands in the Project Area

### **Klamath County**

Agricultural land in Klamath County totals 464,689 acres, while total acreage in Klamath County within the Reclamation's Klamath Project boundaries is 127,406 (Table 3.14-3). As shown in Figure 3.14-5, much of Klamath County's agriculture land in the area of analysis is zoned Exclusive Farming Use (Oregon Zoning (computer file) Oregon State Service Center for GIS, 1998). The agricultural designations in Table 3.14-3 are Klamath County's zoning classes.

**Table 3.14-3. Klamath County Agricultural Land**

	<b>County Lands</b>	<b>Reclamation's Klamath Project</b>
<b>Cropland</b>	76,208	62,937
<b>Cropland/Grazing</b>	249,662	64,469
<b>Grazing</b>	138,819	0
<b>Klamath County Totals</b>	<b>464,689</b>	<b>127,406</b>

*Source: Federal Water Districts – Mid-Pacific Region [computer file].  
Sacramento, CA: U.S. Bureau of Reclamation and MPGIS Service Center,  
2009.(DOI 2009c)*

*Oregon Generalized Zoning [computer file]. Salem, OR: State Service Center for GIS, 1998*

Upper Klamath Lake is a major source of water through Reclamation's Klamath Project to the farmland in Klamath County as well as Siskiyou and Modoc Counties.

### **Siskiyou and Modoc Counties**

The farmland in Siskiyou and Modoc Counties is a combination of Prime Farmland, Farmland of Statewide Importance, and other classifications recognized by the State Department of Conservation (see Figure 3.14-5) (California Department of Conservation (CDC) 2010). Much of the Siskiyou County farmland is outside of the area of analysis, in the Scott River and Shasta River Sub-basins. These areas do not receive water from Reclamation's Klamath Project, and would not be affected by changes in water allocation associated with the Proposed Action. Reclamation's Klamath Project does serve lands in the Upper Klamath Basin within Siskiyou and Modoc Counties (Table 3.14-4).

### **Lands Downstream of Iron Gate Dam Subject to Flooding**

The lands along the Klamath River are subject to flooding. These include agriculture and grazing lands, recreation sites and unincorporated communities along the Klamath River. Flooding risk is discussed in Appendix J for a portion of the Klamath River downstream of Iron Gate Dam to Happy Camp. Effects are included in Section 3.6, Flood Hydrology.

**Table 3.14-4. Acres of Agricultural Land in Siskiyou and Modoc Counties**

Agriculture/Land Use	County		Reclamation's Klamath Project Area	
	<i>Siskiyou</i>	<i>Modoc</i>	<i>Siskiyou</i>	<i>Modoc</i>
Grazing Land	393,892	814,860	9,181	1,278
Prime Farmland	77,209	79,251	34,707	30,900
Unique Farmland	33,008	13,971	804	4,050
Farmland of Local Importance	616,670	148,177	4,480	2,480
Farmland of Statewide Importance	27,678	44,541	2,726	6,587
<b>Total Agricultural Land</b>	<b>1,148,457</b>	<b>1,100,800</b>	<b>51,898</b>	<b>45,296</b>

*Source: GIS Calculations using Federal Water Districts – Mid-Pacific Region [computer file]. Sacramento, CA: Reclamation and MPGIS Service Center, 2009. (DOI 2009c)*

### 3.14.3.2 Existing Infrastructure

Existing infrastructure potentially affected by the Proposed Action are the City of Yreka water line, existing domestic wells, recreation sites and facilities, and roads. Details of utilities and public services are found in Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste and Power, and recreation facilities are described in Section 3.20, Recreation. The existing roads are owned by PacifiCorp, the federal government, counties or private entities; details of which can be found in Section 3.22, Traffic and Transportation.

## 3.14.4 Environmental Consequences

### 3.14.4.1 Effects Determination Methods

The Lead Agencies reviewed the plans, codes, regulations and ordinances listed in Section 3.14.2 to aid this analysis. Existing land uses were identified from a variety of sources including federal and state agencies and the respective counties. The effects analysis identified direct and indirect effects on land use, agricultural and forest resources under the No Action/No Project Alternative, the Proposed Action, and alternatives. The types of land use effects that were analyzed included temporary effects associated with dam removal, demolition, and staging and permanent effects such as transfers of ownership, changes in land use, and required changes to local land use plans and zoning ordinances. The Lead Agencies also considered possible conflicts or inconsistencies between the proposed alternatives and federal, state, regional, local, or tribal land use plans, policies, or controls relevant in the area of analysis. Temporary and permanent direct and indirect conversions of agricultural lands were also analyzed. In addition, the Lead Agencies examined the changes in land ownership, including the ownership and operation of Keno Dam. Section 3.20, Recreation, discusses roads and access to the new river channel, both for public access and for private owners adjacent to the reservoirs. The discussion below includes the effects on land use from new access roads for deconstruction activities. New roads that may be required to mitigate impacts on recreational facilities are discussed in the analysis of mitigation measures for other resource areas.

Changes in shoreline access are addressed in Section 3.20, Recreation, because they would not constitute a land use change. Effects on the property values of private lands adjacent to the reservoirs due to the loss of the reservoirs are addressed in Section 3.15, Socioeconomics, because the land use of those properties would not change.

This section includes an evaluation of potential conflicts between the existing and proposed land uses. Although conflicts with zoning or land use policies, in and of themselves, would not constitute a physical impact on the environment (California Environmental Quality Act (CEQA) Guidelines Section 15064(d)(1)), the act of decommissioning the dams would ultimately cause physical changes in the environment. Physical changes resulting from the Proposed Action and the various alternatives are addressed throughout this EIS/EIR. Where significant adverse environmental impacts would occur, this EIS/EIR offers mitigation measures for reducing the physical impacts on the environment that would be caused by the change in land use.

The No Action/No Project Alternative provides the baseline condition against which the alternatives were measured. In particular, under the No Action/No Project Alternative, allocations of water to the irrigators and KHP would continue as dictated under the existing agreements and the Biological Opinion's from the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service and the USFWS.

#### **3.14.4.2 Significance Criteria**

For the purposes of this EIS/EIR, impacts would be significant if they would result in the following:

- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.
- Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, or Exclusive Farm Zone land as defined by the Oregon Revised Statutes, Chapter 308, to non-agricultural use.
- Conflict with existing zoning for agricultural use, or a Williamson Act contract.
- Conflict with existing zoning for, or cause rezoning of, forestland (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g)).
- Result in the loss of forestland or conversion of forestland to non-forest use.
- Involve other changes in the existing environment that could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use.

### **3.14.4.3 Effects Determinations by Alternative**

#### **Alternative 1: No Action/No Project**

Under the No Action/No Project Alternative, neither the KHSA nor the KBRA would be fully implemented. Under this alternative, resource management actions and restoration activities that are part of the KBRA and that are currently approved and on-going would continue to be implemented.

*The No Action/No Project Alternative could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.* The No Action/No Project Alternative would not conflict with applicable plans, policies or regulations because no action would not result in any changes or actions that would conflict with land use, agriculture, or forest plans, policies, or regulations. **There would be no change from existing conditions to land use and agriculture from the No Action/No Project Alternative.**

*The No Action/No Project Alternative could result in the conversion of farmland to non-agricultural use or conflict with Williamson Act land or agricultural zoning.* No land uses would be converted directly as a result of the No Action/No Project Alternative. Under the No Action/No Project Alternative, there would be continued uncertainty for irrigators dependent on Reclamation's Klamath Project water because of allocation methods required under the Biological Opinions which make it difficult for farmers to plan for the next season. The 2001 Klamath Project Operations Plan that curtailed deliveries to project irrigators due to low water conditions and the flow requirements of the Biological Opinion's indicates potential future water allocations under the No Action/No Project Alternative. Continuing this uncertainty could indirectly result in local farmers retiring farmland to reduce their dependence on Reclamation's Klamath Project water, potentially by selling agricultural property for development or other non-agricultural uses. There has also been a proliferation of groundwater wells by farmers seeking an alternative water source, which may have impacts to local groundwater levels if the trend continues (see Section 3.7, Groundwater, for more details on the groundwater basin). Irrigators would continue to respond to uncertain water allocations under the No Action/No Project Alternative. **There would be no change from existing conditions to land use and agriculture from the No Action/No Project Alternative.**

*The No Action/No Project Alternative could result in the conversion of forest lands to non-forest use or conflict with forest zoning.* The No Action/No Project Alternative would not directly cause conflict with existing zoning for, or cause rezoning of, forest land, timberland, or timberland zoned Timberland Production. **There would be no change from existing conditions in forest lands from the No Action/No Project Alternative.**

*The No Action/No Project Alternative could indirectly convert farmland, to non-agricultural use or forest land to non-forest use.* The No Action/No Project Alternative would not include making changes in forest land use and would not involve other changes in the existing environment which, due to their location or nature, would result in conversion of farmland to non-agricultural use or forest land to non-forest use. **There would be no change from existing conditions to farmland or forest land uses from the No Action/No Project.**

*Under the No Action/No Project Alternative, ongoing restoration actions would continue to be implemented and could affect land use, agriculture, and forest resources.* These actions include the Agency Lake and Barnes Ranches Project, and ongoing fisheries restoration actions. Reclamation purchased the Agency Lake and Barnes Ranches adjacent to Agency Lake in 1998 and is currently using portions of the ranches as pumped storage. These ranches have been transferred to the USFWS and are now part of the Upper Klamath NWR. USFWS is studying the possibility of breaching the dikes which would convert the 63,770 acre-feet of storage from pumped storage to passive storage in Upper Klamath Lake. The Agency Lake/Barnes Ranches Project would go through separate National Environmental Policy Act evaluations as plans are developed for future restoration activities. **Future changes would not substantively change the existing land uses or areas used for agriculture, and do not affect forest lands, and therefore, there would be no change from existing conditions.**

#### **Alternative 2: Full Removal of Four Dams (the Proposed Action)**

Implementation of the KHSA would include full removal of the Four Facilities, drawdown and removal of the associated reservoirs, and restoration of formerly inundated lands in the project area.

*The Proposed Action could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.* The Proposed Action would have no effect on the disposition of Parcel A lands. Activities defined in the Proposed Action would change current uses of the Parcel B lands in the vicinity of J.C. Boyle Dam from rural industrial to non-resource. Activities defined in the Proposed Action would not conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect. The plans and policies described in Section 3.14.2 would not be affected by the Proposed Action, because the inundated lands in Siskiyou County already have zoning and land use designations that would not change once they are no longer inundated (Plucker 2011). In Klamath County, formerly inundated lands would require new land use designations and zoning, the designation of which would likely not conflict with any adopted plans or policies (Gallagher 2011). Private lands adjacent to the reservoirs would not have a land use change; however, those lands would no longer be adjacent to inundated land with reservoir views and that is currently used for water-based recreational purposes. In the future other land-based recreational uses could occur on the publicly owned property. Although the land use designations and zoning would not change *per se*, the functional

use of the area would change and would be noticeable to the private property owners. **The Proposed Action would not conflict with land use plans, policies or regulations adopted for the purpose of avoiding or mitigating an environmental effect.**

*The Proposed Action could result in the conversion of farmland to non-agricultural use or conflict with Williamson Act land or agricultural zoning.* Implementation of the Proposed Action would not involve directly converting farmland to non-agricultural uses, and would not conflict with existing zoning or Williamson Act contracts. There would be no changes in land use under the Proposed Action that would conflict with forest use or zoning. Certain programs of the KBRA may indirectly affect agricultural lands in the Reclamation's Klamath Project. These programs are discussed below in the KBRA section. **The Proposed Action would not result in the conversion of farmland to non-agriculture use, nor would it conflict with Williamson Act land or agricultural zoning.**

*The Proposed Action could result in the conversion of forest lands to non forest use or conflict with forest zoning.* Implementation of the Proposed Action would not affect the forest lands or forest uses surrounding the reservoirs or in the larger area of analysis. **There would be no change from existing conditions as a result of the Proposed Action.**

*The Proposed Action could impact the existing environment resulting in changes that could result in conversion of farmland to non agricultural use or conversion of forest land to non forest use.* Dam decommissioning and removal would require the creation of temporary roads, staging areas and construction sites. Although existing roads provide access to the KHP facilities, new roads would be needed during deconstruction activities. Temporary construction roads and staging sites would also be required during dam removal activity (see Chapter 2). Permanent disposal sites would be needed near the dams on lands currently designated open space and/or conservation. Site access for restoration activities would require construction of temporary gravel access roads and storage pads. Because these temporary roads would be built on lands designated for industrial (dam) or open space use or on currently inundated lands, and could be returned to their original or alternate use following deconstruction, construction of the roads would not conflict with applicable plans and policies or otherwise cause a significant land use impact. The need for new roads and the capacity and use of existing roads is addressed in Section 3.22, Traffic and Transportation. **The development of temporary roads and staging/construction sites would be a less than significant land use impact.**

*New, permanent roads constructed to provide access to recreation areas could constitute a change in the existing environment.* Permanent roads associated with achieving public access to the river would be addressed as part of the recreation plan (mitigation measure REC-1). However, those roads would be constructed on formerly inundated lands and would not constitute a significant land use impact because they would not take agricultural or forest lands out of production. **The development of permanent roads for public access would be a less than significant land use impact.**

*The Yreka water supply pipeline, currently under the Iron Gate Reservoir, would need to be relocated to avoid damage after the reservoir is removed, creating a change in the existing environment and surrounding environment.* The Proposed Action would require the relocation, replacement, and/or burial of the existing 24-inch diameter water line and transmission facilities from the City of Yreka's Fall Creek diversion (KHSA Section 7.2.3). The Proposed Action calls for placing the City of Yreka's waterline on a pipe bridge across the river. This would require construction of footings and other infrastructure to support the pipe bridge, resulting in construction at the site. However, a structure for the purpose of water conveyance would not constitute a land use change and would not conflict with applicable regulations and codes, because the contractor would be required to obtain all building permits prior to construction. Impacts on visual resources from a pipe bridge are addressed in Section 3.19, Scenic Quality.

Another option under consideration is to place the pipeline along the Lakeview Bridge at Iron Gate Dam rather than creating a new span for the pipeline. The pipe would be relocated from its current route and cross the river along the underside of the bridge. Surveys are still required to determine if the bridge is adequate to support the pipeline and the construction traffic from the decommissioning activities. A detailed discussion of the traffic impacts and road conditions concerns is provided in Section 3.22, Traffic and Transportation, and Mitigation Measure TR-1 addresses these concerns. Therefore, the Proposed Action would not conflict with policies or regulations within the City of Yreka. **There would be no change from existing conditions as a result of the Proposed Action and pipeline relocation.**

*Under the Proposed Action, removal of recreational facilities currently located on the banks of the existing reservoirs could change land use classification.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities would be removed, an action that would not result in a change of forest land uses or convert forest lands to other uses. **There would be no change from existing conditions resulting from the removal of the recreational facilities.**

### **Keno Transfer**

*The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could result in a change in land use.* The Keno Transfer would not change the use or operation of the Keno Dam or the Keno Impoundment, nor directly result in a change of land use in the surrounding area. **There would be no change from existing conditions as a result of the Keno Transfer.**

### **East and West Side Facilities**

*The decommissioning of the East and West Side facilities could impact land use.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA would redirect water flows currently diverted at Link River Dam into the two canals, back into Link River. Although the land used for hydropower would no longer be used for that purpose, the decommissioning would not directly change the current land use of the canal system. **Therefore, the**

**decommissioning of these facilities would have no impact on land use, agriculture, or forest resources.**

### **KBRA**

The KBRA has several programs that could affect land uses within the Klamath Basin:

- Fisheries Reintroduction and Management Plan
- Water Diversion Limitations
- Water Use Retirement Program
- Power for Water Management
- Mazama Forest Project

### **Fisheries Reintroduction and Management Plan**

*Construction of fish handling facilities for trap and haul operations within the Fisheries Reintroduction and Management Plan could change land use.* The Fisheries Reintroduction and Management Plan includes trap and haul operations that move fish around Keno Impoundment and Link River during times of poor water quality. Trap and haul operations would require construction of new fish handling facilities near Keno Dam and Link River Dam. Because these new facilities would be built on lands designated for industrial (dam) use, their construction would not conflict with applicable plans and policies or otherwise cause a significant land use impact. The potential land use conversions generated by development of trap and haul facilities would not be expected to contribute to any land use effects generated by the hydroelectric facility removal action analyzed above. **The development of new fish handling facilities would be a less than significant land use impact.**

### **Water Diversion Limitations**

*The implementation of the Water Diversion Limitations could convert farmland to non-agricultural uses, a potentially significant effect.* The Water Diversion Limitations is part of the On-Project Water Users Program and would limit water diversions to specific irrigators receiving water on Reclamation's Klamath Project, and could decrease the total acreage under cultivation or indirectly convert farmland to non-agricultural use. The Water Diversion Limitations (KBRA 15.1 and 15.2) outlines water diversion limitations to specific diversions that are intended to increase water availability for fisheries purposes, especially in drier years. Agricultural water diversion limitations would be based on annual water level forecasts for Upper Klamath Lake which could result in less available water for irrigators during drought years and result in the conversion of farmland to non-agricultural uses. Also included are allocation and delivery guidelines for water provided to the Tule Lake NWR and Lower Klamath NWR for both wildlife and agricultural interests, which include the Tule Lake Irrigation District and the Klamath Drain District.

Activities in the Water Diversion Limitations that have the potential to impact agriculture in the region include:

- Creation of conservation easements, forbearance agreements, and/or land acquisitions intended to reduce water use for irrigation. This could result in land fallowing and/or a shift in crop types to dry land crops.
- Implementation of water use efficiency and conservation measures to reduce surface water use, including drip irrigation.
- Development of new groundwater sources, and the potential creation of new surface and groundwater storage areas.

Implementation would include the establishment of fixed, annual water diversion amounts to agricultural uses based on available water and forecast water levels in the Upper Klamath Lake. While the diversion could reduce the availability of irrigation water by up to 100,000 acre feet less than irrigators received in the past, these fixed volumes would provide a base level for agricultural diversions and establish an irrigation framework that would provide security and increased certainty for farmers, allowing them to make decisions about the year's crops and activities based on the water forecast. This security would mitigate the effects of the lower delivery amount that may be expected in dry years.

The activities in the Water Diversion Limitations have the potential to reduce the amount of agriculture occurring on Reclamation's Klamath Project. Implementation of the On-Project Water Use Program will maximize the use of available water supplies, improve water supplies for the National Wildlife Refuges, and increase reliability for agricultural users. The conversion of farmland to non-agricultural uses that could occur as a result of agricultural diversion limitations would be a significant impact. However many of the actions described in the KBRA are anticipated to be beneficial to the environment and thus likely to have beneficial effects. The Diversion Limitations will also provide a more reliable water supply to the NWRs, a beneficial effect. The potential land use conversions generated by activities in the Water Diversion Limitations would not be expected to contribute to any land use effects generated by the hydroelectric facility removal action analyzed above. **The Water Diversion Limitations would maximize the use of available water, increase reliability for irrigators, and benefit the long-term sustainability of agricultural practices in the Klamath Basin. Impacts are therefore expected to be less than significant and potentially beneficial in the long term.**

#### **Water Use Retirement Program (WURP)**

*The WURP could result in the fallowing or conversion of agricultural land non agricultural uses, such as open space or wetland restoration areas.*

The WURP is part of the Off-Project Water Program and is intended to resolve the existing disputes between the Off-Project Irrigators, The Klamath Tribes, and the Bureau of Indian Affairs, and increase the stream flow into Upper Klamath Lake. The

Off-Project Water Program applies to the Wood, Sprague, Sycan, and Williamson River sub-basins, all of which are upstream of Upper Klamath Lake and outside the boundaries of Reclamation's Klamath Project.

The increase of permanent inflow to Upper Klamath Lake would be accomplished through various methods outlined in the WURP. The program is intended to permanently retire 30,000 acre-feet of water rights from irrigators to permanently increase inflow to Upper Klamath Lake (KBRA Section 16.2.2). The description of the WURP program in the KBRA does not mandate how this 30,000 acre feet would be acquired, but it could include:

- Retirement of water rights and forbearance agreements
- Short-term water leasing and split season irrigation
- Upland management techniques, such as juniper removal and timber thinning
- Water efficiency measures and dry land cropping
- Natural storage improvements, such as wetlands or improved riparian areas.

While no part of KBRA implementation would directly convert agricultural land to other uses, the KBRA provisions discussed above could result in agricultural land being temporarily or permanently retired. However, the EIS/EIR cannot characterize the specific impact from the KBRA on the conversion of farmland to non-agricultural use as a result of these programs because the number of voluntary participants, acres of farmland, and the final use of the lands affected by the program is unknown. The KBRA programs would protect the sustainability of agricultural uses and communities by improving the reliability of the agricultural water supply and settling long standing disputes on the amount, timing, and other conditions of water diversion and delivery for agriculture. The potential land use conversions generated by activities in the WURP would not be expected to contribute to any land use effects generated by the hydroelectric facility removal action. The KBRA could result in the conversion of farmland to non-agricultural use or conflict with Williamson Act land or agricultural zoning, a potentially significant impact. **However, the other potential measures outlined in the WURP would improve operational efficiency and are expected to benefit the long-term sustainability of agricultural practices in the Klamath Basin. Implementation of these programs will require future environmental compliance as appropriate.**

#### **Power for Water Management**

*The Power for Water Management could affect land use in the Reclamation's Klamath Project area.* The Power for Water Management program is intended to deliver power to eligible users at a cost that is targeted at or below the average cost for similarly situated Reclamation irrigation and drainage projects. The goals of the program include providing affordable electricity for efficient use, distribution, and management of water

within Reclamation's Klamath Project and the Klamath Basin NWR System, facilitating the return of water to the Klamath River as part of the implementation and administration of the On-Project Plan, and facilitating the implementation of the WURP and Off-Project Water Settlement (OPWAS). There are three components of the Power for Water Management – the Interim Power Program, a Federal Power Program, and a Renewable Power Program. Under the KBRA a power management entity would be created to manage the delivery of affordable power to eligible users.

- The Interim Power Program is intended to maintain the power cost target for eligible users while other programs from the KBRA are implemented. The program will help to offset the impacts of rising power prices on agricultural producers, and could prevent some agricultural producers from selling their property and/or converting it to other users. The Interim Power Program is unlikely to have an adverse effect on land use, agriculture, or forest resources.
- The Federal Power Program is a management program intended to obtain and provide for the transmission and delivery of federal preference power to eligible users. The implementation of the program is unlikely to have adverse effects on land use, agriculture, or forest resources.
- The Renewable Power Program is a combination of energy efficiency measures and renewable generation projects intended to reduce power costs for eligible power users. The Program includes development of a financial and engineering plan to identify efficiency measures and renewable energy resources. These include solar arrays, wind farms, and biomass energy facilities. These green power projects could be constructed on land currently used for agriculture or zoned for non industrial uses, which would have an adverse effect on land use, agriculture, or forest resources.

Implementation of the KBRA would not include construction or other projects that would conflict with existing zoning or Williamson Act contracts. However, green power projects, such as solar arrays or wind farms, could be constructed to replace part of the power generation capacity lost with the removal of the Four Facilities on land currently used for agriculture or zoned for non industrial uses. This would result in a change of land use should these potential projects be sited on agricultural lands. The potential land use conversions generated by siting and construction of renewable power projects would not be expected to contribute to any land use effects generated by the hydroelectric facility removal action. The KBRA Power for Water Management would have beneficial effects on land use, agriculture, and forest resources in the short term by creating incentives for agricultural producers. Impacts associated with siting and construction of renewable energy generation projects in the Renewable Power Program could generate significant, adverse, long term effects on land use and agriculture. However, other KBRA measures analyzed in this section are expected to benefit the long-term sustainability of agricultural practices in the Klamath Basin. **When considered with other KBRA programs that would benefit agriculture, implementation of the Power for Water**

**Management would be expected to generate a less than significant impact on land use. These effects will be analyzed in future environmental documents as necessary.**

#### **Mazama Forest Project**

*The KBRA's Mazama Forest Project could result in the conversion of forest land to non-forest use or conflict with forest zoning.* The Mazama Forest Project is a planned purchase of 90,000 acres of former reservation land by the Klamath Tribes. The land would be managed under the Klamath Tribes Forest Management Plan. The management of the adjacent Fremont-Winema National Forest would be influenced by the Mazama Forest Project under collaboration language from the federal Tribal Forest Protection Act. The project would allow for long term forest management and timber operations, and thus would not convert forest land to other uses or conflict with forest zoning. Implementation of specific plans and projects described in the KBRA would require future environmental compliance as appropriate. **The KBRA is not expected to convert forest land to non-forest use and would not conflict with forest zoning, therefore it is expected to result in no change from existing conditions.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

The effects of the Partial Facilities Removal of Four Dams Alternative would be similar to those described for the Proposed Action. However, the powerhouses at Copco 1, 2 and Iron Gate, and the warehouses and support buildings at Copco 2 would be left in place and shuttered for the foreseeable future. The shuttering would not constitute a change in land use, nor would it conflict with an applicable plan or policy. **Effects would be less than significant.**

#### **Keno Transfer**

The effects of the Keno Transfer would be the same as those described for the Proposed Action.

#### **East and West Side Facilities**

The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action.

#### **KBRA**

Under this alternative, the KBRA would be fully implemented and the potential effects would be the same as described for the Proposed Action.

#### **Alternative 4: Fish Passage at Four Dams**

The effects of the Fish Passage at Four Dams Alternative would be the same as those described above for the No Action/No Project Alternative, except that it would require the creation of new permanent roads to access fish ladder facilities.

*Construction of permanent access roads could change land use.* The Fish Passage at Four Dams Alternative would require the creation of new permanent roads. Although existing roads provide access to the KHP facilities, new roads would be needed for the fish passage alternative to provide permanent access to those facilities. Because these new

roads would be built on lands designated for industrial (dam) use, their construction would not conflict with applicable plans and policies or otherwise cause a significant land use impact. **The development of new permanent roads would be a less than significant land use impact.**

***Trap and Haul – Programmatic Measure***

*Construction of fish handling facilities for trap and haul operations could change land use.* Trap and haul operations would move fish around Keno Impoundment and Link River during times of poor water quality. Trap and haul operations would require construction of new fish handling facilities near Keno Dam and Link River Dam. Because these new facilities would be built on lands designated for industrial (dam) use, their construction would not conflict with applicable plans and policies or otherwise cause a significant land use impact. **The development of new fish handling facilities would be a less than significant land use impact.**

**Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

The effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as those described above for the Proposed Action with respect to removal of Copco 1 and Iron Gate Dams, and the same as the Fish Passage at Four Dams with respect to the new roads.

***Trap and Haul – Programmatic Measure***

*Construction of fish handling facilities for trap and haul operations could change land use.* The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. **The development of new fish handling facilities would be a less than significant land use impact.**

**Mitigation Measures Associated with Other Resource Areas**

*Mitigation REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam.* Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoir is removed. The areas that would be used for the relocation are currently inundated and their development would not result in a land use conversion or change in forest land uses. **There will be no impact to forest or agricultural land uses resulting from the implementation of Mitigation Measure REC-1.**

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## 3.15 Socioeconomics

This section describes socioeconomic effects of the four action alternatives and No Action/No Project Alternative. Socioeconomic effects include potential changes to economic output, labor income, and employment in the area of analysis, as well as, fiscal effects on local governments. This section also describes socioeconomic effects on Indian Tribes in the Klamath Basin.

### 3.15.1 Area of Analysis

The socioeconomic study area includes Del Norte, Humboldt, Modoc, and Siskiyou Counties in California and Curry, Klamath, and Jackson Counties in Oregon. The Four Facilities are in Siskiyou and Klamath Counties. The remaining counties have local economies linked to the Klamath River through fishing, recreation/tourism, or agriculture industries. Indian Tribes' economic and social welfare is also closely linked to the Klamath River. Various economic regions have been developed for the economic analysis based on where the direct economic activity would likely occur. For example, changes to irrigated agriculture as a result of the action alternatives would occur on Klamath Irrigation Project lands in Modoc, Siskiyou, and Klamath Counties; therefore, the economic region for irrigated agriculture effects includes these three counties. Figure 3.15-1 shows all counties in the direct area of analysis. Some economic effects for commercial fishing may occur in counties further from the Klamath Basin, most notably Mendocino, Sonoma, Marin, San Francisco, and San Mateo Counties in California and Lane, Douglas, and Coos Counties in Oregon. Section 3.15.2 defines the regions (groups of counties) and potential span of effects for each economic effect analyzed.

### 3.15.2 Regulatory Framework

Socioeconomics within the area of analysis is regulated by several federal laws and policies, which are listed below.

#### 3.15.2.1 Federal Authorities and Regulations

- Magnuson Fishery Conservation and Management Act of 1976
- Federal Endangered Species Act (ESA)
- Pacific Coast Salmon Plan and Amendments
- 1993 Solicitor's Opinion Fishing Rights of the Yurok and Hoopa Valley Tribes
- 1994 Northwest Forest Plan

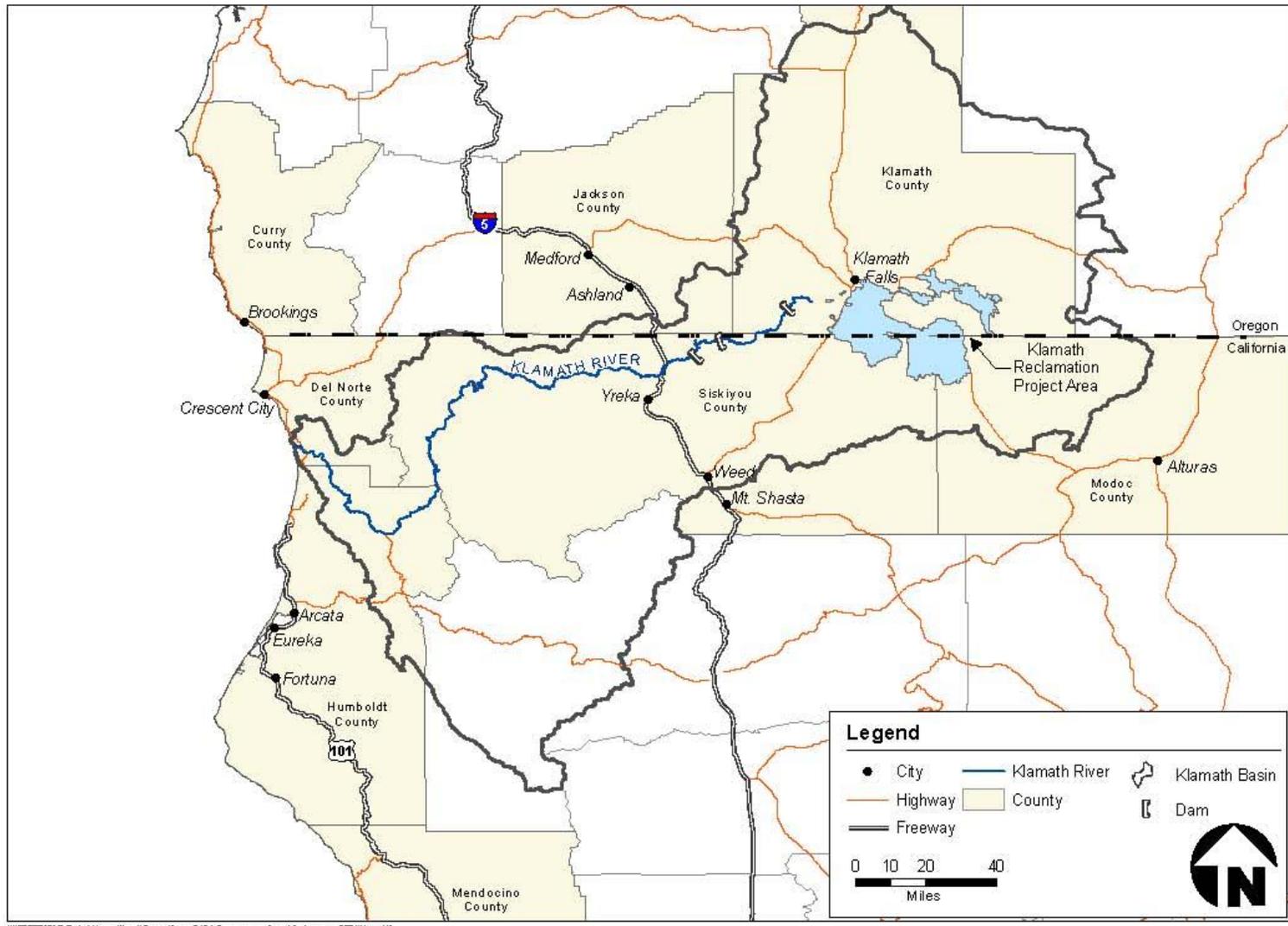


Figure 3.15-1. Socioeconomic Area of Analysis

### **3.15.3 Existing Conditions/Affected Environment**

This section describes regional economic conditions and economic information relevant to the specific industries in which potential economic effects could occur, such as fishing, recreation tourism, or agriculture. The areas of potential effects, which for this analysis are groups of counties, vary depending on the industry and are identified below for each industry. In general, the counties in the area of analysis (except for counties in the San Francisco Bay area) are in rural areas of the states and have resource- and environmental amenity-based economies (e.g., timber, agriculture, fishing, recreation). Similar to many rural areas, the counties in the area of analysis have lower populations, incomes, and economic output and fewer employment opportunities than counties with larger urban centers in California and Oregon. Government entities and services are typically the largest employers in the counties. Appendix O includes detailed regional economic descriptions of each county. The nature and magnitude of economic effects depends on whether the economic industry is prevalent in a county.

Indian Tribes are also affected by the project alternatives. Tribes' cultural practices, subsistence, and economies are closely linked to the Klamath River. This section describes economic conditions of the tribes. Sections 3.12, Tribal Trust and 3.16, Environmental Justice describe Indian Tribes' social and cultural uses of the river in detail.

#### **3.15.3.1 Four Facilities**

The area of analysis for the Four Facilities includes Siskiyou and Klamath Counties. Table 3.15-1 summarizes the regional economy in the two counties aggregated into eight industry sector classifications for employment, labor income, and output. 2009 data is presented.

Employment is a measure of the number of jobs related to each industry. The service industry sector was 44 percent of the total regional employment in the region. The government and trade industry sector jobs provided 21 and 14 percent of regional employment, respectively.

Labor income is the sum of employee compensation and proprietor income. The largest portion of labor income in the region, 37 percent, was provided by the service industry sector. The government and trade industry sectors made up 28 and 11 percent of the total regional labor income, respectively.

Industry output represents the value of goods and services produced by businesses within a sector of the economy. The service sector produced the greatest level of output (42 percent) in the region. The manufacturing and government sectors each generated 14 percent of regional output, while the agricultural sector was 10 percent of total output.

**Table 3.15-1. Summary of the 2009 Regional Economy for Klamath and Siskiyou Counties**

Industry Sector	Employment <sup>1</sup>		Labor Income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of Total	\$ (million)	Percent of Total	\$ (million)	Percent of Total
Agriculture	3,232	6.7	107.8	5.6	497.3	9.7
Mining	84	0.2	3.2	0.2	15.7	0.3
Construction	2,174	4.5	90.1	4.7	242.8	4.7
Manufacturing	2,621	5.4	135.7	7.0	703.6	13.7
Transportation, Information, and Public Utilities (TIPU)	1,920	4.0	109.3	5.7	394.6	7.7
Trade	6,886	14.3	220.5	11.4	455.4	8.9
Service	21,197	44.0	722.0	37.4	2,131.2	41.5
Government	10,091	20.9	539.8	28.0	697.9	13.6
Total	48,205	--	1,928.4	--	5,138.5	--

Source: Reclamation 2011.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including positive effects) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

Siskiyou County's unemployment rate has been higher than state averages from 1998 through 2010. Unemployment rates in 2009 and 2010 have been the highest the county has had in the past 20 years (California Employment Development Department [EDD] 2010). Klamath County has also had consistently higher unemployment rates than the State. The 2009 unemployment rate was the highest of the 12-year period (Oregon Employment Department 2010).

During the past 10 years, there has been a sharp decline in the Siskiyou County timber industry, which has been an economic base for the county historically. In 2009, the total value of the timber harvest in Siskiyou County was \$11.6 million, about a \$52 million decrease from 2000 (Board of Equalization [BOE] 2010b). The 2009 timber harvest was at its lowest value observed in the past 10 years. Reductions in timber harvesting have also reduced employment opportunities in the county. Similar to Siskiyou County, timber harvests in Klamath County have been declining in recent years. Timber harvests in 2008 and 2009 showed substantial decreases relative to previous years (Oregon Department of Forestry 2010). Appendix O further describes economic conditions in Siskiyou and Klamath Counties.

### **3.15.3.2 Commercial Fishing**

The commercial fishing information provided here is taken directly from analyses contained in Reclamation (2011) and National Oceanic and Atmospheric Administration (NOAA Fisheries Service) (2011a). The area of analysis for commercial fishing includes Curry, Coos, Douglas and Lane Counties in Oregon and Del Norte, Humboldt,

Mendocino, San Mateo, San Francisco, Marin, and Sonoma Counties in California. Participants in the ocean commercial fishery potentially affected by the project alternatives consist of small, independently owned and operated trollers that land salmon south of Cape Falcon, Oregon. The fishery is a mixed stock fishery, that is, the commercial harvest includes salmon stocks from different rivers, including the Klamath River. The PFMC manages the salmon fishery on the basis of ‘weak stock management’, whereby regulations are designed to protect weaker stocks, even if that means foregoing some harvest of the healthier stocks that comingle with the weaker ones in the ocean harvest. In the ocean, Klamath River fall Chinook salmon ranges from approximately Point Sur, California to Cape Falcon, Oregon. About 99 percent of the increase in commercial fishery revenue attributable to the project alternatives occurs in the following ocean management areas: (1) San Francisco, (2) Fort Bragg, (3) Klamath Management Zone (KMZ) (Figure 3.15-2) and (4) Central Oregon. The regional impact analysis focuses on these four areas. For purposes of this analysis, the KMZ (which straddles the Oregon-California border) is divided at the border into two areas: KMZ-OR and KMZ-CA. Tables 3.15-2 to 3.15-6 summarize the regional economy for San Francisco (San Mateo, San Francisco, Marin and Sonoma Counties), Fort Bragg (Mendocino County), KMZ-CA (Humboldt and Del Norte Counties), KMZ-OR (Curry County), and Central Oregon (Coos, Douglas and Lane Counties) in terms of employment, labor income, and output. Employment, labor income, and output related to commercial fishing are reflected in various sectors in the tables, including agriculture and services.

While Klamath River fall Chinook salmon abundance routinely constrains the troll fishery in the areas cited above, troll harvest in two additional areas (Monterey and Northern Oregon) may also become more constrained when Klamath River fall Chinook salmon is at low levels of abundance. Table 3.15-7 summarizes landings (numbers of fish) in the last three decades in all management areas south of Cape Falcon, Oregon. Tables 3.15-8 and 3.15-9 describe poundage and ex-vessel value of landings (gross landed value) over 1981-2010. Landings and value decreased from the 1980s to the 1990s. Factors contributing to this decline include more conservative management policies to protect weak stocks (including two Chinook salmon and three coho salmon stocks listed under the Endangered Species Act) and a 1993 opinion by the Department of the Interior Solicitor reserving 50 percent of Klamath-Trinity River salmon for the Yurok Tribe and Hoopa Valley Tribe. Landings are generally highest in San Francisco and lowest in KMZ-CA and KMZ-OR. Landing reductions began occurring in KMZ-CA and KMZ-OR in the mid-1980s to address conservation concerns for Klamath River fall Chinook; low landings remain persistent features in those areas. Landings in most areas rebounded during 2001-2005 but have since fallen to record lows in the past five years.

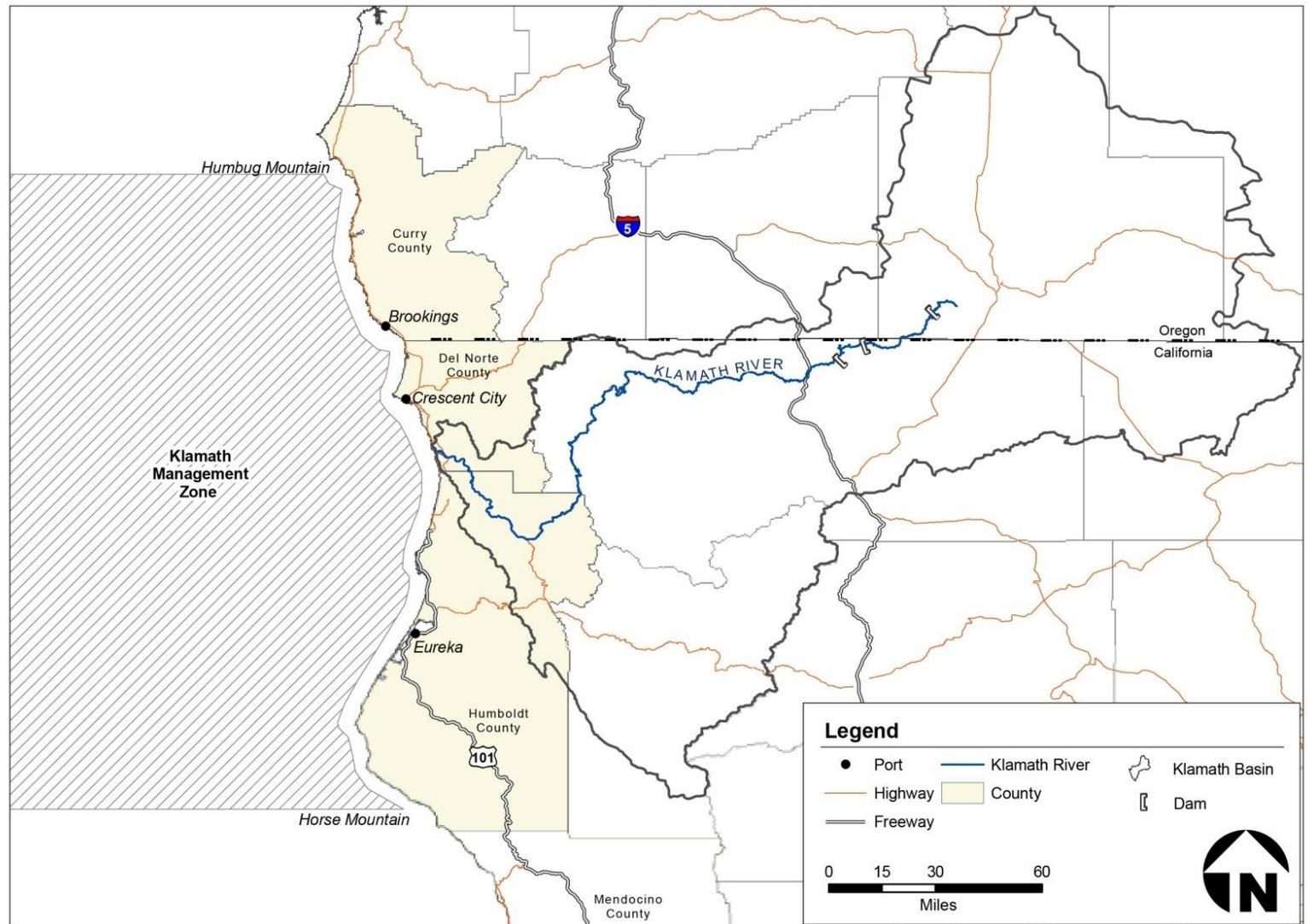


Figure 3.15-2. Klamath Management Zone Boundary and Ports

**Table 3.15-2.—Summary of the Regional Economy for the San Francisco Management Area (San Mateo, San Francisco, Marin, and Sonoma Counties CA)**

Industry sectors	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of total	\$ million	Percent of total	\$ million	Percent of total
Agriculture	10,401	0.34	570.53	0.28	1,536.15	0.26
Mining	2,683	0.09	404.25	0.20	1,529.34	0.26
Construction	153,734	5.02	11,116.50	5.43	23,970.50	4.00
Manufacturing	149,053	4.87	17,552.96	8.58	151,443.53	25.28
TIPU	98,914	3.23	6,843.29	3.34	24,426.35	4.08
Trade	372,967	12.19	19,026.25	9.30	42,067.56	7.02
Service	1,933,85	63.19	121,200.87	59.21	318,440.96	53.15
Government	338,759	11.07	27,970.63	13.67	35,749.56	5.97
<b>Total</b>	<b>1,319,896</b>		<b>204,685.28</b>		<b>599,163.95</b>	

Source: Reclamation 2011

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

**Table 3.15-3.—Summary of the Regional Economy for the Fort Bragg Management Area (Mendocino County CA)**

Industry sector	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of total	\$ million	Percent of total	\$ million	Percent of total
Agriculture	2,339	5.83	118.11	6.82	312.39	6.49
Mining	66	0.17	1.80	0.10	9.14	0.19
Construction	2,233	5.57	115.93	6.70	281.60	5.85
Manufacturing	2,449	6.11	128.21	7.41	808.43	16.79
TIPU	1,093	2.73	58.26	3.37	346.44	7.20
Trade	6,304	15.71	250.07	14.45	520.20	10.81
Service	18,190	45.34	649.96	37.55	1,970.63	40.94
Government	7,442	18.55	408.64	23.61	564.71	11.73
<b>Total</b>	<b>40,116</b>		<b>1,730.98</b>		<b>4,813.54</b>	

Source: Reclamation 2011

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

**Table 3.15-4. Summary of the 2009 Regional Economy for the KMZ-CA (Humboldt and Del Norte Counties, CA)**

Industry sector	Employment <sup>1</sup>		Labor Income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of total	\$ million	Percent of total	\$ million	Percent of total
Agriculture	2,481	3.46	111.27	3.73	413.34	5.62
Mining	43	0.06	2.37	0.08	7.38	0.10
Construction	3,672	5.13	192.04	6.44	464.58	6.31
Manufacturing	2,465	3.44	126.28	4.23	798.32	10.85
TIPU	1,967	2.75	105.77	3.55	365.00	4.96
Trade	10,586	14.78	380.59	12.76	777.07	10.56
Service	32,462	45.32	1,113.71	37.34	3,327.87	45.21
Government	17,958	25.07	950.47	31.87	1,206.59	16.39
<b>Total</b>	<b>71,634</b>		<b>2,982.50</b>		<b>7,360.15</b>	

Source: Reclamation 2011

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

**Table 3.15-5. Summary of the 2009 Regional Economy for the KMZ-OR (Curry County, OR)**

Industry sector	Employment <sup>1</sup>		Labor Income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of total	\$ million	Percent of total	\$ million	Percent of total
Agriculture	676	7.81	20.60	6.61	53.21	6.20
Mining	25	0.29	1.26	0.41	4.39	0.51
Construction	673	7.78	21.94	7.04	67.28	7.84
Manufacturing	611	7.06	33.42	10.73	130.97	15.25
TIPU	180	2.08	11.33	3.64	43.17	5.03
Trade	1,252	14.47	38.04	12.21	74.43	8.67
Service	3,885	44.88	114.81	36.86	393.11	45.79
Government	1,354	15.64	70.07	22.50	91.97	10.71
<b>Total</b>	<b>8,656</b>		<b>311.47</b>		<b>858.53</b>	

Source: Reclamation 2011

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

**Table 3.15-6. Summary of the Regional Economy for the Central Oregon Management Area (Coos, Douglas, and Lane Counties OR)**

Industry sector	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of total	\$ million	Percent of total	\$ million	Percent of total
Agriculture	8,718	3.38	273.06	2.68	865.38	3.11
Mining	449	0.17	23.57	0.23	92.68	0.33
Construction	12,681	4.91	547.94	5.39	1,451.52	5.22
Manufacturing	17,716	6.87	1,012.13	9.95	5,480.22	19.70
TIPU	6,726	2.61	332.09	3.27	1,070.39	3.85
Trade	37,815	14.65	1,259.06	12.38	2,657.42	9.55
Service	130,484	50.57	4,415.17	43.41	13,062.44	46.96
Government	43,459	16.84	2,307.17	22.69	3,134.82	11.27
<b>Total</b>	<b>258,048</b>		<b>10,170.19</b>		<b>27,814.87</b>	

Source: Reclamation 2011

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

**Table 3.15-7. Landings of Troll-Caught Chinook Salmon and Coho Salmon (# fish), 1981-2010, by Management Area**

Year(s)	Management Area							Total
	Monterey	San Francisco	Fort Bragg	KMZ-CA	KMZ-OR	Central OR	North OR	
81-85 Avg	85,260	186,680	124,320	124,020	61,320	170,560	190,200	942,360
86-90 Avg	146,460	360,480	278,380	56,120	33,920	385,940	351,700	1,613,000
91-95 Avg	137,720	205,480	14,760	1,540	1,000	36,820	128,240	525,560
96-00 Avg	156,305	195,662	12,529	3,505	3,542	36,042	89,479	497,064
01-05 Avg	64,827	210,228	96,466	12,401	5,245	117,529	151,698	658,393
06-10 Avg	5,330	24,806	7,906	1,752	1,188	7,736	11,598	60,315
2001	35,940	136,630	14,993	5,523	3,599	72,272	195,001	463,958
2002	69,980	242,872	65,336	13,467	6,803	122,174	162,415	683,047
2003	36,099	202,876	248,875	4,044	5,072	132,156	182,066	811,188
2004	64,707	298,229	107,259	31,915	8,484	140,142	100,965	751,701
2005	117,408	170,531	45,869	7,054	2,266	120,900	118,044	582,072
2006	11,204	47,689	10,835	0	738	1,979	21,759	94,204
2007	14,009	75,254	16,116	8,762	4,097	24,096	11,393	153,727
2008	0	0	0	0	236	208	76	520
2009	0	0	0	0	0	979	8,738	9,717
2010	1,435	1,086	12,577	0	869	11,418	16,022	43,407

Sources: PFMC as cited in Reclamation 2011, NOAA Fisheries Service 2011a. 2010 data are preliminary.

**Table 3.15-8. Landings of Troll-Caught Chinook Salmon and Coho Salmon (1000s of pounds dressed weight), 1981-2010, by Management Area**

Year(s)	Management Area							Total
	Monterey	San Francisco	Fort Bragg	KMZ-CA	KMZ-OR	Central OR	North OR	
81-85 Avg	748	1,849	1,218	967	495	1,140	1,080	7,497
86-90 Avg	1,601	3,700	2,434	624	537	2,765	2,259	13,920
91-95 Avg	1,350	1,949	194	31	32	339	869	4,764
96-00 Avg	1,699	2,155	146	37	92	435	861	5,425
01-05 Avg	756	2,704	1,268	149	204	1,124	1,605	7,810
06-10 Avg	54	318	163	24	40	86	156	841
2001	418	1,735	192	64	152	776	1,898	5,235
2002	912	3,060	872	162	218	1,223	1,722	8,169
2003	498	2,753	3,096	45	142	1,353	1,890	9,777
2004	853	3,712	1,292	373	267	1,214	1,256	8,967
2005	1,098	2,258	889	102	239	1,054	1,259	6,899
2006	87	684	273	0	45	56	290	1,435
2007	165	888	357	115	101	246	160	2,032
2008	0	0	0	0	8	0	20	28
2009	0	0	0	0	5	5	82	92
2010	20	16	187	4	43	122	226	618

Sources: PFMC as cited in Reclamation 2011, NOAA Fisheries Service 2011a. 2010 data are preliminary.

**Table 3.15-9. Ex-vessel Value of Troll-Caught Chinook Salmon and Coho Salmon (\$1000s, Base Year=2012), 1981-2010, by Management Area**

Year(s)	Management Area							Total
	Monterey	San Francisco	Fort Bragg	KMZ-CA	KMZ-OR	Central OR	North OR	
81-85 Avg	3,671	9,170	5,881	4,536	2,426	4,637	3,965	34,286
86-90 Avg	7,003	16,751	10,884	2,736	2,219	10,983	8,128	58,704
91-95 Avg	4,095	6,097	670	104	98	899	2,349	14,312
96-00 Avg	3,755	4,912	340	81	217	1,038	1,950	12,293
01-05 Avg	2,129	7,422	3,371	440	608	3,206	4,280	21,456
06-10 Avg	307	1,797	925	134	243	500	834	4,740
2001	1,051	4,362	483	161	311	1,586	3,878	11,832
2002	1,766	5,927	1,689	314	420	2,354	3,309	15,779
2003	1,164	6,432	7,233	105	342	3,260	4,539	23,075
2004	2,912	12,672	4,411	1,273	1,096	4,982	5,096	32,442
2005	3,754	7,719	3,039	349	872	3,846	4,577	24,156
2006	497	3,911	1,561	0	275	342	1,757	8,343
2007	925	4,981	2,002	645	607	1,451	789	11,400
2008	0	0	0	0	62	0	150	212
2009	0	0	0	0	27	11	188	226
2010	114	91	1,063	23	245	696	1,286	3,518

Sources: PFMC as cited in Reclamation 2011, NOAA Fisheries Service 2011a. 2010 data are preliminary.

In years where a stock fails to meet its conservation goal for three consecutive years, the Pacific Fishery Management Council declares a conservation concern, and the commercial fishery is closed or otherwise highly constrained, even in areas far removed from the stock's river of origin. Multiple conservation concerns over the past five years have led to record low landings and (in some years and management areas) unprecedented closures of the commercial fishery. In 2006, the failure of Klamath River fall Chinook salmon to meet its escapement floor<sup>1</sup> for the third consecutive year resulted in closure of the commercial salmon fishery in KMZ-CA and major restrictions elsewhere along the coast; landings in 2006 south of Cape Falcon fell to 14 percent of the 2001-2005 average. In 2008 and 2009, the commercial salmon fishery in California was closed statewide (the first time this had occurred in California history) and the Oregon fishery was significantly curtailed due to low escapement of Sacramento River fall Chinook. In 2010, the California commercial fishery reopened, but continuing concerns about Sacramento River fall Chinook salmon prompted restrictive regulations in both California and Oregon. The drastic fishery restrictions associated with the conservation concerns led to the provision of disaster relief for salmon-dependent fishing communities, as described in Chapter 1.

### **3.15.3.3 Recreation**

The area of analysis for recreation includes Curry, Jackson and Klamath Counties in Oregon and Del Norte, Humboldt, and Siskiyou Counties in California. The Klamath Basin offers a myriad of outdoor recreational opportunities. Section 3.20, Recreation, describes recreation activities within the Basin. Recreation is an important asset to the regional economy because it attracts visitors from outside the region that spend money and generate economic activity locally. Recreation expenditures and economic activity generally increase with visitation levels. If recreational opportunities are adversely affected, recreational expenditures may decrease and affect the local economy, unless recreational participants engage in substitute or alternative opportunities in the region. This section describes how existing recreational activities within the Klamath Basin contribute to the regional economy. The affected area for potential economic effects associated with recreation depends on the recreation activity. The following sections identify the potentially affected area for each activity.

#### **Reservoir**

In the area of analysis, economic effects could occur to reservoir-based recreation at J.C. Boyle, Copco 1, and Iron Gate Reservoirs in Klamath and Siskiyou Counties. Copco 2 Reservoir does not generate significant recreation activity. Table 3.15-1 summarizes the 2009 regional economy for Siskiyou and Klamath Counties. Employment, labor income, and output related to reservoir recreation are reflected in the services and trade sectors in the table. Section 3.20.3 describes existing recreation opportunities and existing use at the reservoirs. Visitors go to the reservoir areas for overnight and day uses, and activities generally include sightseeing, camping, boating, fishing, picnicking and hiking.

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<sup>1</sup> Escapement floor is set by the PFMC as the minimum number of salmonids that are not harvested in ocean and in river fisheries and return to the river for spawning.

Reservoir-based recreation attracts visitors from outside the region; these visitors spend money at local stores, gas stations, and other businesses, contributing to the local economy.

### **Ocean Sport Fishing**

The ocean sport fishing information provided here is taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011h). The area of analysis for ocean sport fishing includes Curry County, Oregon and Del Norte and Humboldt Counties in California. Klamath River fall Chinook salmon is harvested in sport as well as commercial fisheries. About 91 percent of the increase in angler expenditures attributable to the project alternatives occurs in the KMZ-CA and KMZ-OR management areas; therefore, these two areas are the focus of this ocean sport fishing analysis. Tables 3.15-4 and 3.15-5 summarize the 2009 regional economy in those areas. Employment, labor income, and output related to ocean sport fishing are reflected in the services sectors in the tables.

While recreational fishery regulations such as closed seasons are generally more stringent in the KMZ, they may also become more constraining in other management areas south of Cape Falcon when Klamath River fall Chinook salmon is at low levels of abundance. Tables 3.15-10 and 3.15-11 summarize recreational effort (angler days) and landings in the KMZ and other management areas south of Cape Falcon. Effort and landings in all areas have generally declined from the 1980s to the 1990s. Factors contributing to this decline include more conservative management policies to protect weak stocks (including two Chinook salmon and three coho salmon stocks listed under the ESA), and a 1993 opinion by the Department of the Interior Solicitor reserving 50 percent of Klamath-Trinity River salmon for the Yurok Tribe and Hoopa Valley Tribe. Effort and landings rebounded during 2001-2005. However, regulation of the recreational fishery has been unusually restrictive over the past five years, due to the failure of Klamath River fall Chinook salmon to meet its conservation objective during 2004-2006 and failure of Sacramento River fall Chinook salmon to meet its conservation objective during 2007-2009. The restrictions triggered by Sacramento River fall Chinook salmon concerns were particularly stringent, including near-closure of the California fishery in 2008-2009 and additional restrictions in Oregon as well.

**Table 3.15-10. Ocean Sport Salmon Effort (# angler days) during 1981-2010, by Management Area**

Year(s)	Management Area							Total
	Monterey	San Francisco	Fort Bragg	KMZ-CA	KMZ-OR	Central OR	North OR	
81-85 Avg	12,220	78,920	9,560	46,260	56,260	63,720	87,560	354,500
86-90 Avg	49,180	98,580	15,420	77,500	58,380	61,360	103,640	464,060
91-95 Avg	71,240	92,800	20,360	29,100	22,720	25,960	38,520	300,700
96-00 Avg	63,020	94,000	19,140	18,540	18,360	8,260	13,480	234,800
01-05 Avg	47,340	83,560	28,220	21,000	18,300	34,520	48,760	281,700
06-10 Avg	14,320	24,700	9,040	9,300	7,720	14,120	32,660	111,860
2001	38,100	71,500	30,800	24,700	26,100	31,100	40,100	262,400
2002	67,900	88,800	31,800	21,600	19,700	33,400	42,400	305,600
2003	28,500	66,600	23,700	15,800	14,800	42,900	67,500	259,800
2004	56,500	106,100	30,500	25,600	18,300	40,500	68,300	345,800
2005	45,700	84,800	24,300	17,300	12,600	24,700	25,500	234,900
2006	27,700	61,300	21,000	16,400	10,700	17,200	26,300	180,600
2007	25,200	43,100	17,100	20,500	11,100	22,900	41,900	181,800
2008	0	0	400	0	4,800	7,400	14,600	27,200
2009	0	0	0	5,400	6,000	14,400	52,000	77,800
2010	18,700	19,100	6,700	4,200	6,000	8,700	28,500	91,900

Sources: PFMC as cited in Reclamation 2011, NOAA Fisheries Service 2011h. 2010 data are preliminary.

**Table 3.15-11. Ocean Sport Chinook Salmon and Coho Salmon Landings (# fish) during 1981-2010, by Management Area**

Year(s)	Management Area							Total
	Monterey	San Francisco	Fort Bragg	KMZ-CA	KMZ-OR	Central OR	North OR	
81-85 Avg	6,720	86,800	4,380	34,680	28,460	60,420	70,620	292,080
86-90 Avg	30,400	99,960	10,800	65,680	37,660	74,080	112,860	431,440
91-95 Avg	58,260	93,460	18,620	21,060	10,840	37,840	44,140	284,220
96-00 Avg	52,345	82,804	14,414	8,631	6,178	3,961	5,913	174,246
01-05 Avg	31,408	77,653	24,008	15,885	7,349	27,255	45,485	229,043
06-10 Avg	4,809	15,719	4,378	7,479	2,356	7,655	23,316	65,712
2001	20,256	40,345	26,501	13,010	7,277	28,849	43,613	179,851
2002	47,729	87,308	31,409	16,426	10,042	24,817	32,001	249,732
2003	13,286	56,823	16,289	8,889	5,499	39,125	77,588	217,499
2004	44,863	130,690	23,581	23,404	8,112	30,880	64,595	326,125
2005	30,905	73,097	22,259	17,695	5,817	12,606	9,627	172,006
2006	11,308	55,598	14,368	16,644	2,473	8,783	9,989	119,163
2007	6,381	17,000	5,772	19,297	4,619	14,150	29,834	97,053
2008	0	0	6	0	2,414	3,738	4,503	10,661
2009	0	0	0	680	1,392	9,979	59,417	71,468
2010	6,356	5,995	1,743	774	884	1,623	12,835	30,210

Sources: PFMC as cited in Reclamation 2011, NOAA Fisheries Service 2011h. 2010 data are preliminary.

Angler trips occur on both private and charter vessels. Charter vessels are typically run by local companies that advertise and sell fishing trips to visitors or residents. Private vessels are privately owned boats and owners do not sell trips. The majority of trips from all ports are on private vessels. From 2001 to 2010, trips on charter vessels averaged 25 percent of total salmon angler trips south of Cape Falcon, 7 percent in the KMZ-CA (excluding 2008, when the KMZ-CA was closed), and 3 percent in the KMZ-OR.

**In-River Sport Fishing**

The in-river sport fishing information provided here is taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011g). In-river Chinook salmon fishing on the Klamath River occurs in Siskiyou, Humboldt, and Del Norte Counties in California. Under the project alternatives, Chinook salmon would be reintroduced in the Upper Basin (Klamath County, Oregon). Table 3.15-12 summarizes the combined regional economy for these four counties. Employment, labor income, and output related to fishing are reflected in the services and trade sectors in the table.

Table 3.20-12 provides recent harvest and effort data for the Klamath River Chinook salmon fishery downstream of Iron Gate Dam. Angler days averaged about 23,809 per year during 2001-2005 and 16,792 during 2006-2010.

**Table 3.15-12. Summary of the Regional Economy for Del Norte, Humboldt and Siskiyou Counties in California and Klamath County, OR**

Industry sector	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of total	\$ million	Percent of total	\$ million	Percent of total
Agriculture	5,713	4.77	219.03	4.46	910.68	7.29
Mining	127	0.11	5.58	0.11	23.06	0.18
Construction	5,845	4.88	282.12	5.74	707.41	5.66
Manufacturing	5,086	4.24	261.96	5.33	1,501.95	12.02
TIPU	3,887	3.24	215.09	4.38	759.63	6.08
Trade	17,471	14.58	601.06	12.24	1,232.50	9.86
Service	53,659	44.78	1,835.74	37.38	5,459.12	43.68
Government	28,049	23.41	1,490.23	30.35	1,904.47	15.24
<b>Total</b>	<b>119,837</b>		<b>4,910.81</b>		<b>12,498.82</b>	

Source: Reclamation 2011.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

Another popular Klamath River recreational fishery is the steelhead fishery, which also occurs in Siskiyou, Humboldt and Del Norte Counties. Analysis of data from steelhead

report cards collected by the California Department of Fish and Game suggest that approximately 17,155 angler trips occurred annually on the Klamath River during 2003-2008 (Table 3.20-13). This should be interpreted as a conservative estimate of effort, as the report card requirement extends only to steelhead greater than 16 inches and thus provides limited coverage of the half-pounder fishery.

A trophy fishery for redband trout occurs in Klamath County in Upper Klamath Lake, lower Williamson River, Wood River, and the Keno Reach of the Klamath River. According to results of a statistical creel survey conducted by Oregon Department of Fish and Wildlife, about 15,191 angler trips (6,109 bank trips, 9,082 boat trips) occurred in Upper Klamath Lake and Agency Lake during March 18-September 30, 2009 . This estimate should be viewed as conservative, as the creel survey did not cover an entire year of lake fishing and did not include angler effort in the tributaries above Upper Klamath Lake or the mainstem Klamath River below Keno Dam.

### **Whitewater Boating**

The affected region for whitewater boating on the Upper Klamath and Lower Klamath River reaches includes Jackson, Klamath, Siskiyou, and Humboldt Counties. Jackson County, which includes the urban Medford area, contributes substantially to the regional economy for whitewater boating. Many commercial outfitters are based in Jackson County. The Upper Klamath River is defined as the section of the Klamath River upstream of Iron Gate Dam and the Lower Klamath River starts downstream of the Iron Gate Dam. Table 3.15-13 summarizes the 2009 economy in the four-county region. Employment, labor income, and output related to whitewater boating are reflected in services and trade sectors in the table.

**Table 3.15-13. Summary of the 2009 Regional Economy for Klamath, Jackson, Humboldt, and Siskiyou Counties**

Industry Sector	Employment <sup>1</sup>		Labor Income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of Total	\$ (million)	Percent of Total	\$ (million)	Percent of Total
Agriculture	8,337	3.7	306.8	3.5	1,078.2	4.6
Mining	324.7	0.1	12.5	0.1	54.8	0.2
Construction	16,545	7.4	632.9	7.3	1,782.0	7.6
Manufacturing	10,604	4.7	540.8	6.2	3,225.9	13.8
TIPU	7,746	3.4	411.9	4.7	1,400.3	6.0
Trade	37,272	16.6	1,187.9	13.7	2,591.3	11.1
Service	108,382	48.2	3,642.6	42.0	10,690.4	45.8
Government	35,456	15.8	1,946.5	22.4	2,507.6	10.7
Total	224,667	--	8,681.9	--	23,330.5	--

Source: Reclamation 2011.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

Section 3.20, Recreation, describes whitewater boating activities on the Klamath River, including annual estimates for number of visitors. Many visitors are from San Francisco Bay Area, southern California, northern Oregon, and other parts of the western U.S. (PacifiCorp 2004). Boating trips can be one- or multi-day trips and typically run from May through October. Multiple outfitters in the region organize and guide boating trips. Tables 3.15-14 and 3.15-15 provide an estimate of commercially guided whitewater boating trips on the Upper and Lower Klamath River, respectively. The estimate of commercially guided trips is based on Bureau of Land Management and United States Forest Service trip card data files (2010). Trip cards are required to be submitted by permitted commercial outfitters when they provide a guided whitewater boating trip on the Klamath River. The whitewater boating outfitters provide jobs to people living in the region.

**Table 3.15-14. Commercially Guided Whitewater Boating Trips on Upper Klamath River from 2001 to 2009**

Year	Trip Length in Days				Total
	1 Day	2 Days	3 Days	4 Days	
2001	274	17	5	0	296
2002	283	20	2	0	305
2003	248	20	1	1	270
2004	306	31	2	0	339
2005	317	27	0	0	344
2006	243	27	4	0	274
2007	276	28	1	0	305
2008	248	20	1	0	269
2009	220	7	1	0	228
Total	2,415	197	17	1	2,630

*Source: Bureau of Land Management 2010, United States Forest Service 2010 as cited in United States Department of the Interior (DOI) 2011b*

**Table 3.15-15. Commercially Guided Whitewater Boating Trips on Lower Klamath River from 2000 to 2009**

Year	Trip Length in Days									Total
	1 Day	2 Days	3 Days	4 Days	5 Days	6 Days	7 Days	8 Days	9 Days	
2000	254	48	80	13	7	1	1	0	0	404
2001	309	68	68	28	3	1	0	0	0	477
2002	242	49	68	10	6	1	1	0	0	377
2003	301	55	57	21	6	1	2	0	0	443
2004	224	47	55	13	6	1	0	1	1	348
2005	366	48	58	15	5	0	0	0	0	492
2006	230	33	44	8	1	2	0	0	0	318
2007	255	47	45	12	1	0	1	3	0	364
2008	237	26	38	18	2	0	0	0	0	321
2009	235	27	44	11	4	1	1	0	0	323
Total	2,653	448	557	149	41	8	6	4	1	3,867

Source: Bureau of Land Management 2010, United States Forest Service 2010 as cited in DOI 2011b

Table 3.15-16 provides an estimate of whitewater boating user days for the Klamath River from 1994 through 2009. A user day is defined as one user engaging in whitewater boating for any part of a day. For example, three people taking a two day whitewater boating trip would equate to six user days (3 users x 2 days: 6 user days). Analysis of data presented in PacifiCorp (2004) show that on average an estimated 93 percent of the total user days for the Upper Klamath are associated with commercial use and 70 percent of total user days for the Lower Klamath are associated with commercial use. These percentages were applied to the estimates of commercial use from 2001 through 2009 to derive estimates of total and private use over this same time period.

**Table 3.15-16. Whitewater Boating User Days on the Klamath River from 1994 to 2009**

Year	Upper Klamath River			Lower Klamath River			Klamath River		
	Commercial	Private	Total	Commercial	Private	Total	Commercial	Private	Total
1994	4,471	735	5,206	8,491	3,639	12,130	12,962	4,374	17,336
1995	5,763	602	6,365	12,203	5,230	17,433	17,966	5,832	23,798
1996	5,963	244	6,207	10,280	4,406	14,686	16,243	4,650	20,893
1997	5,509	317	5,826	10,529	4,512	15,041	16,038	4,829	20,867
1998	4,081	314	4,395	11,298	4,842	16,140	15,379	5,156	20,535
1999	4,614	283	4,897	11,885	5,094	16,979	16,499	5,377	21,876
2000	5,100	269	5,369	10,449	4,478	14,927	15,549	4,747	20,296
2001	3,290	243	3,533	10,744	4,605	15,349	14,034	4,848	18,882
2002	3,369	249	3,618	9,783	4,193	13,976	13,152	4,442	17,594
2003	3,075	228	3,303	11,143	4,776	15,919	14,218	5,003	19,221
2004	3,800	281	4,081	9,708	4,161	13,869	13,508	4,442	17,950
2005	3,638	269	3,907	10,695	4,584	15,279	14,333	4,853	19,186
2006	3,714	275	3,989	8,226	3,525	11,751	11,940	3,800	15,740
2007	3,505	259	3,764	8,879	3,805	12,684	12,384	4,065	16,449
2008	3,335	247	3,582	8,643	3,704	12,347	11,978	3,951	15,929
2009	2,405	178	2,583	8,230	3,527	11,757	10,635	3,705	14,340
Average (1994-2009)	4,102	312	4,414	10,074	4,317	14,392	14,176	4,630	18,806

Source: PacifiCorp 2004 for the Upper Klamath for 1994 to 2000 (based on figures reported in Table 2.7-41) and Payne 2009 Lower Klamath for 1994 to 1999 as cited in DOI 2011b

**3.15.3.4 Indian Tribes**

Section 3.16, Environmental Justice, presents demographic and socioeconomic conditions for Indian Tribes in the Klamath Basin. Five of the six federally recognized tribes in the Klamath Basin are potentially affected by the project alternatives. Table 3.15-17 summarizes income, poverty, and unemployment statistics for those tribes. The table and all other tribal information provided here are taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011b-f).

For the tribes of the Klamath Basin, fish are integral to a world view that emphasizes interconnectedness, balance, and mutual respect as guiding principles. The diversity, abundance, distribution, run timing and health of fish are important indicators of how well such balance is being maintained. The seasonal round of harvest provides sustained access to food that is synchronous with the cycles of nature. Fish are honored in rituals such as the First Salmon Ceremony and (for the Klamath Tribes) the Return of the C’waam, which traditionally precede the commencement of fishing for spring Chinook salmon and suckers respectively. Fishing itself is a social and cultural activity – an opportunity to meet with family and friends; to engage in traditional fishing practices; to strengthen community bonds, demonstrate respect and promote food security by sharing fish with elders and others who are unable to fish; and to transmit these traditions to the next generation. Trade and barter occur both within and between tribes as a means of increasing access to fish and other valued goods, and cementing social relationships.

**Table 3.15-17. Income, Poverty and Unemployment for Affected Federally Recognized Tribes**

<b>Tribes</b>	<b>1999 Median Personal Income (dollars)<sup>1</sup></b>	<b>1999 Individuals below Poverty Level (percent)<sup>1</sup></b>	<b>2005 Unemployment Rate (percent)<sup>2</sup></b>
The Klamath Tribes	8,646	40.4	21
Karuk Tribe	4,938	53.9	63
Hoopa Valley Indian Reservation	9,757	34.4	40
Yurok Reservation	6,839	39.7	74
Resighini Rancheria	6,925	NA	60

*Based on the following sources, as cited in Reclamation 2011 and NOAA Fisheries Service 2011b-f:*

- 1 - U.S. Census Bureau 2000. Income and poverty statistics based on available data as follows: Indians residing in Chiloquin, Oregon used to represent The Klamath Tribes; Resighini Rancheria residents (whether Indian or not) used to represent Resighini Rancheria members; Indians residing on the Karuk, Hoopa Valley and Yurok Indian Reservations used to represent members of the Karuk, Hoopa Valley, and Yurok Indian Tribes respectively.
- 2 - Bureau of Indian Affairs 2005. The unemployment rates provided by the Bureau of Indian Affairs (BIA) pertain to the percentage of adults who are available for work but unemployed, regardless of whether or not they have recently looked for work. These rates differ from and are therefore not comparable to the unemployment rates estimated by the Bureau of Labor Statistics for the general population.

Note: Quartz Valley is not included in the table because the project alternatives would have no direct effects on Quartz Valley and that tribe is not claiming any effects (positive or negative).

Table 3.15-18 summarizes harvests since 1981 by the Yurok Tribe and Hoopa Valley Tribe for commercial, subsistence and ceremonial purposes. The average harvest in the 1990s was much lower than the 1980s and 2000s. Annual harvests over the last decade were lowest in 2005 and 2006 and highest in 2001. For these two tribes, harvest opportunities over the last few decades are much lower than they were historically.

**Table 3.15-18. Yurok and Hoopa Valley Reservation Indian Tribes Gillnet Chinook Salmon Spring and Fall Run Harvest (# fish) from 1981 to 2010.**

Year	Klamath River	Trinity River	Total
1981–1990 Average	26,466	4,527	30,992
1991–2000 Average	17,130	3,200	20,905
2001	49,460	9,224	58,684
2002	35,508	4,328	39,836
2003	33,973	5,170	39,143
2004	30,938	3,715	34,653
2005	5,754	4,295	12,277
2006	9,111	5,996	15,107
2007	29,790	3,653	33,443
2008	22,869	3,471	26,340
2009	26,040	6,087	32,127
2010 <sup>1</sup>	26,620	5,814	32,434
2001-2010 Average	27,006	5,175	32,404

Sources: PFMC as cited in Reclamation 2011, NOAA Fisheries Service 2011b, 2011f

Notes:

1. 2010 data are preliminary

For other tribes in the Klamath Basin (who fish for subsistence and ceremonial purposes), harvest opportunities for salmonids and other fish have declined to lower levels than those experienced by the Yurok and Hoopa Valley Tribes. For The Klamath Tribes, despite the Treaty of 1864 which reserved fishing rights, their anadromous fisheries were eliminated in 1917 when Copco 1 Dam was constructed without fish ladders. Two other fisheries that had sustained the Tribes were eliminated in 1986 when the Klamath Tribes closed their fisheries for c'wam (Lost River sucker) and qapdo (shortnose sucker) to prevent extinction; both fish were listed as Endangered in 1988. For the Karuk Tribe, current harvest opportunities are limited to a short season at Ishi Pishi Falls. Members of the Resighini Rancheria historically fished and continue to attach cultural and subsistence value to fishing, although their current fishing opportunities are minimal. Section 3.12, Tribal Trust, describes the cultural role of fisheries for the tribes.

### **3.15.3.5 PacifiCorp Hydroelectric Service**

PacifiCorp operates and maintains hydroelectric power plants at the Four Facilities. Operation and maintenance of the facilities provides employment and incomes in Siskiyou and Klamath Counties.

PacifiCorp provides electricity to about 1.7 million customers in six western states, including residential and commercial customers in southern Oregon and northern California (PacifiCorp 2004). Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste, and Power, further describes PacifiCorp hydroelectric facilities

and service. PacifiCorp is subject to regulations established by utility authorities in each state, which influences operations, customer rates, and cost recovery. PacifiCorp sets customer rates based on multiple factors, including energy prices, future demands, resource adequacy, overhead costs, and long-term investments. PacifiCorp uses customer rates to recover a portion of operating and investment costs. If expenditures are not directly offset by any associated project revenues or cost reductions, the utility's rates increase, subject to regulatory approvals.

#### **3.15.3.6 Real Estate, Property Tax and Other County Revenues**

Establishment of the Copco Dams in the early 1900's and the Iron Gate Dam in the 1960's created reservoirs behind the dams. The reservoirs were opened to the general public and are used for recreational purposes. These recreational uses over time have led to light residential development of some of the privately held real estate surrounding the reservoirs.

At Iron Gate Reservoir, the majority of the land around the reservoir is held by PacifiCorp, and much of the area along the shoreline is designated for recreation use. Private parties do not own any properties that front the reservoir. Iron Gate Lake Estates has five units that have full or partial views of the reservoir. Some parcels outside of Iron Gate Lake Estates have partial views of the reservoir.

Some parcels have views of Copco 1 and Copco 2 Reservoirs. Most of these sites are along the southern shore of the reservoir along Patricia Avenue and Ager Beswick Road. Of the properties that front the reservoir, a few properties have relatively level sites, but most are elevated from the lakeshore water level and have steep terrain to access the reservoir. Properties across the roads have obstructed views due to terrain and heavy tree cover. Where the Klamath River enters Copco Reservoir, some parcels front the river along Copco Road and have views of the river.

PacifiCorp owns all land surrounding J.C. Boyle Reservoir in Klamath County; this land is zoned as rural industrial. Land outside of PacifiCorp's ownership boundary is zoned as forestry with some public lands. Figure 3.14-4 in Section 3.14, Land Use, Agricultural and Forest Resources, shows land ownership around J.C. Boyle Reservoir. There are no private properties with views of the reservoir; therefore, private property land values at J.C. Boyle Reservoir would not be affected by the Proposed Action and alternatives, and are not further analyzed.

Siskiyou and Klamath Counties' receive tax revenues from multiple tax accounts, including property taxes paid by PacifiCorp and landowners, and sales and use tax. The counties use tax receipts for the general fund, which funds many county programs, such as health, education, public assistance, fire and emergency services, and recreation. Taxes are generated through multiple tax accounts.

Siskiyou County provided tax revenue data to the Lead Agencies. Table 3.15-19 summarizes Siskiyou County revenues from tax accounts over a 10-year period, which accounts for normal market fluctuations. On average, from 2000 to 2010, Siskiyou

County received a majority of the total Siskiyou County revenue from property tax and sales and use tax. The remaining accounts provided 0.1 to 3.4 percent of county revenue, on average.

**Table 3.15-19. Siskiyou County Average Tax Revenues from 2000 to 2010**

Account Description <sup>1</sup>	2000–2010 Annual Average	
	Revenues	Percentage of Total Revenue
<b>Property Taxes</b>		
Prior Secured	\$532,851	3.4%
Prior Supplemental	\$19,963	0.1%
Prior Unsecured	\$10,529	0.1%
Secured	\$8,745,403	53.0%
Current Unsecured	\$535,829	3.3%
Supplemental	\$333,962	2.0%
<b>Property Transfer Tax</b>	\$198,111	1.2%
<b>Race Horse Tax</b>	\$167	0.0%
<b>Sales &amp; Use Tax</b>	\$4,757,226	29.7%
<b>Hotel – Motel Tax</b>	\$438,865	2.7%
<b>Local Transportation</b>	\$276,582	1.7%
<b>Timber Yield</b>	\$391,581	2.5%
<b>Triple Flip</b>	\$207,857	1.1%

Source: Siskiyou County 2011a

Notes

1- Property taxes include the following accounts: secured, current unsecured, supplemental, prior secured, prior unsecured, and prior supplemental

PacifiCorp pays property taxes to Siskiyou County on land owned at the Klamath Hydroelectric Project facilities. Siskiyou County received an average of \$1.4 million from PacifiCorp property taxes annually (Table 3.15-20) over 2000 to 2010. In 2008 and 2009, PacifiCorp indicated that \$305,000 and \$290,000 of property taxes were associated with hydroelectric facilities (PacifiCorp 2009). The variation in tax payments indicated between years in table 3.15-20 was driven by an increase in investment in operating property in Siskiyou County, which has lead to an increase in assessment on property subject to tax.

**Table 3.15-20. Siskiyou County Annual Tax Amount Received from PacifiCorp from 2000 to 2011**

Tax Year	Tax Amount
2000-2001	\$1,257,537
2001-2002	\$1,187,891
2002-2003	\$1,180,011
2003-2004	\$1,178,678
2004-2005	\$1,184,970
2005-2006	\$1,210,490
2006-2007	\$1,285,173
2007-2008	\$1,513,189
2008-2009	\$1,637,105
2009-2010	\$1,798,210
2010-2011 <sup>1</sup>	\$1,746,074

Source: *Siskiyou County 2011b*

Notes

1. Includes 2nd installment which County will receive in April 2011

In fiscal year 2009–2010, Siskiyou County dispersed property taxes to the following: schools (68.04 percent), county (21.33 percent), cities (6.03 percent), and special districts (4.60 percent). Special districts include cemetery, fire, recreation, community service, flood control, county service, and sanitary districts. Of the 6.03 percent that went to cities, Yreka received 2.2 percent, Mt. Shasta received 1.2 percent, Weed received 0.9 percent, Dunsuir received 0.6 percent, and the remaining cities all received less than 0.35 percent (Siskiyou County 2010).

In 2008, property taxes levied in Klamath County were about \$57.2 million. The majority of taxes were from residential ownership (\$28.5 million). Utilities contributed about 14.7 percent to total property taxes, about \$8.4 million in 2008 (Klamath County Assessor 2008). PacifiCorp pays property taxes to Klamath County on land owned at the Klamath Hydroelectric Project facilities. In 2010-2011, Klamath County anticipates to receive about \$519,000 in property tax revenues from PacifiCorp (Turner 2011).

In Klamath County, property taxes are used to finance local governments, such as cities, school districts, fire districts, park districts, vector control districts, road districts, cemetery districts, sanitary districts, and special districts.

Klamath and Siskiyou Counties also receive funding from Federal sources. The counties received Recovery Act funds to stimulate spending during the economic recession. As of February 2011, Siskiyou County received \$63.5 million and Klamath County received \$55.9 million (Recovery.Gov 2011). Appendix O includes a summary of Recovery Act funds.

**3.15.3.7 Irrigated Agriculture**

Reclamation’s Klamath Project delivers water to approximately 200,000 farmland acres and 35,000 wetland acres in Klamath, Siskiyou, and Modoc Counties, primarily along the California-Oregon border. Table 3.15-21 provides a summary of the regional economy in Klamath County, Oregon and Siskiyou and Modoc Counties, California. The agricultural sector was 7.3 percent of total regional employment, 6.0 percent of the regional labor income and 10.2 percent of output.

**Table 3.15-21. Summary of the 2009 Regional Economy for Klamath, Modoc, and Siskiyou Counties**

Industry Sector	Employment <sup>1</sup>		Labor Income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent of Total	\$ (million)	Percent of Total	\$ (million)	Percent of Total
Agriculture	3,803	7.3	124.2	6.0	560.9	10.2
Mining	85	0.2	3.3	0.2	16.1	0.3
Construction	2,358	4.5	99.3	4.8	265.5	4.8
Manufacturing	2,629	5.0	135.9	6.5	706.1	12.8
TIPU	2,122	4.1	118.1	5.7	426.3	7.8
Trade	7,272	13.9	237.7	11.4	491.6	8.9
Service	22,421	43.0	752.2	36.1	2,245.1	40.8
Government	11,452	22.0	611.8	29.4	785.7	14.3
Total	52,142	--	2,082.5	--	5,497.3	--

Source: Reclamation 2011.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

Table 3.15-22 summarizes crops grown and acreages in Reclamation’s Klamath Project. Alfalfa, pasture, and wheat have the most irrigated acreage.

**Table 3.15-22. Crop Acreage Summary for Irrigated Agriculture in Reclamation's Klamath Project Lands (acres)**

Crops	2005	2006	2007	2008	2009	Average
Small Grains						
Feed Barley	10,962	13,674	14,083	11,827	8,430	11,795
Malt Barley	0	278	0	4,389	3,513	1,636
Wheat						
Wheat	31,716	24,163	22,172	27,290	31,563	27,381
Oats	2,679	3,334	2,947	2,774	2,809	2,909
Other Cereals	1,006	617	600	247	834	661
Corn	0	12	42	7	5	13
Alfalfa						
Alfalfa	55,197	61,619	65,851	63,701	61,336	61,541
Other Hay	21,032	18,968	17,082	15,710	15,918	17,742
Silage	875	1,000	0	150	400	485
Irrigated Pasture						
Irrigated Pasture	40,046	42,880	43,409	44,846	44,564	43,149
Other Forage	0	93	145	0	0	48
Potatoes						
Chip Potatoes	7,450	5,890	2,640	2,430	6,688	5,020
Fresh Potatoes	3,727	9,549	8,941	9,556	5,951	7,545
Potato Seed	250	430	280	140	150	250
Onions						
Onions	2,863	3,239	3,618	3,441	3,533	3,339
Peppermint	2,394	2,922	2,846	2,682	3,200	2,809
Horseradish	913	734	810	436	421	663
Strawberry	413	259	176	536	505	378
Other	72	423	591	345	258	338
Fallow	11,711	5,949	7,746	6,500	4,962	7,374
<b>Total</b>	<b>193,306</b>	<b>196,033</b>	<b>193,979</b>	<b>197,007</b>	<b>195,040</b>	<b>195,073</b>

Source: Reclamation 2011b.

For analysis purposes, crops in Table 3.15-22 are aggregated based on the availability of data on crop prices, production costs, and yields and each group is assigned a representative crop. Table 3.15-23 shows prices of the representative crops. Prices vary annually based on market conditions.

Table 3.15-24 shows gross farm revenues, based on crop yields and prices. Alfalfa had the highest gross revenue of the crops, likely a result of the consistently high percentage of the land base dedicated to the crop and the relatively high price of alfalfa per ton. Potatoes and onions also had high gross revenues related to other crops. The onions group, as shown in Table 3.15-22, contains a number of other vegetables and specialty crops that have had increasing amounts of acreage in past years.

**Table 3.15-23. Representative Crop Prices from 2005 to 2009**

Year	Small Grains	Wheat	Irrigated Pasture	Potato	Onions	Alfalfa
	\$/Ton	\$/Ton	\$/AUM	\$/Ton	\$/Ton	\$/Ton
2005	82.00	103.47	14.50	159.89	99.00	128.94
2006	120.00	136.06	15.40	99.43	99.00	135.00
2007	164.99	272.00	16.50	129.36	110.00	140.00
2008	300.02	225.00	16.50	155.96	126.00	200.00
2009	300.02	200.24	17.80	127.57	128.60	154.71
Average	193.41	187.35	16.14	134.44	112.52	151.73

Sources: Reclamation 2011b.

Key:

AUM: annual unit month

**Table 3.15-24. Average Gross Farm Revenue Generated on Reclamation’s Klamath Project Lands from 2005 to 2009**

Representative Crop	Gross Revenue (\$1,000)	Gross Revenue per Acre (\$/acre) <sup>1</sup>
Alfalfa Hay	\$58,769.60	\$736.76
Irrigated Pasture	\$6,996.10	\$161.96
Onions	\$21,108.20	\$2,804.33
Potato	\$39,910.10	\$3,114.33
Small Grain	\$4,706.10	\$350.39
Wheat	\$17,119.20	\$552.87
Total Gross Revenue	\$148,609.40	--

Source: Klamath Basin Hydro-Economic Model (KB\_HEM) , as cited in Reclamation 2011b

1 – Gross revenue per acre based on average acreages in Table 3.15-22

### 3.15.3.8 Refuge Recreation

Reclamation’s Klamath Project provides water supply to the Tule Lake National Wildlife Refuge (NWR) and Lower Klamath NWR. The refuges attract visitors to Klamath and Siskiyou Counties for hunting and wildlife viewing. Table 3.15-1 presents a summary of regional economy in Klamath and Siskiyou Counties. Employment, labor income, and output related to refuge recreation are reflected in services and trade sectors in the table. In 2009, the two refuges reported a combined total of 96,300 wildlife watching visits and 10,526 hunting visits. In general, visitation to the refuges has been declining over the past decade.

### 3.15.4 Environmental Consequences

For purposes of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR), economic or social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project. Since economic effects of the project are related to physical environmental effects, a National Environmental Policy

Act (NEPA) economic analysis is required. However, NEPA does not require that economic effects be judged for significance. The California Environmental Quality Act (CEQA) does not consider economic or social changes resulting from a project as adverse effects on the environment. If a physical change in the environment is caused by economic or social effects, the physical change may be regarded as an adverse effect. Physical effects of the project alternatives are evaluated separately and do not require economic analysis; therefore, CEQA analysis and associated significance criteria are not required. The following sections describe analysis methods and potential economic effects of the project alternatives.

#### **3.15.4.1 Effects Determination Methods**

The modeling package used to assess the regional economic impacts from the expenditures associated with each alternative was IMPLAN (IMpact analysis for PLANning). IMPLAN is an economic input-output modeling system that estimates the effects of economic changes in a defined analysis area.

IMPLAN is a static model that estimates impacts for a snapshot in time when the impacts are expected to occur, based on the makeup of the economy at the time of the underlying IMPLAN data (2009 data is used for this analysis). IMPLAN measures the initial impact to the economy but does not consider long-term adjustments as labor and capital move into alternative uses. This approach is used to compare the alternatives. Realistically, the structure of the economy will adapt and change; therefore, the IMPLAN results can only be used to compare relative changes between the No Action/No Project Alternative and the action alternatives and cannot be used to predict or forecast future employment, labor income, or output (sales).

Input-output models measure commodity flows from producers to intermediate and final consumers. Purchases for final use (final demand), or direct effects, are inputs into the model and drive the results. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the analysis area (imports and value added) stop the cycle. These indirect and induced effects (the effects of household spending) can be mathematically derived using a set of multipliers. The multipliers describe the change in output for each regional industry caused by a 1-dollar change in final demand. Multipliers are built into IMPLAN.

This analysis used 2009 IMPLAN data for the counties which encompass the economic regions. IMPLAN data files for the analysis area are compiled from a variety of sources including, but not limited to, the U.S. Bureau of Economic Analysis (BOE), the U.S. Bureau of Labor (BOL), and the U.S. Census Bureau.

Methods and assumptions for the regional impact analysis are further described in Reclamation 2011. The following sections identify specific technical reports as relevant. This section presents the total economic effects of the project alternatives. Total effects are equal to the sum of direct, indirect, and induced effects, described above.

Regional economic total effects are presented in terms of employment, labor income, and output. IMPLAN defines these parameters as follows:

- Employment – Number of jobs, a job can be full-time, part-time, or temporary.
- Labor Income - All forms of employment income, including employee compensation (wages and benefits) and proprietor income.
- Output - Value of industry production. In IMPLAN these are annual production estimates for the year of the data set.

Using IMPLAN, this section presents quantified results for regional economic effects from changes in expenditures or revenues associated with:

- Dam decommissioning, operation and maintenance (O&M), mitigation
- Commercial fishing
- Reservoir recreation
- Ocean sport fishing
- In-river sport fishing
- Whitewater recreation
- Klamath Basin Restoration Agreement (KBRA) Fisheries, Water Resources and Tribal Programs
- Irrigated agriculture related to KBRA actions
- Refuge recreation related to KBRA actions

The KHSA Section 3.2.1(iii), signed by Secretary of the Interior Ken Salazar on February 18, 2010, directs the Secretary to undertake environmental review in support of the Secretarial Determination. All alternatives carried forward for further analysis in the EIS/EIR were analyzed using existing studies and other appropriate data as suggested in KHSA Section 3.2.1 (i), where such analysis met criteria in (40 CFR 1502.22 and 43 CFR 46.125) to incorporate available information. As part of developing the basis for the Secretarial Determination, the KHSA requires in Section 3.3.2 that the Secretary prepare a Detailed Plan, including the identification, qualifications, management, and oversight of a non-federal DRE, if any, that the Secretary may designate. KHSA Section 3.3.4.D requires that an estimate of costs be prepared as part of the Detailed Plan. The Detailed Plan analysis provides most of the information for the project description for Alternatives 2 and 3, and this information was used to analyze these two action alternatives. As described in KHSA Section 3.2.1(i), the FERC record is used to form the project description for Alternatives 4 and 5. Alternatives 4 and 5 were analyzed to ensure that the review of reasonable fish passage alternatives was comprehensive. In addition, at the time of developing a reasonable range of alternatives, the lead agencies recognized that the inclusion of Alternatives 4 and 5 would provide an assessment of the short- and long-term effects from a broader range of reasonable alternatives. Alternatives 4 and 5 are outside the authority of the Department of the Interior, the four facilities proposed for removal are privately owned structures, and there was no provision in the KHSA to include them in the Detailed Plan. The result is differing levels of available information

for alternatives carried forward in the EIS/EIR consistent with the elements of each action alternative.

Regional economic effects were quantified for the No Action/No Project Alternative, the Proposed Action, and the Partial Facilities Removal of Four Dams Alternative. These regional economic effects provide the broadest range of economic impacts expected from implementation of any of the alternatives and bookend the expected economic impact to the area of analysis. Once that information was developed, a comparative analysis of the Fish Passage at Four Dams Alternative and Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative provide the information required to evaluate the relative impacts of each action alternative within the identified range of economic effects.

Specific economic effects for construction and changes in commercial fishing, recreation, and irrigated agriculture were not individually quantified for Fish Passage at Four Dams Alternative and Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative. The missing data is relevant to reasonable foreseeable significant adverse human effects on the environment. However, that unavailable data is not essential to a reasoned choice among alternatives because potential impacts can be compared to the data developed for the No Action/No Project Alternative, the Proposed Action, and Partial Facilities Removal of Four Dams Alternative. The range of impacts anticipated for the two alternatives for which data is missing falls within the range of impacts analyzed and data developed for the remaining alternatives, though the ratio of expenditures to impacts might not have the same proportional effect across the various economic sectors. The comparative analysis required by NEPA is achieved using this qualitative method.

The socioeconomic section of the EIS/EIR addresses primarily regional economic impacts on employment, income and output that occur within the Klamath region and related ocean areas, as well as qualitative information related to tribal effects, real estate, property tax revenues, and PacifiCorp's customers' energy rates. However, changes in some resources may have effects that take the form of economic benefits and costs that may extend to individuals or entities outside and inside the regional impact area and are separate and distinct from the regional impacts considered in the EIS/EIR. For example, economic effects on hydropower resources (beyond just the rates PacifiCorp charges to individual in the region) are not evaluated as part of the regional analysis. In addition, the EIS/EIR does not include an evaluation of any non-use values held by individuals both within and outside the region. In the context of the Klamath Basin, non-use values accrue to members of the public who value Klamath Basin environmental restoration regardless of whether they consume Klamath River fish or visit the Basin. Both hydropower and non-use values - as well as other benefits and costs - are addressed in the Secretarial Determination Overview Report, a separate document from the EIS/EIR.

#### **Four Facilities**

Deconstruction of the dams would result in economic effects in Siskiyou and Klamath Counties. Deconstruction or construction activities would create jobs and generate additional economic activity within the region during the period of construction. Direct effects represent equipment rentals, purchase of materials, and payment for labor.

An important consideration in evaluating regional economic effects is how much money is spent within the region for construction supplies and equipment, and how many workers are employed that originate from the region. Costs for dam decommissioning were divided into expenditures that would be made inside and outside of Siskiyou and Klamath Counties. The expenditures assumed to be spent within the counties were used in IMPLAN to estimate employment, labor income, and output from dam decommissioning. Dam decommissioning expenditures made outside the analysis area would have no impact on the local economy.

Reclamation estimated total dam decommissioning costs and allocated the costs associated to within-region expenditures. Dam decommissioning costs assumed to be spent within the region are described in more detail in the Benefit Cost and Regional Economic Development (RED) Technical Report (Reclamation 2011a). The analysis assumed that the onsite construction workforce would be hired from within the region. Some workers would be brought into the region from outside areas. Money from out-of-region workers spent on goods and services within Siskiyou and Klamath Counties contributes to regional economy, while money that originates from in-region workers is much less likely to generate regional economic effects because spending from sources within the region represents a redistribution of income and output.

O&M expenditures made in the region would generate positive economic effects to the regional economy. Annual O&M expenditures for each alternative are summarized in the Benefit Cost and RED Technical Report (Reclamation 2011a). Based on estimates from Reclamation, it was assumed that 80 percent of the O&M expenditures would be made inside the two-county area. This analysis measures annual O&M effects after dam removal in the year 2020. Like the dam commissioning expenditures, in-region O&M expenditures associated were placed into relevant sectors of the economy and run through IMPLAN to estimate effects to the regional economy. This analysis does not quantify the positive effects resulting from periodic replacement costs. O&M effects would occur annually.

The in-region mitigation costs associated with the action alternatives were also analyzed in IMPLAN to estimate employment, labor income, and output effects in the regional economy. The costs associated with the major dam mitigation activities were allocated to within-region expenditures. Dam mitigation costs assumed to be spent within the region are described in more detail in the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011a). Like the dam decommissioning analysis, the onsite mitigation workforce would be hired from within Siskiyou and Klamath Counties. The regional economic effects associated with dam mitigation costs would be spread over the 2018-2025 period and would vary year-by-year proportionate to actual expenditures.

### **Commercial Fishing**

The commercial fishing information is taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011a). The regional economic analysis evaluates effects from changes in commercial fishing in the area of analysis based on annual gross revenues projected under the project alternatives. Section 3.3, Aquatic Resources, evaluates effects to fish. Five of the seven management areas

account for 99 percent of total gross revenue attributable to Klamath River Chinook salmon abundance under the No Action/No Project Alternative and project alternatives. Thus the regional economic analysis focuses on those five areas: San Francisco, Fort Bragg, KMZ-CA, KMZ-OR, and Central Oregon.

The estimates of gross revenue used in this analysis are based on relative projections of Klamath River Chinook salmon harvest provided by the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model (Hendrix 2011). The EDRRA model is a simulation model that provides 50-year projections of Klamath River Chinook salmon escapement and harvest under the alternatives. The EDRRA harvest projections pertain to Klamath River Chinook salmon and do not distinguish between spring and fall runs. Harvest is estimated for each simulated year on the basis of a new Klamath River fall Chinook salmon harvest control rule recommended by the Pacific Fishery Management Council (PFMC) to the NOAA Fisheries Service in June 2011. The model allocates total Klamath River Chinook salmon harvest among fisheries as follows: 50 percent to tribal fisheries, 7.5 percent to the in-river recreational fishery (up to a maximum of 25,000 fish – with any surplus above 25,000 allocated to escapement), 34 percent to the ocean commercial fishery, and 8.5 percent to the ocean recreational fishery. The 50/50 tribal/non-tribal split is a “hard” allocation specified by the United States Department of the Interior (DOI) (1993). The remaining allocations are “soft” allocations as they represent customary practice rather than mandatory conditions.

For the No Action/No Project Alternative, fishery conditions are characterized in terms of average annual troll harvest of Klamath River fall Chinook salmon during 2001-05. The years 2001-05 were selected as the base period for the following reasons: Klamath River fall Chinook salmon fell within a ‘normal’ range of abundance during those years, abundance of Sacramento River fall Chinook salmon (the other salmon stock targeted south of Cape Falcon) also fell within a ‘normal’ range, and constraints and policies that are likely to continue into the future (e.g., the PFMC’s weak stock management policy, consultation standards for ESA-listed salmonids, 50-50 tribal/non-tribal harvest allocation) were well established by that time. For the project alternatives, harvest is estimated on the basis of the 43 percent increase in troll harvest projected by the EDRRA model, scaled to average annual troll harvest of Klamath River fall Chinook salmon during 2001-2005.

The following steps were taken to estimate gross revenues and regional economic effects under the No Action/No Project Alternative and the project alternatives:

- Klamath River Chinook salmon harvest was expanded to account for total salmon harvest (all stocks) in the troll fishery due to the availability of Klamath River Chinook.
- Total salmon harvest (all stocks) was converted from numbers of fish to pounds dressed weight, using 2001-2005 data on average weight of troll-caught Chinook salmon (PFMC 2011).
- Total salmon harvest (all stocks) was converted from pounds to gross revenue, using 2004-2005 data on ex-vessel price per pound (PFMC 2011).

The analysis assumes that salmon troll revenues are spent in the management area where the landings occur. The gross revenue estimates by management area were used in IMPLAN to estimate employment, labor income, and output from commercial fishing.

### **Recreation**

Depending on the recreation activity, visitors typically spend money on guide fees, food, hotels, restaurants, gasoline, equipment rentals, and/or other supplies required for outdoor activities. Any change to recreation opportunities that would result from implementation of the Proposed Action or alternatives would affect visitor spending and the region's economy. Increases in recreation spending would be considered a positive effect and decreases would be an adverse effect. This recreation economic impact analysis evaluates potential changes in direct visitor spending for recreation activities and subsequent, secondary economic effects. Estimates for changes in number of visitors and daily visitor spending are needed to calculate total reduction in recreation expenditures. IMPLAN is used to evaluate secondary effects in the regional economy. The economic effects presented in this section are directly related to the recreation effects discussed in Section 3.20, Recreation.

To estimate direct effects of visitor spending on a regional economy, it is important to consider the number of local visitors to the project area versus the number of visitors that originate from outside the region, or non-local visitors. If visitors are from the region, it is more likely that recreational spending intended for the project area would be spent elsewhere in the regional economy and there would be no net change in economic activity in the region. Non-local visitors bring money into the region that would not otherwise be there, and generate new economic activity. Changes in visits by non-locals largely drive the changes in recreational spending that would occur under the project alternatives. Therefore, this analysis requires data on the number of local visitors versus non-local visitors to estimate recreation-related economic effects.

Another important consideration is the availability and proximity of alternate recreation locations in the area. If visitors have multiple regional options for recreation similar to that available in the project area, they could substitute those areas for Klamath Hydroelectric Project area recreation and continue to spend money within the regional economy. Section 3.20, Recreation, describes alternate recreation sites in the area.

### ***Reservoir***

The reservoir recreation information is taken directly from analyses contained in Reclamation 2011 and Reclamation 2011d. The affected area is defined as Siskiyou and Klamath Counties, which include J.C. Boyle, Copco 1 and Iron Gate Reservoirs, where reservoir recreation occurs. Nonlocal visitors to the three reservoirs (J.C. Boyle, Copco 1, and Iron Gate) spend money in the region purchasing gas, food and drink, lodging, guide services, and other items. These expenditures generate economic activity measured in terms of total industry output, labor income, and employment within the two-county economic region. Economic activity could change under the project alternatives.

Within region reservoir recreation expenditures per visit were obtained from the recreation survey presented in the PacifiCorp (2004) report. The expenditure information was gathered by expenditure category such as accommodations, food, gas, supplies and guide fees. This analysis assumes an average of \$15.35 per visit. Changes to average annual within region, nonlocal visitor expenditures were run through IMPLAN to estimate regional economic effects associated with the Full and Partial Facilities Removal Alternatives.

### ***Ocean Sport Fishing***

The ocean sport fishing information is taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011h). This analysis focuses on economic effects of expenditures for ocean sport fishing in the KMZ-CA and KMZ-OR (where the effects of Klamath River fall Chinook salmon abundance are largely felt). Expenditures within the region by resident and nonresident anglers generate economic activity measured in terms of industry output, labor income, and employment. A basic assumption underlying this analysis is that any increase in expenditures by resident anglers associated with expanded fishing opportunities would be accommodated by reducing expenditures on other locally purchased goods and services, with no net change in local economic activity. For nonresident anglers, however, increases in local expenditures associated with increases in local fishing opportunities would be accomplished by diverting money that they would otherwise spend in their area of residence. Thus the economic analysis focuses on nonresident angler expenditures, which represent 'new money' whose injection serves to stimulate the local economy.

For the No Action/No Project Alternative, fishery conditions are characterized in terms of average annual ocean recreational harvest of Klamath River fall Chinook salmon during 2001-2005. For the project alternatives, Klamath River fall Chinook salmon harvest is estimated on the basis of the 43 percent increase in ocean recreational harvest of Klamath River Chinook salmon projected by the EDRRA model (Hendrix 2011), scaled to average annual harvest during 2001-2005.

The following steps were taken to estimate nonresident angler expenditures and regional economic effects under the project alternatives:

- Klamath River Chinook salmon harvest was expanded to account for total salmon harvest (all stocks) in the ocean recreational fishery due to the availability of Klamath River Chinook.
- Total salmon harvest (all stocks) was converted to angler days, using 2001-2005 fishery data (PFMC 2011).
- Number of angler days by fishing mode (party/charter, private boat) was estimated by multiplying total effort by the proportion of effort attributable to each mode, estimated using 2001-2005 fishery data (PFMC 2011).

- Number of angler days by nonresident anglers was estimated by using zip code of residence data collected in ocean recreational creel surveys conducted by the California Department of Fish and Game (CDFG) and Oregon Department of Fish and Wildlife (ODFW) to estimate the proportion of effort in each mode and area attributable to nonresident anglers.
- Average expenditures per angler day by nonresident anglers (for lodging, food, gasoline, fishing gear, party/charter boat fees, private boat fuel, equipment rental, access fees, and bait/ice) was estimated to be \$200.02 for party/charter mode and \$54.66 for private boat mode (in 2012 dollars), based on data collected in a 2000 economic survey of saltwater anglers conducted by NOAA Fisheries Service.
- Total within region expenditures by nonresident anglers were estimated by multiplying nonresident angler days by average nonresident expenditures per angler day. Total within region direct expenditures were run through IMPLAN to estimate regional economic impacts.

### ***In-River Sport Fishing***

The in-river sport fishing information is taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011g). For the in-river salmon fishery, the affected area includes Klamath, Siskiyou, Humboldt, and Del Norte Counties. The three California counties cover the current location of the in-river salmon and steelhead fisheries; Klamath County covers the area above the dams where salmon and steelhead could potentially recolonize under the action alternatives. Details regarding the methods, assumptions, and conclusions underlying this analysis are in the In-River Sport Fishing Economics Technical Report (NOAA Fisheries Service 2011g).

### **Klamath River Chinook**

For the No Action/No Project Alternative, fishery conditions are characterized in terms of in-river recreational harvest of Klamath River fall Chinook salmon during 2001-2005. For the project alternatives, Klamath River fall Chinook salmon harvest is estimated on the basis of the eight percent increase in in-river recreational harvest of Klamath River fall Chinook salmon projected by the EDRRA model (Hendrix 2011), scaled to average annual harvest during 2001-2005. For all alternatives, harvest was converted to angler days, using 2001-2005 data on the ratio of angler days to harvest (NOAA Fisheries Service 2011g)

The proportion of angler days attributable to nonresident anglers was calculated on the basis of location-of-residence data collected in the Klamath River creel survey conducted by CDFG (Borok 2009). Location of residence is reported in the creel survey as the first three digits of the angler's zip code of residence. Each three-digit location corresponds to a Sectional Center Facility (SCF) of the U.S. Postal Service – a processing and distribution center that serves zip code destinations beginning with those three digits. For purposes of this analysis, anglers identified with SCF 955 and SCF 960 are defined as resident anglers. Because these SCFs extend beyond the boundaries of the four-county regional economic impact area, the analysis provided here likely understates expenditures by nonresident anglers and their contribution to the regional economy. Average

expenditures per angler day by nonresident anglers (for lodging, food, gasoline, fishing gear, private boat fuel, and guide services) is \$105.02 (in 2012 dollars), based on data from a 2004 economic survey of in-river salmon and steelhead anglers sponsored by National Marine Fisheries Service (NMFS).

#### Steelhead

Economic effects of the No Action/No Project Alternative on the in-river steelhead fishery were analyzed on the basis of current fishery conditions, as little change in the status of steelhead is anticipated under that alternative. Estimation of regional effects for the action alternatives was precluded due to data limitations; instead those effects are expressed in qualitative terms.

The No Action/No Project Alternative is characterized in terms of average annual 2003-2008 steelhead fishing effort on the Klamath River, estimated from CDFG steelhead report card data in collaboration with Terry Jackson (CDFG). The proportion of total effort attributable to nonresident anglers is based on report card data on city/state of residence. Average nonresident expenditures per angler day (for lodging, food, gasoline, fishing gear, boat fuel, guide fees) is assumed to be \$105.98 (2012 dollars), based on data from a 2004 economic survey of in-river salmon and steelhead anglers sponsored by NOAA Fisheries.

Half-pounders are an important component of the steelhead fishery (Hopelain 1998). However, half-pounder catch is not included on steelhead report cards (Jackson 2007), and data for this fishery from other sources is sparse. Thus the regional effects estimated for the No Action/No Project Alternative should be viewed as conservative.

#### Redband Trout

The recreational redband trout fishery is a well-known trophy fishery. Major fishing sites include Upper Klamath Lake, the lower Williamson and Wood Rivers, and the Keno Reach of the Klamath River. Effort estimates for Upper Klamath Lake and Agency Lake are available from a statistical creel conducted by ODFW in 2009. However similar estimates are not available for the lower Williamson and Wood Rivers or for the Keno Reach – making it difficult to infer how much is spent on this fishery. Regional economic effects of this fishery are qualitatively assessed.

#### Sucker

The recreational sucker fishery is not considered in the regional analysis, as that fishery closed in 1987 and is unlikely to re-open under the No Action/No Project Alternative and action alternatives.

#### ***Whitewater Boating***

The affected area for whitewater boating is defined as Jackson, Klamath, Siskiyou, and Humboldt Counties. Klamath River users that engage in whitewater boating recreation spend money in the region purchasing gas, food and drink, lodging, guide services, and other items. The expenditures associated with these trips generate economic activity

measured in terms of total industry output, labor income, and employment within the four county economic region.

Reclamation (2011) and the Whitewater Boating Recreation Economics Technical Report (DOI 2011b) discusses the methods and results of the whitewater boating recreation regional economic impact analysis summarized in this section. The technical report also provides estimates of average annual whitewater boating user days for the Upper Klamath and Lower Klamath Rivers. The estimate of average annual total direct expenditures for whitewater boating was derived from expenditures per user day and the number of whitewater boating user days, and total number of user days are differentiated by local versus nonlocal and commercial versus private.

Johnson and Moore (1993) estimated 78 percent of total whitewater boating activity on the Upper Klamath River is by non-local users. This same percentage was applied for activity on the Lower Klamath River. The number of local user days was further adjusted to account for those local users that would have engaged in a substitute activity outside of the local area if the Klamath River was not available. Following Johnson and Moore (1993), it was assumed that 11 percent of the local user days would have been substituted to an activity outside of the local region if the Klamath River was not available. Expenditures associated with these user days represent increased economic activity to the local region and are included in the estimation of total direct expenditures. The expenditures associated with the other 89 percent of local user days would have still occurred in the local area if the Klamath River was not available and therefore, do not represent an increase in economic activity to the local region and are not included.

Expenditures per user day are differentiated by private and commercial users, where commercial use is associated with the use of a whitewater boating outfitter. Table 3.15-15 shows annual and average private and commercial user days on the Upper and Lower Klamath River between 1994 and 2009. Whitewater boating outfitter fees vary among Upper Klamath River and Lower Klamath River trips and private and commercial trips. Table 3.15-25 shows average visitor expenditures per user day on whitewater boating trips. Expenditures other than outfitter fees (e.g., accommodations, food, gas, supplies, and shuttle services) were based on Johnson and Moore (1993) and inflated to 2012 dollars. Total whitewater boating expenditures were input in the IMPLAN model to determine total economic effects.

**Table 3.15-25. Expenditures per User Day for Whitewater Boating on the Klamath River (2012 dollars)**

Expenditure	Upper Klamath River		Lower Klamath River	
	Private	Commercial	Private	Commercial
Outfitter Fees	\$0	\$157	\$0	\$130
Gasoline/fuel	\$26	\$26	\$26	\$26
Meals/food	\$59	\$59	\$59	\$59
Accommodations	\$59	\$59	\$59	\$59
Retail/supplies	\$21	\$21	\$21	\$21
Shuttle Services	\$11	\$11	\$11	\$11
Total	\$176	\$333	\$176	\$306

Source: DOI 2011b

### **Indian Tribes**

This analysis focuses on fishing opportunities, related cultural and social practices, standard of living, and health for five of the six federally recognized tribes in the Klamath Basin (Klamath Tribes, Karuk Tribe, Resighini Rancheria, Yurok Tribe, Hoopa Valley Tribe). The sixth tribe, the Quartz Valley Indian Community, is not expected to be directly affected by the outcome of the Secretarial Determination. The tribal information is taken directly from analyses contained in Reclamation (2011) and NOAA Fisheries Service (2011b-f). Sections 3.12, Tribal Trust, and 3.16, Environmental Justice, include more detailed analysis on potential social effects to Indian Tribes.

### **PacifiCorp Hydroelectric Service**

The analysis qualitatively discusses potential effects to PacifiCorp customer rates.

### **Property Values around Reservoirs**

All else equal, the removal of the four facilities including loss of the reservoirs could impact real estate values of parcels surrounding Copco 1, and Iron Gate Reservoirs in Siskiyou County by changing a reservoir view to a river view. The “Dam Removal Real Estate Evaluation Report” (DOI 2011a) evaluates potential short term effects of dam removal on property values. The discussion in this EIS/EIR discusses potential effects qualitatively. Dam removal could also potentially increase the value of property near and adjacent to the Klamath River downstream of Iron Gate Dam due to improved water quality and more robust runs of anadromous fish. The net value of the changes, and the time over which such changes might be observed in market prices, is uncertain.

In concept, to evaluate impacts on real estate values, one would collect market sales data for different properties with different characteristics, which would include “view amenities.” This data would include market values for land that had reservoir views, river view, and no views. All else equal, the difference in the land values for properties with different amenities would represent the impacts on real estate values. This is a challenging exercise in thin markets, where the long-term value changes are not known,

and where other exogenous factors affecting real estate markets may overwhelm the effects of dam removal.

### **PacifiCorp Property Taxes**

This analysis discusses effects to county property tax revenues qualitatively. PacifiCorp pays property taxes to Siskiyou and Klamath Counties. After dam removal, the States of California and Oregon would assume payment of property tax assessments in the form of in-lieu fees for the lands underneath and adjacent to the reservoirs that will come under state management. In-lieu fees would be equivalent to the current assessment paid by PacifiCorp for hydroelectric properties, as defined by California Fish and Game Code Section 1504 and Oregon Revised Statutes Section 496.340:

California Fish and Game Code Section 1504. (a) When income is derived directly from real property acquired and operated by the state as wildlife management areas, and regardless of whether income is derived from property acquired after October 1, 1949, the department shall pay annually to the county in which the property is located an amount equal to the county taxes levied upon the property at the time title to the property was transferred to the state. The department shall also pay the assessments levied upon the property by any irrigation, drainage, or reclamation district.

Oregon Revised Statutes Section 496.340. Except as provided in subsection (3) of this section, whenever real property owned by the State Fish and Wildlife Commission is exempt from taxation on January 1 of any year by reason of its ownership by the state, the commission shall pay to the county in which the property is situated an amount equal to the ad valorem taxes that would have been charged against the property if it had been assessed to a taxable owner as of January 1 of such year as provided in subsection (2) of this section. The county assessor shall determine the value of such property and shall notify the commission of the determination of the county assessor. Upon request of the commission, the Department of Revenue shall review the determination of value and shall re-determine the value if it concludes the value initially determined was substantially incorrect.

### **KBRA**

The KBRA identified 112 actions that could result in new economic activity in the counties within the Klamath Basin. Actions focus on fisheries restoration, monitoring, reintroduction, water resources, agriculture, and economic development for tribes and counties in the Klamath Basin. Chapter 2 describes programs and actions included in the KBRA. Appendix P includes the detailed KBRA regional economic effects analysis.

KBRA actions would increase labor income, output and employment in the region through planning and implementation of local projects and funding to local governments. The KBRA would be implemented over a 15 year period from 2012 to 2026. Federal and state agencies provided funding estimates for KBRA actions. This analysis uses funding estimates and the IMPLAN model to estimate regional economic effects of each KBRA action. Beyond the funding programmed in the KBRA in year 15, the expectation is that

federal financial support in the Klamath Basin would return to existing conditions. Additional funds would be subject to annual appropriations.

Federal agencies identified initial base funding values for actions listed in the KBRA. Base funding was provided on an annual basis for each year that the KBRA would be implemented (2012-2026). The base funding dollars are assumed to be spent whether the KBRA is implemented or not; therefore, the base funding values are assumed for the No Action/No Project Alternative. Base funding values were run in IMPLAN to determine effects of the No Action/No Project Alternative. The KBRA funding would be in addition to the base funding that would be spent under the No Action/No Project Alternative.

To estimate in-region spending for the KBRA, project experts from federal and state agencies and tribes were interviewed regarding the percentage of total costs that would be spent in the region. Experts were from U.S. Fish and Wildlife Service (USFWS), Bureau of Reclamation, NOAA, United State Geologic Survey, U.S. Forest Service, U.S. Department of the Interior, California Department of Fish and Game, Oregon Department of Fish and Wildlife, Karuk Tribe, Yurok Tribe, and The Klamath Tribes. Appendix P summarizes personal communication records, which are referenced as personal communications at the end of this section. Project experts considered project requirements, similar past projects, existing industries and work force in the counties to determine a percentage for in-region costs. Percentages were applied to both base funding and KBRA funding.

Once in-region spending percentages were agreed upon, project experts helped identify the appropriate industry or institution that would experience the direct economic effect, or change in demand. For the majority of actions, money would be spent in the construction sector or in local and state governments to implement activities. This analysis uses the total funds over the 15-year period and does not evaluate effects on an annual basis. The KBRA effects shown in this analysis are not annual effects; instead, they are effects over the entire 15 year period.

### ***Irrigated Agriculture***

Some KBRA actions would change agricultural water supply, on-farm pumping costs, and water acquisitions in Reclamation's Klamath Project area, which would affect irrigated agriculture and farm revenues. Details on the methodology and results of the economic analysis are in Reclamation 2011 and the Irrigated Agriculture Economics Technical Report (Reclamation 2011b).

Hydrology modeling was based on Biological Opinions for the No Action/No Project Alternative and incorporated KBRA criteria for the Full Facilities Removal Alternative, including the On-Project Water Users Program (KBRA Section 15) and the Drought Plan (KBRA Section 19). The hydrology modeling drives the agricultural regional analysis (Reclamation 2011c). The Klamath Basin Hydro-Economics model (KB\_HEM) evaluated effects to Reclamation's Klamath Project irrigators based on the hydrology. KB\_HEM measures changes to cropping patterns and gross farm revenue. Gross farm revenue was used in IMPLAN to measure regional economic effects.

KB\_HEM also evaluated current pumping rates for lands irrigated within Reclamation's Klamath Project, which were compared to estimates of reduced cost of electricity and the cost of pumping groundwater for irrigation under the KBRA. IMPLAN was then used to estimate regional effects from pumping cost changes. Because KBRA does not provide enough information to quantify the effects from power rates to off-project irrigators, this analysis describes those effects in qualitative terms.

KBRA programs such as the Water Use Retirement Program, the Off-Project Reliance Program, and Interim Flow and Lake Level Program were also evaluated in IMPLAN. These programs encourage voluntary water right sales or short term water leasing. The regional economic impact of water right transfers or short term water leases are measured in two stages: (1) regional economic effects from the reduction in irrigated agricultural production and (2) the regional economic impact of the water transfer compensation or lease payment to growers. Water transfer/lease payments may offset negative economic effects from reduced irrigated crop production. The net regional economic impact is the sum of the stage one and stage two effects.

### ***Refuge Recreation***

Some KBRA actions would change water supply for refuges; therefore, refuge recreation is described under the KBRA. Visitors target the refuge primarily for one of two recreational purposes: wildlife viewing or waterfowl hunting. Visitation to refuges typically lasts for no more than one-half a day. Reclamation 2011 and the Refuge Recreation Economics Technical Report (Maillett 2011) discusses in greater detail the methodology followed and the results derived associated with the direct economic contribution to the local area associated with the economic expenditures of nonlocal refuge visitors.

Expenditures associated with visitation include lodging, food and beverages, transportation, and equipment. Expenditure data was obtained from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Expenditures were prorated to prevent over-estimation of the contribution based on the amount of time a typical visitor spends on the Refuge. Table 3.15-26 shows estimated daily expenditures by visitors to the NWRs for hunting and wildlife viewing activities (in 2012 dollars). Non-residents spend more on recreation than residents, and all visitors spend more on hunting than on wildlife viewing.

**Table 3.15-26. Daily Expenditures per Person for Hunting and Wildlife Viewing (2012 dollars)**

Economic Sector	Migratory Bird Hunting		Wildlife Viewing	
	Resident	Non-Resident	Resident	Non-Resident
Lodging	\$2.54	\$12.78	\$9.12	\$36.44
Food/drink	\$16.75	\$50.25	\$11.74	\$38.66
Air transport	\$25.39	\$107.57	\$9.27	\$33.09
Other transport	\$ -	\$11.95	\$1.51	\$3.59
Other	\$13.25	\$18.33	\$3.13	\$14.95
Total	\$57.93	\$200.87	\$34.76	\$126.73

Source: 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, U.S. Fish and Wildlife Service. Expenditures updated to 2012 dollars using Western Region Consumer Price Index, U.S. Census.

### 3.15.4.2 Effects Determinations

As described above, the following effects determinations comply with the required NEPA analysis of socioeconomic effects. Effects of the project alternatives are compared to the No Action/No Project Alternative.

#### Alternative 1: No Action/No Project Alternative

##### *Four Facilities*

The Four Facilities would be retained under the No Action/No Project Alternative; therefore, there would be no construction activities and short-term construction related effects associated with dam removal.

*Annual O&M expenditures required to continue the operation of the existing facilities could result in long-term economic effects to jobs, labor income, and employment.* Table 3.15-27 summarizes the regional effects from annual O&M expenditures. IMPLAN results indicate that existing O&M generates approximately 49 jobs. Labor income and output from O&M expenditures were estimated at \$2.05 million and \$5.19 million, respectively. Annual O&M expenditures and associated effects to employment, labor income, and output would remain the same under the No Action/No Project Alternative relative to existing conditions for the long term.

**Table 3.15-27. Regional Economic Effects from Annual O&M Expenditures for the No Action/No Project Alternative**

	Employment <sup>1</sup> (Jobs)	Labor income <sup>2</sup> (\$ millions)	Output <sup>3</sup> (\$ millions)
Total effect <sup>4</sup>	49	2.05	5.19

Source: Reclamation 2011 presented in 2012 dollars

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

**Commercial Fishing**

Changes in commercial fishing harvests could change fishing revenues and affect employment, labor income, and output in the regional economy. Under the No Action/No Project Alternative, Klamath River fall Chinook salmon would continue to be the constraining stock for the troll fishery in San Francisco, Fort Bragg, KMZ-CA, KMZ-OR, and Central Oregon. In years of low Klamath River Chinook salmon abundance, troll restrictions to protect that stock would extend to Monterey and Northern Oregon and be more widespread than the areas identified above. Annual gross revenue projected for each of the five areas under the No Action/No Project Alternative is described in Table 3.15-28. Revenues range from \$266,900 in KMZ-OR to \$9.126 million in San Francisco (Reclamation 2011, NOAA Fisheries Service 2011a).

**Table 3.15-28. Annual Ex-Vessel Revenue for Management Areas for the No Action/No Project Alternative**

Management area	Revenue (2012 dollars)
San Francisco	9,125,553
Fort Bragg	4,202,992
KMZ-CA	328,574
KMZ-OR	266,894
Central Oregon	6,847,058

Table 3.15-29 shows the regional economic effects from ocean commercial fishing under the No Action/No Project Alternative. Employment ranges from 26 to 510 jobs. Labor income ranges from \$0.15 million to \$6.10 million. Output ranges from \$0.32 million to \$15.52 million.

**Table 3.15-29. Regional Economic Total Effects from Ocean Commercial Fishing under No Action/No Project Alternative**

Management Area	Total Effects <sup>1</sup>		
	Employment <sup>2</sup> (Jobs)	Labor income <sup>3</sup> (\$ millions)	Output <sup>4</sup> (\$ millions)
Central Oregon	319	4.15	9.55
Fort Bragg	162	2.45	5.62
KMZ-CA	44	0.19	0.45
KMZ-OR	26	0.15	0.33
San Francisco	510	6.1	15.52

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

Commercial fishing harvests and associated effects on employment, labor income, and output in the regional economy would be similar to current conditions for the long term.

***Recreation***

**Reservoir**

*Changes to reservoir recreation expenditures could affect jobs, labor income, and employment in the regional economy under the No Action/No Project Alternative.* The reservoir recreation analysis assumes that 71,584 non-local visitors would recreate at Copco 1, Iron Gate and J.C. Boyle Reservoirs under the No Action/No Project Alternative. It should be noted that a substantial blue-green algae problem exists at Copco 1 and Iron Gate Reservoirs (but not at J.C. Boyle Reservoir) sufficient to warrant health advisories related to water ingestion or contact. These advisories suggest avoiding use of water for cooking and washing, as well as avoiding the consumption of fish. While these advisories have been in place for several years, no data exists as to their impact on recreation visitation. Should these algae problems under the No Action/No Project Alternative continue, a large percentage of visits at Copco 1 and Iron Gate Reservoirs may be lost. This could reduce the level of reservoir recreation visitation. At this point, the impact of the blue-green algae problem on visitation is unknown, therefore attempting to provide algae adjusted visitation estimates are speculative. Non-local recreation at Copco 1, Iron Gate, and J.C. Boyle Reservoirs would generate average annual spending of about \$1.1 million per year, which would result in regional economic activity shown in Table 3.15-30. Reservoir recreation under the No Action/No Project Alternative would be the same as existing conditions for the long term.

**Table 3.15-30. Regional Economic Effects from Reservoir Recreation for the No Action/No Project Alternative**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	7	0.22	0.54

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

**In-River Sport Fishing**

*Changes to in-river sport fishing opportunities could affect recreational expenditures and employment, labor income, and output in the regional economy.* Annual salmon fishing effort on the Klamath River is estimated at 24,683 angler days under the No Action/No Project Alternative. The portion of this effort attributable to nonresident anglers is 15,822 angler days. Annual expenditures in the region by nonresident anglers would be \$1.7 million (2012 dollars). Table 3.15-31 shows the regional economic effects from in river salmon fishing trip expenditures for the No Action/No Project Alternative (Reclamation 2011, NOAA Fisheries Service 2011g).

**Table 3.15-31. Regional Economic Effects from In-river Salmon Fishing for the No Action/No Project Alternative**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	34	0.93	2.01

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

Annual steelhead fishing effort on the Klamath River is estimated at 17,155 angler days under the No Action/No Project Alternative, of which 11,103 were attributable to nonresident anglers. Annual expenditures by nonresidents in the region would be \$1.2 million. Table 3.15-32 shows the estimated regional effects from in-river steelhead fishing trip expenditures for the No Action/No Project Alternative (Reclamation 2011, NOAA Fisheries Service 2011g).

**Table 3.15-32. Regional Economic Effects from In-river Steelhead Fishing for the No Action/No Project Alternative**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	20	0.62	1.31

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

According to results of a creel survey conducted during May-September 2009, fishing effort for redband trout on Upper Klamath Lake totaled 15,191 angler days during that period (pers. comm. William Tinniswood, ODFW). County-of-residence data collected as part of the survey indicate that 24 percent of this effort was by nonresident anglers. Effort estimates for other major fishing sites (lower Williamson and Wood Rivers, Keno Reach of the Klamath River) are not available. A popular guide fishery occurs on the lower Williamson River. Given that demand for guide trips is generally higher among nonresident than resident anglers, the proportion of trips by nonresident anglers is likely higher on the Williamson River than in Upper Klamath Lake; however, data are lacking to verify this. The redband trout fishery would remain similar under the No Action/No Project Alternative relative to existing conditions (Reclamation 2011, NOAA Fisheries Service 2011g).

In conclusion, in-river sport fishing opportunities and associated effects on employment, labor income, and output in the regional economy under the No Action/No Project Alternative would remain similar to existing conditions for the long term.

**Ocean Sport Fishing**

*Changes to ocean sport fishing opportunities associated with dam removal could affect recreational expenditures in the regional economy. Table 3.15-33 summarizes annual ocean sport salmon fishing effort (in total and by nonresident anglers) and nonresident angler expenditures under the No Action/No Project Alternative. Annual nonresident expenditures total \$981,500 in KMZ-CA and \$223,500 in KMZ-OR (Reclamation 2011, NOAA Fisheries Service 2011h).*

**Table 3.15-33. Total Annual Recreational Salmon Effort, Nonresident Effort and Nonresident Expenditures for the No Action/No Project Alternative**

Management area	Angler days (Total)		Angler days (Nonresident)		Expenditures (Nonresident [2012 dollars])	
	Party/charter	Private	Party/charter	Private	Party/charter	Private
KMZ-CA	1,665	23,569	1,538	11,926	313,644	667,856
KMZ-OR	382	14,293	197	3,273	40,174	183,288

Table 3.15-34 shows the estimated regional economic effects from ocean sport fishing trip expenditures for the No Action/No Project Alternative for KMZ-CA and KMZ-OR, respectively.

**Table 3.15-34. Regional Economic Effects from Ocean Sport Salmon Fishing for the No Action/No Project Alternative**

Management Area	Total Effects <sup>1</sup>		
	Employment <sup>2</sup> (Jobs)	Labor income <sup>3</sup> (\$ millions)	Output <sup>4</sup> (\$ millions)
KMZ-CA	13	0.42	1.12
KMZ-OR	3	0.08	0.21

Source: Reclamation 2011 presented in 2012 dollars

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

In conclusion, ocean sport fishing opportunities and associated effects on employment, labor income, and output in the regional economy under the No Action/No Project Alternative would be similar to existing conditions for the long term.

Whitewater Boating

*Changes to whitewater boating opportunities could affect recreational expenditures and employment, labor income, and output in the regional economy.* Regional economic activity under the No Action/No Project Alternative is based on the average annual whitewater boating use and in-region expenditures per user day for the Upper Klamath River and Lower Klamath River. Total average annual visitation for the Klamath River was estimated at 18,806 user days, where the associated within region expenditures were estimated at \$4.2 million for the No Action/No Project Alternative. Table 3.15-35 displays estimates of whitewater boating recreation regional economic effects for the No Action/No Project Alternative. Whitewater boating under the No Action/No Project Alternative would remain similar to existing conditions for the long term.

**Table 3.15-35. Regional Economic Effects from Whitewater Recreation for the No Action/No Project Alternative**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	56	1.56	4.31

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

***Indian Tribes***

*The continuation of dam operations would result in no change to the existing economic conditions of Indian Tribes in the area of analysis.* Access to fish has declined relative to historical levels due to reductions in abundance and distribution and loss of access to traditional fishing sites. Opportunities to utilize fish for subsistence and ceremonial purposes and trade and barter would continue to be limited under the No Action/No Project Alternative similar to existing conditions. The information contained in this section is taken directly from Reclamation (2011) and NOAA Fisheries Service (2011b-f).

The Klamath Tribes

The decline in spring run Chinook salmon began prior to construction of Copco 1 Dam due to factors such as mining and unregulated cannery operations at the river mouth (Snyder 1931). Construction of Copco 1 Dam eliminated much of the spawning and rearing habitat for the spring run (Hamilton et al. 2010). For the Klamath Tribes, access to both fall and spring Chinook salmon ceased completely with the construct of Copco 1 Dam. Out-of-area fishing and barter proved to be untenable as a regular practice due to

the distances traveled, the relatively small amounts of salmon obtained, and the need to meet obligations closer to home. Moreover, salmon obtained elsewhere did not have the same cultural significance as salmon harvested by tribal members on their own fishing grounds. After almost a century without salmon, first salmon ceremonies have ceased and been replaced by ceremonies focused on other species or prayers for the return of salmon. Efforts by the Klamath Tribes to educate the younger generations regarding the cultural and social importance of salmon are challenged by the lack of direct experience with salmon in their daily lives (Deur 2011).

Lost River (c'waam) and shortnose (qapdo) suckers were also important sources of sustenance and became increasingly so after the loss of salmon harvest opportunities. Studies conducted by The Klamath Tribes, ODFW, and the USFWS in the early 1980s revealed the poor status of these populations. The Klamath Tribes drastically curtailed their sucker fishery in 1985 and closed it entirely in 1986 (Markle and Cooperman 2001). The only fish species currently available to the Klamath Tribes is redband trout. Klamath tribal regulations allow subsistence harvest of trout, five fish per day on the Williamson River and up to ten fish per day in other areas.

#### Karuk Tribe

The Karuk Tribe does not have federally recognized fishing rights. However, the California Fish and Game Commission allows members of the Tribe to fish with traditional hand-held dip nets at their indigenous fishing site at Ishi Pishi Falls. Karuk tribal fishing is bound by California sport fishing regulations, including bag and possession limits. The seasonal round at Ishi Pishi is much diminished and consists mostly of fall Chinook, available in modest numbers and for a very limited period. The First Salmon Ceremony has not been practiced in traditional form in the spring for decades, due to the dramatic decline in spring Chinook. Lamprey have also declined in abundance to such an extent that traditional family eeling spots are no longer used (Lewis 2009). Quantities of fish harvested are not sufficient to meet subsistence needs, engage in trade and barter, or even provide adequately for tribal elders.

The Karuk Tribe routinely participates in the posting of health warnings along the river in the summer that advise people to avoid contact with the water and ingestion of fish livers and to thoroughly wash fish before consumption. The Tribe's concerns extend not only to finfish but also to freshwater mussels, crayfish and food plants that contribute to their diet (Norgaard 2005). Water quality also affects cultural practices, as the Piky'avish ceremonies (which require some participants to ritually immerse themselves in the river) extend into the summer months, when water quality is at its worst. Other tribal activities (e.g., basket making, use of medicinal plants) also involve contact with the river. Basket makers wade in the river to collect basket materials such as willows and cottonwood, wash the materials in the river, and strip the willows with their teeth. Medicinal plants are often washed in the river and some water is consumed along with the plants (Karuk Tribe undated, Gates and Novell 2011).

### Resighini Rancheria

The Resighini do not have tribal fishing rights but retain a strong affinity to fishing and other cultural practices such as basket weaving and use of medicinal plants. Resighini members regularly participate in World Renewal Ceremonies hosted by neighboring tribes. Today candlefish and sturgeon are rarely seen on the Klamath River, coho salmon has been listed as ‘threatened’ under the Endangered Species Act, and Pacific lamprey and spring Chinook salmon are at very low levels of abundance. The declines in fish abundances have impacted the modest fishing opportunities available to the Resighini Rancheria.

Poor water quality at certain times of year affects the quantity and quality of basket materials and also exposes basket makers (who wade in the river and also strip willows and other materials with their teeth) to adverse water conditions. Gathering and use of medicinal plants is also adversely affected by poor water quality.

### Yurok Tribe

Historical declines in fish abundances has impaired the ability of Yurok tribal members to meet their subsistence needs and engage in trade and barter and commercial fishing. With the decline of spring Chinook, the First Salmon Ceremony and the Cappell Weir have not been practiced for many decades. Water quality problems interfere with fishing operations by causing algae to become entangled in fishing nets.

The Yurok Tribe hosts the World Renewal Ceremonies, which include the Deerskin Dance and Jump Dance, every other year in the Lower Basin in rotation with the Hoopa Valley Tribe. When fish harvest is low, the Yurok Tribe must supplement the harvest with sources off the reservation to meet their obligation to share salmon and other food with ceremonial participants and attendees (USFWS et al. 1999, Gates and Novell 2011). The World Renewal Ceremonies, Brush Dance and Flower Dance involve the use of basket materials that grow along the river and immersion of some ceremonialists in the river. Poor water quality at certain times of year affects the quantity and quality of basket materials and also exposes basket makers (who wade in the river and also strip willows and other materials with their teeth) and ceremonialists (who engage in ritual immersion) to adverse water conditions. Gathering and use of medicinal plants is also adversely affected by poor water quality.

### Hoopa Valley Tribe

The decline in fish abundances on the Trinity River has impaired the ability of Hoopa tribal members to meet their subsistence needs and utilize fish for trade and barter. The Hoopa incorporate traditional cultural understandings and ceremonies into their everyday life, including fish harvesting (USFWS et al. 1999). Due to the decline of spring Chinook, they have not had a First Salmon Ceremony in decades. However, they are active participants in the World Renewal Ceremonies, which they host every other year in the Lower Basin in rotation with the Yurok. When fish harvest is low, the Hoopa must supplement the harvest with sources off the reservation to meet their obligation to share salmon and other food with ceremonial participants and attendees (USFWS et al. 1999, Gates and Novell 2011).

Ceremonial and cultural practices affected by Trinity River water quality include ritual immersion of some ceremonial participants in the river, basket making (which requires basket makers to wade in the river and also strip willows and other materials with their teeth), and gathering and use of medicinal plants.

In conclusion, under the No Action/No Project Alternative, the economic conditions of the Klamath, Karuk, Resighini Rancheria, Yurok and Hoopa Valley Indian Tribes would be the same as existing conditions.

### ***PacifiCorp Hydroelectric Service***

*Energy rates for PacifiCorp customers would be uncertain under the No Action/No Project Alternative.* Under the No Action/No Project Alternative PacifiCorp would continue to operate under the current annual license, PacifiCorp customers would stop paying surcharges associated with dam removal costs. Funds collected would be returned to rate payers or used for restoration actions. While the modified mandatory terms and conditions and prescriptions developed by the DOI and the NMFS in the FERC relicensing proceedings are not included in the No Action/No Project Alternative, the potential changes in customer energy rates that could be generated by implementation of these terms and conditions are characterized below in the analysis of Alternative 4. PacifiCorp considers many factors in setting customer rates which in turn are subject to Oregon Public Utilities Commission (OPUC) and California Public Utilities Commission (CPUC) approval; therefore, it is difficult to assess the size of potential rate effects or even the extent to which rates might increase at all under the No Action/No Project Alternative.

### ***Property Values***

*Property values surrounding Iron Gate and Copco Reservoirs could change under the No Action/No Project Alternative.* Property values of parcels around the reservoir and along the river would be subject to, and fluctuate, based on economic conditions. Values around Copco 1 and Iron Gate Reservoirs could decline in the future if the current trend of postings of health advisories for microcystin algal toxins continues. This analysis does not attempt to predict market conditions and future housing values. Market trends would be similar under the No Action/No Project Alternative relative to existing conditions and property values would be affected similarly. The No Action/No Project Alternative would not affect property values relative to existing conditions.

### ***PacifiCorps Property Taxes***

*PacifiCorp's property tax payments to Siskiyou and Klamath Counties could change under the No Action/No Project Alternative.* PacifiCorp would continue to operate the Klamath Hydroelectric Project and pay property taxes to Siskiyou and Klamath Counties. In 2008 and 2009, PacifiCorp indicated that \$305,000 and \$290,000 of property taxes were associated with hydroelectric facilities in Siskiyou County (PacifiCorp 2009). PacifiCorp would continue to pay a similar amount annually to Siskiyou and Klamath Counties under the No Action/No Project Alternative. There would be no substantial

changes in property tax revenues to the counties under the No Action/No Project Alternative relative to existing conditions.

***Ongoing Restoration Activities***

*Ongoing restoration activities could generate employment, labor income, and output in the regional economy.* Federal agencies have identified funding for ongoing restoration actions under the No Action/No Project Alternative. Table 3.15-36 summarizes regional economic effects of ongoing restoration actions under the No Action/No Project Alternative. Effects would occur in Klamath, Siskiyou, Humboldt, and Del Norte Counties. The regional economic impacts associated with ongoing restoration actions would be spread over the 2012-2026 period and would vary year-by-year proportionate to actual expenditures. Spending on local actions would affect employment, labor income, and output in the regional economy. Impacts would mostly occur in local or state governments and the construction sector. Effects would be the same as existing conditions. Effects would be temporary and only occur during the implementation period.

**Table 3.15-36. Total Economic Effects over a 15 year period of In-Region Spending for Ongoing Restoration Actions under the No Action/No Project Alternative**

Ongoing Action	Total In-Region Spending (1000\$)	Total Economic Effects <sup>1</sup>		
		Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
Coordination and Oversight	\$1,350	22	\$1,024	\$1,622
Planning & Implementation--Phase I and II Restoration Plans	\$420	7	\$319	\$505
Williamson River aquatic habitat restoration	\$3,735	50	\$2,378	\$5,277
Sprague River aquatic habitat restoration	\$11,216	147	\$7,000	\$16,086
Wood River Valley aquatic habitat restoration	\$2,997	39	\$1,801	\$4,420
Williamson & Sprague USFS uplands	\$4,680	62	\$2,921	\$6,712
Upper Klamath Lake aquatic habitat restoration	\$2,997	38	\$1,770	\$4,476
UKL watershed USFS uplands	\$1,159	16	\$724	\$1,663
Keno Impoundment wetlands restoration	\$2,250	29	\$1,325	\$3,369
Keno to Iron Gate upland USFS	\$504	8	\$311	\$732
Shasta River aquatic habitat restoration	\$16,674	166	\$7,991	\$17,613
Shasta River USFS uplands	\$606	9	\$373	\$878
Scott River aquatic habitat restoration	\$18,720	241	\$11,515	\$27,139
Scott River USFS uplands	\$958	14	\$590	\$1,389
Scott River private uplands	\$2,100	29	\$1,368	\$3,205
Mid Klamath River & tributaries aquatic habitat restoration	\$6,750	88	\$4,152	\$9,786
Mid Klamath tributaries USFS upland	\$3,600	47	\$2,215	\$5,220
Mid Klamath tributaries private upland	\$4,200	55	\$2,585	\$6,090
Lower Klamath River & tributaries aquatic habitat restoration	\$18,200	234	\$11,196	\$26,385
Lower Klamath private uplands	\$9,900	128	\$6,090	\$14,352
Salmon River aquatic habitat restoration	\$1,650	23	\$1,029	\$2,400
Salmon River USFS upland	\$2,082	28	\$1,281	\$3,018
Adult Salmonids	\$7,400	115	\$5,608	\$8,890
Juvenile Salmonids	\$4,110	64	\$3,115	\$4,938
Genetics Otololith	\$2,055	35	\$1,720	\$2,719
Hatchery Tagging	\$315	6	\$240	\$380
Disease	\$316	6	\$241	\$380
Green Sturgeon	\$2,480	39	\$1,880	\$2,979

**Table 3.15-36. Total Economic Effects over a 15 year period of In-Region Spending for Ongoing Restoration Actions under the No Action/No Project Alternative**

Ongoing Action	Total In-Region Spending (1000\$)	Total Economic Effects <sup>1</sup>		
		Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
Lamprey	\$371	7	\$282	\$446
Geomorphology	\$153	3	\$116	\$184
Water Quality	\$1,545	26	\$1,176	\$1,985
UKL bloom dynamics	\$1,545	26	\$1,176	\$1,985
UKL water quality/phytoplankton/zooplankton	\$2,020	34	\$1,537	\$2,595
UKL internal load/bloom dynamics	\$1,800	30	\$1,370	\$2,313
UKL external nutrient loading	\$60	2	\$46	\$78
UKL listed suckers	\$8,985	146	\$6,834	\$11,542
Tributaries listed suckers	\$930	16	\$708	\$1,196
Keno Impoundment water quality/algae/nutrients	\$70	2	\$54	\$91

Source: Source: Barry 2011; Bird 2011; Hicks 2011; Mahan 2011; Nota 2011; Radford 2011; Stopher 2011; Wise 2011  
2012 dollars as estimated using IMPLAN

UKL: Upper Klamath Lake USFS: United States Forest Service

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

### ***Irrigated Agriculture***

*Changes in Reclamation's Klamath Project hydrology could affect farm revenues, employment, labor income, and output in the regional economy. Under the No Action/No Project Alternative, KB\_HEM model results predict five drought years for Reclamation's Klamath Project. Table 3.15-37 shows the gross farm revenue by IMPLAN sector for drought years, which was used in IMPLAN to estimate the potential regional economic effects from on farm production in drought years. Table 3.15-38 summarizes regional economic effects from agriculture during drought years. The three-county region supports a total of approximately 52,000 jobs, \$2,082.6 in labor income, and \$5,497 million in output by comparison. Under the No Action/No Project Alternative, farm revenues would remain the same as existing conditions.*

**Table 3.15-37. Gross Farm Revenue for the No Action/No Project Alternative during Drought Years**

IMPLAN Crop Sectors	Gross Farm Revenue for Drought Years (1,000 \$)				
	2027	2043	2045	2052	2059
Grains	19,189	4,519	11,462	17,078	20,300
Vegetables	60,675	55,966	58,562	60,127	60,791
Other (Hay & Pasture)	58,387	27,640	47,250	55,815	60,457
Total	138,251	88,125	117,274	133,020	141,548

Source: KB\_HEM estimated gross farm revenue by IMPLAN crop sectors as cited in Reclamation 2011b.

**Table 3.15-38. Regional Economic Effects from Irrigated Agriculture for the No Action/No Project Alternative during Drought Years**

Drought Year	Total Effect <sup>1</sup>		
	Employment <sup>2</sup> (Jobs)	Labor income <sup>3</sup> (\$ millions)	Output <sup>4</sup> (\$ millions)
2027	1,361	45.20	183.56
2043	766	33.21	118.30
2045	1,076	40.24	156.34
2051	1,286	43.97	176.78
2059	1,403	45.94	187.84

Source: Reclamation 2011b presented in 2012 dollars.

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

*Changes in on-farm pumping costs could affect farm revenues, employment, labor income, and output in the regional economy.* Electricity costs and on farm groundwater pumping costs would not be impacted under the No Action/No Project Alternative.

*Water acquisitions could affect farm revenues, employment, labor income, and output in the regional economy.* Under the No Action/No Project Alternative, water acquisitions would not impact the regional economy. The Klamath Water and Power Association currently manages the Water Use Mitigation Plan. This plan is similar to a water leasing mitigation program in which farmers are paid to idle land in exchange for the use of the water to reduce on project demand. This is a pilot project whose authorization ends in 2012; therefore it was assumed this program will not continue under the No Action/No Project Alternative. Thus, water acquisitions would have no effect under the No Action/No Project Alternative.

### ***Refuge Recreation***

*Changes in water supply could affect visitor spending for refuge recreation and affect employment, labor income, and output in the regional economy.* Water supply would be similar to historical water supply operations, and therefore recreation quality and opportunities would not change. Visitor expenditures for refuge recreation under the No Action/No Project Alternative would be the same as existing conditions. Table 3.15-39 shows the regional economic effects from refuge hunting trip expenditures for the No Action/No Project Alternative. Visitor spending for the long term would not change under the No Action/No Project Alternative, and the regional economy would not be affected relative to existing conditions.

**Table 3.15-39. Regional Economic Effects from Refuge Hunting for the No Action/No Project Alternative**

	Employment <sup>1</sup> (Jobs)	Labor income <sup>2</sup> (\$ millions)	Output <sup>3</sup> (\$ millions)
Total effect <sup>4</sup>	11	0.26	0.62

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

### ***Tribal Program***

*Ongoing fisheries and conservation management by The Klamath Tribes, Karuk Tribe, and Yurok Tribe could generate employment, labor income, and output in the regional economy.* Federal agencies have identified funding for fisheries and conservation management actions to be implemented by tribes under the No Action/No Project Alternative. Table 3.15-40 summarizes in-region spending and regional economic effects of tribal program actions under the No Action/No Project Alternative. Effects would occur in Klamath, Siskiyou, Humboldt and Del Norte Counties where tribes are located. The regional economic impacts associated with tribal program actions would be spread over the 2012-2026 period and would vary year-by-year proportionate to actual expenditures. Spending on local actions would affect employment, labor income, and output in the regional economy. Most actions would be implemented by tribal staff and would positively affect the economic conditions of the tribes. A portion of the funding would result in positive effects in the construction sector and professional and technical services sector. Economic effects would be the same as existing conditions.

**Table 3.15-40. Total Economic Effects over a 15-year Period of In-Region Spending for Tribal Program Under the No Action/No Project Alternative**

Action	Total In-Region Spending (1000\$)	Total Economic Effects <sup>1</sup>		
		Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
Fisheries Management, Karuk Tribe	\$10,468	169	\$7,505	\$11,643
Fisheries Management, The Klamath Tribes	\$8,997	118	\$5,935	\$9,717
Fisheries Management, Yurok Tribe	\$8,934	141	\$6,792	\$12,108
Conservation Management, Karuk Tribe	\$4,200	68	\$3,012	\$4,672
Conservation Management, The Klamath Tribes	\$4,200	56	\$2,771	\$4,537
Conservation Management, Yurok Tribe	\$4,200	67	\$3,188	\$5,724

Source: Dunsmoor 2011; Tucker 2011; Hillemeier 2011

2012 dollars as estimated using IMPLAN

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

**Alternative 2: Proposed Action – Full Facilities Removal of Four Dams**

***Four Facilities***

*Construction activities associated with dam removal would increase economic output, employment, and labor income during the construction period in Klamath and Siskiyou Counties. Effects from dam decommissioning expenditures would occur for one year in 2020. The costs for full facility removal would be approximately \$178.4 million<sup>2</sup> in 2012 dollars. Not all dollars would be spent within the region. Approximately \$114.3 million of \$178.4 million would be spent in Klamath and Siskiyou Counties. For more detail on the cost estimates and in-region spending, see the Benefit Cost and RED Technical Report (Reclamation 2011a).*

IMPLAN results for employment, labor income and output are shown in Table 3.15-41. Only in-region expenditures would generate positive regional economic effects. Dam decommissioning would support approximately 1,400 jobs and generate approximately \$60 million in labor income and \$163 million in output. Most economic effects would be in the sector where the direct impact occurs. For dam deconstruction expenditures, this analysis assumes direct effects would mostly occur in the construction sector. Employment created in this sector would be full and part time jobs and include contractors and subcontractors directly engaged in construction operations (such as equipment operators, drillers, carpenters, electricians, mechanics, apprentices, skilled and unskilled laborers, truck drivers, on-site record keepers and security guards), and any of their related office or administrative staff (in executive, purchasing, accounting, personnel, professional, technical activities and routine office functions, and supervisory employees). The Proposed Action would result in short term positive effects to output, employment, and labor income in the region relative to the No Action/No Project Alternative. Effects would only occur during the construction period.

**Table 3.15-41. Regional Economic Effects from Dam Decommissioning for Alternative 2, the Proposed Action**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	1,423	59.70	163.32

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Dam removal as described in this EIS/R would occur from May 2019 through December 2020. For this socioeconomic analysis, all effects have been described in 2012 dollars to compare economic effects of alternatives. These costs for facilities removal should not be considered a most probable cost estimate for dam removal in 2020. For a more detailed analysis of the cost of dam removal please see Detailed Plan for Dam Removal – Klamath River Dams, June 2011.

*Dam removal would reduce annual O&M expenditures for the Klamath Hydroelectric Project and could affect employment, labor income, and output in the regional economy.* The Proposed Action would not require any long term annual O&M expenditures for operation of hydroelectric facilities. As a result, there would be a decrease in expenditures in the region under the Proposed Action relative to the No Action/No Project Alternative. As shown in Table 3.15-42, the regional economy would lose 49 jobs, \$2.05 million in labor income and \$5.19 million in output relative to the No Action/No Project Alternative. For reduced O&M expenditures, this analysis assumes direct effects would occur in the construction sector. Employment created in this sector could be full time or part time and include various types of jobs, such as engineer, management, and administrative jobs. Reduction of O&M associated with the Four Facilities under the Proposed Action would result in adverse, long-term economic effect on employment, labor income, and output in the regional economy relative to the No Action/No Project Alternative.

**Table 3.15-42. Regional Economic Effects from O&M Expenditures between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	% Change from No Action	\$ millions	% Change from No Action	\$ millions	% Change from No Action
Total effect <sup>4</sup>	-49	-100.0	-2.05	-100.0	-4.61	-100.0

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

*Mitigation spending after the deconstruction period could increase economic output, employment, and labor income in the regional economy.* Mitigation costs associated with the Proposed Action are presented on an annual basis in Table 3.15-43. Spending on mitigation would occur within the region after construction is complete. Mitigation would generally include repaving roads, replanting vegetation, restoring river banks, and monitoring. Not all mitigation dollars would be spent within the region. Klamath County has highway, street, and bridge construction companies that provide asphalt and asphalt products for road construction. Siskiyou and Klamath Counties also have county road crews. Much of the roadwork could be done by local workers and businesses. Local workers could also provide much of the replanting and habitat restoration required for mitigation. The Benefit Cost and RED Technical Report (Reclamation 2011a) includes percentages of mitigation costs assumed to be spent within the region.

**Table 3.15-43. Mitigation Costs by Facility and Year (2012 \$) for Alternative 2, the Proposed Action**

Year	J.C. Boyle	Copco 1	Copco 2	Iron Gate	Yreka Water Supply	Total
2018	1,770,000	0	0	2,420,000	0	4,190,000
2019	2,080,000	4,200,000	3,340,000	5,400,000	0	15,020,000
2020	3,250,000	10,000,000	960,000	5,020,000	1,000,000	20,230,000
2021	2,290,000	4,700,000	0	2,790,000	0	9,780,000
2022	280,000	0	0	390,000	0	670,000
2023	280,000	0	0	390,000	0	670,000
2024	280,000	0	0	390,000	0	670,000
2025	280,000	0	0	390,000	0	670,000

Mitigation spending would be temporary and would vary year by year from 2018-2025. Spending would increase employment, labor income and output in the region, as presented in Table 3.15-44. Approximately 220 jobs, \$10 million in labor income, and \$31 million in output between the years 2018-2025 would be generated by mitigation expenditures for the Proposed Action. For mitigation expenditures, this analysis assumes direct effects would occur in the construction sector. Employment created in this sector could be full time or part time and include construction, management, administrative and other types of jobs. The Proposed Action would result in positive, temporary effects to employment, labor income, and output during the mitigation period (2018-2025) relative to the No Action/No Project Alternative.

**Table 3.15-44. Regional Economic Effects from Mitigation Expenditures for Alternative 2, the Proposed Action**

	Employment <sup>1</sup> (Jobs)	Labor income <sup>2</sup> (\$ millions)	Output <sup>3</sup> (\$ millions)
Total effect <sup>4</sup>	217	10.01	30.86

Source: Reclamation 2011 data presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

After construction and mitigation activities are complete, there would no longer be increased spending or employment in the region as a result of the Proposed Action. Some longer term monitoring activities would continue, but it would be substantially less than spending during the construction period. Output, employment, and labor incomes within the region would largely return to levels prior to construction. Some wholesale suppliers, retail businesses, hotels, motels, and restaurants that served the influx of construction workers would have increased profits for potential investments, but sales would return to pre-construction levels. Mitigation activities would return most resources, such as roads and public utilities, to at least pre-construction conditions.

**Commercial Fishing**

*Increases in commercial fishing harvests would increase fishing revenues and associated jobs, labor income, and output in the regional economy.* The Proposed Action would restore a more natural Klamath River flow regime and improve and expand spawning and rearing habitat for salmon on the Klamath River, which would benefit salmon populations. Commercial fishing landings would increase because of increased salmon abundance, which would increase fishing revenues. Table 3.15-45 shows projected revenue under the Proposed Action and changes in revenues under the Proposed Action relative to the No Action/No Project Alternative in each management area. The differences range from about \$114,000 in KMZ-OR to \$3.9 million in San Francisco (Reclamation 2011, NOAA Fisheries Service 2011a).

**Table 3.15-45. Annual Ex-vessel Revenue for Management Areas (2012 dollars)**

Management area	Revenue under Proposed Action (\$)	Change in Revenue relative to No Action/No Project Alternative (\$)
San Francisco	13,028,998	3,903,445
Fort Bragg	6,000,817	1,797,825
KMZ-CA	469,121	140,547
KMZ-OR	381,058	114,164
Central Oregon	9,775,879	2,928,821

Table 3.15-46 summarizes regional economic effects from the change in ocean commercial fishing revenue between the No Action/No Project Alternative and the Proposed Action. Additional employment would range from 11 to 218 jobs, labor income would increase between \$0.06 million to \$2.56 million, and output would increase from \$0.13 million to \$6.6 million compared to the No Action/No Project Alternative. Most employment, labor income, and output effects would occur in the agricultural sector of the regional economy. Employment created in this sector could be full time or part time and include various types of services, such as fishing, provision of fuel, bait, and ice, and other supporting jobs. Increases in fish landings and revenues under the Proposed Action would have a long term, positive impact on employment, labor income and output in the regional economy relative to the No Action/No Project Alternative.

**Table 3.15-46 Regional Economic Effects from Ocean Commercial Fishing between the No Action Alternative and Alternative 2, the Proposed Action**

Management Area	Total Effects					
	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent Change	\$ millions	Percent Change	\$ millions	Percent Change
Central Oregon	136	42.6	1.74	42	4.07	42.6
Fort Bragg	69	42.7	1.05	42.8	2.41	42.8
KMZ-CA	19	41.7	0.07	42	0.19	42.6
KMZ-OR	11	43.8	0.06	42.8	0.13	42.8
San Francisco	218	42.7	2.56	42	6.6	42.6

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects.

<sup>2</sup> Employment is measured in number of jobs.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

## **Recreation**

### Reservoir

*Dam removal would eliminate in-reservoir recreation activities, which could reduce recreational expenditures and affect employment, labor income, and output in the regional economy. Under the Proposed Action, dam removal would eliminate reservoir recreation activities in the short- and long-term. This analysis assumes the loss of recreation at Copco 1, Iron Gate, and J.C. Boyle Reservoirs under the Proposed Action relative to the No Action/No Project Alternative.*

This analysis assumes an average annual reduction of 40,901 visits under the Proposed Action relative to the No Action/No Project Alternative. The change in average annual expenditures would be a reduction of \$627,838. Table 3.15-47 summarizes results that compare expenditures under the Proposed Action relative to the No Action/No Project Alternative. Most employment, labor income, and output effects would occur in the services sector. Employment affected in this sector could be full time or part time. Lost reservoir recreation would be a long term adverse effect to the regional economy under the Proposed Action relative to the No Action/No Project Alternative.

**Table 3.15-47. Regional Economic Effects from Reservoir Recreation between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	% Change from No Action	\$ millions	% Change from No Action	\$ millions	% Change from No Action
Total effect <sup>4</sup>	-4	-57.4	-0.13	-59.1	-0.31	-56.9

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

### Ocean Sport Fishing

*Changes to ocean sport fishing recreation opportunities could affect recreational expenditures in the regional economy.* Increased salmon populations would attract more ocean recreational fishing effort, which would increase spending in the regional economy. Table 3.15-48 summarizes annual salmon fishing effort (in total and by nonresident anglers) and nonresident angler expenditures for the Proposed Action (Reclamation 2011, NOAA Fisheries Service 2011h).

**Table 3.15-48. Total Annual Recreational Salmon Effort, Nonresident Effort and Nonresident Expenditures by Fishing Mode and Management Area for Alternative 2, the Proposed Action**

Management area	Angler days total		Angler days nonresident		Expenditures nonresident (2012 dollars)	
	Party/charter	Private	Party/charter	Private	Party/charter	Private
KMZ-CA	2,378	33,650	2,197	17,027	448,034	953,512
KMZ-OR	545	20,407	281	4,673	57,304	261,688

Table 3.15-49 summarizes regional economic effects of ocean sport fishing in the KMZ under the Proposed Action relative to the No Action/No Project Alternative. The Proposed Action would support and increase in regional activity because of increased angler expenditures. Most employment, labor income, and output effects associated with ocean sport fishing would occur in the services sector. Employment created in this sector could be full time or part time. Recreational expenditures for ocean sport fishing would increase under the Proposed Action relative to the No Action/No Project Alternative, which would increase employment, labor income and output in the region. Effects would be long term.

**Table 3.15-49. Regional Economic Effects from Ocean Sport Salmon Fishing between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

Management Area	Total Effects <sup>1</sup>					
	Employment <sup>2</sup>		Labor income <sup>3</sup>		Output <sup>4</sup>	
	Jobs	Percent change from No Action	\$ millions	Percent change from No Action	\$ millions	Percent change from No Action
KMZ-CA	5.5	42.3	0.18	42.8	0.48	42.8
KMZ-OR	1.2	41.4	0.02	42.7	0.09	42.7

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

### In-River Sport Fishing

Changes to in-river sport fishing opportunities associated with dam removal could affect recreational expenditures in the local economy. Annual salmon fishing effort on the Klamath River is estimated at 26,578 angler days under the Proposed Action. The portion of this effort attributable to nonresident anglers is 17,036 angler days. Expenditures in the region by nonresident anglers are estimated at \$1.789 million (2012 dollars). The annual increase in nonresident expenditures under the Proposed Action relative to Alternative would be \$127,000. Table 3.15-50 summarizes increased economic activity supported by the Proposed Action relative to the No Action/No Project Alternative (Reclamation 2011, NOAA Fisheries Service 2011g).

The Proposed Action would result in increased numbers of steelhead spawners and provide conditions conducive to establishment of a steelhead fishery above Iron Gate Dam (Hamilton et al. 2010). However, because these changes were not quantified, it is not possible to quantify the effects of the Proposed Action on the steelhead fishery. However, expansion of that fishery would likely generate additional expenditures, jobs, labor income, and output in the regional economy.

**Table 3.15-50. Regional Economic Effects from In-river Salmon Fishing between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	Percent change from No Action	\$ millions	Percent change from No Action	\$ millions	Percent change from No Action
Total effect <sup>4</sup>	2.6	7.6	0.07	7.7	0.15	7.7

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

The Proposed Action would result in increased abundance and distribution of redband trout in Upper Klamath Lake and its tributaries and a potential seven-fold expansion of the fishery below Keno Dam (Buchanan et al. 2011). The effects of this increase could not be quantified with available data but would likely yield a notable increase in economic impacts, given the size of the potential increase in the fishery noted.

Most employment, labor income, and output effects associated with in-river sport fishing would occur in the services sector. Employment created in this sector could be full time or part time. In conclusion, employment, labor income and output in the regional economy would increase as a result of increased in-river fishing expenditures under the Proposed Action relative to the No Action/No Project Alternative. Effects would be long term.

### Whitewater Boating

*Changes to whitewater boating recreation opportunities associated with dam removal could affect recreational expenditures, employment, labor income and output in the regional economy.* The primary area of whitewater boating on the Upper Klamath River occurs on the Hell's Corner Reach, which is heavily dependent on releases from the J.C. Boyle Dam to provide sufficient and predictable whitewater flows. The Lower Klamath River is not dependant on reservoir releases to maintain sufficient whitewater flow, and hydrologic modeling indicated that the average number of days with acceptable flow conditions suitable for whitewater boating on the Lower Klamath River would not be impacted by dam removal (see Section 3.20, Recreation).

On the Upper Klamath River, the average number of days with acceptable flow conditions for whitewater boating in the Hell's Corner Reach would decrease under the Proposed Action. The Hell's Corner Reach is somewhat unique in the project area in that it provides Class V rapids during the late summer months. Analysis of predicted hydrology modeling shows that the average number days with acceptable flows for whitewater boating on the Hell's Corner Reach are estimated to decline by 47.3 percent

during the five month period from May through September (months when the majority of whitewater boating activity occurs annually) and decline by 29.5, 36.4, and 88.2 percent in June, July and August, respectively, relative to the No Action/No Project Alternative. The combination of the decline in the number of days with acceptable flows, particularly during the three months when most of the use is observed (June, July, and August), and the lack of consistency and predictability of days with acceptable flows could make it more challenging for outfitters to continue offering trips for this reach of the Upper Klamath River in the future. Therefore, it is assumed whitewater boating activity on the Upper Klamath River would be negatively affected under the Proposed Action for the long term.

The economic analysis for the Lower Klamath River assumes that there would not be a measurable change in visitation levels for whitewater boating on the Lower Klamath River after dam removal. Whitewater boaters would continue to spend money in the local economy. Expenditures would be similar to existing levels described for the No Action/No Project Alternative.

Table 3.15-51 summarizes estimates of the changes in whitewater boating recreation regional economic activity for the Proposed Action compared to the No Action/No Project Alternative. The loss of whitewater boating activity on the Upper Klamath River (primarily the Hell’s Corner Reach) would result in losses in expenditures and regional economic activity in the local region as compared to the No Action/No Project Alternative. Annual losses would begin in 2020. The difference in total average annual user days between the Proposed Action and the No Action/No Project Alternative was estimated at 2,763 user days. The difference in average annual lost expenditures between the Proposed Action and the No Action/No Project Alternative was estimated as \$715,903. Most employment, labor income, and output effects associated with whitewater boating would occur in the services sector. Employment created in this sector could be full time or part time. Reduced whitewater boating expenditures would result in long term adverse effects to the regional economy under the Proposed Action relative to the No Action/No Project Alternative.

**Table 3.15-51. Regional Economic Effects from Whitewater Recreation between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	% Change from No Action	\$ millions	% Change from No Action	\$ millions	% Change from No Action
Total effect <sup>4</sup>	-14	-25.2	-0.43	-27.6	-0.89	-20.6

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

### ***Indian Tribes***

*Dam removal would increase fish harvest for subsistence, cultural practices and commercial uses and provide economically beneficial opportunities for Indian Tribes residing on the Klamath River (excluding the Hoopa Valley Tribe, who reside on the Trinity River). Tribal harvest opportunities for Chinook, Pacific lamprey and steelhead are expected to increase in varying degrees under the Proposed Action relative to the No Action/No Project Alternative. The information contained in this section is taken directly from Reclamation (2011) and NOAA Fisheries Service (2011b-f).*

### The Klamath Tribes

The return of Chinook salmon to the Upper Basin (even in small numbers) would have great cultural significance for the Klamath Tribes, who have not experienced Chinook salmon in the Upper Basin for almost a century. Spring Chinook salmon is of particular importance, as it would allow for the revival of the First Salmon Ceremony. Should spring Chinook salmon become sufficiently abundant to support subsistence, it would also lengthen the duration of the seasonal round for salmon. Opportunities for subsistence harvest of suckers (which has not occurred since 1986) and redband trout are also likely to increase over the long term.

Benefits to be derived from this increased access to fish would include greater social and cultural cohesion associated with harvesting activities and associated ceremonies, greater opportunity to transmit cultural values and practices to the younger generation, and greater ability to provide food security, care for elders in the community, and engage in trade and barter. Poverty and rural isolation have constrained the ability of tribal members to replace fish with healthy food alternatives. Improved fishing opportunities would increase opportunities for healthy food consumption.

### Karuk Tribe

Fish population effects would provide greater opportunities for the Karuk Tribe to engage in subsistence fishing and associated cultural practices (e.g., sharing fish with elders, transmitting values to the next generation, trade and barter). Spring Chinook salmon is of particular importance, as it could lead to revival of the traditional First Salmon Ceremony in the spring. Also, spring Chinook salmon are highly desirable for their fat content and would provide quality benefits to the subsistence fishery and lengthen the duration of the seasonal round for salmon. Improved fishing opportunities would increase opportunities for healthy food consumption.

### Resighini Rancheria

The Proposed Action may yield benefits to Resighini Rancheria members in terms of improved access to salmonids and other fish (through fishing and trade and barter). Improved fishing opportunities would increase opportunities for healthy food consumption. Also, given their current dedication to attending ceremonies, it is likely that the Resighini would welcome a revival of the First Salmon Ceremony that may accompany improvements in the status of spring Chinook.

### Yurok Tribe

Fish population effects would provide greater opportunities for the Yurok Tribe to engage in subsistence and commercial fishing and associated cultural practices (e.g., sharing of fish with elders, transmitting values to the next generation, trade and barter). Spring Chinook salmon is of particular importance and would allow for revival of the First Salmon Ceremony. Also, spring Chinook salmon are highly desirable for their fat content and would provide quality benefits to the subsistence and commercial fisheries and lengthen the duration of the seasonal round for salmon. The tribal guide fishery would benefit and also bring additional money into the community. Improved fishing opportunities would increase opportunities for healthy food consumption.

### Hoopa Valley Tribe

Demand for water exports from the Klamath and Trinity Rivers originates from two separate sources: the Reclamation's Klamath Project in the case of the Klamath River, and the Central Valley Project's Trinity River Division in the case of the Trinity River. Anadromous fish that return to the Trinity River are generally distinct from fish that return to the Klamath River, although Trinity River fish must first pass through 42 miles of the Klamath River before reaching the Trinity River.

To the extent that dam removal activities cause sedimentation in areas below the confluence with the Trinity River, such activities may adversely affect Trinity River fish and fisheries (including Hupa fisheries); however, these effects are expected to be short lived (Close *et al.* 2010, Dunne *et al.* 2011, Goodman *et al.* 2011). Potential long-term benefits to anadromous Klamath River fish populations associated with dam removal are likely to have little effect on Trinity River (including Hupa) fisheries, as beneficiaries of those actions are stocks that return to the Klamath River rather than the Trinity River.

Effects of implementation of the KBRA Tribal Program are described below in the section KBRA Effects.

### ***PacifiCorp Hydroelectric Service***

*Removal of the Four Facilities could result in increased energy rates for PacifiCorp customers.* PacifiCorp has added an approximately 2 percent surcharge to customer rates in Oregon and California to cover costs of dam removal. Under the Klamath Hydroelectric Settlement Agreement (KHSAs), ratepayer liability is capped at \$200 million, prorated between PacifiCorp's customers in Oregon (up to \$184 million) and California (up to \$16 million). The OPUC and CPUC issued rulings that approved dam removal surcharges for PacifiCorp customers in Oregon and California (OPUC 2010, CPUC 2011). Under the Proposed Action, customer rates would not likely increase above the existing surcharges as a direct result of dam removal costs.

### ***Property Values and Local Government Revenues***

*Removal of the Four Facilities could affect property values of parcels near Copco 1 and Iron Gate Reservoirs.* Private parcels with partial reservoir views, frontage/access or with river views subsequent to the action, could be affected by the Proposed Action. Parcels were excluded from consideration if they were (1) publicly owned, (2) PacifiCorp owned,

(3) had no assessed value, (4) in an area influenced by river, (5) above the reservoir ridge and/or (6) larger than 50 acres. The evaluation identified 1,467 parcels that could be affected (DOI 2011a).

Of the 1,467 applicable parcels, about 46 percent (668) were in an area that would be affected by dam removal (DOI 2011a). Table 3.15-52 shows affected private parcels by land use category. A majority of the applicable private parcels are vacant residential land and single-family residential. The assessed land value of affected parcels was about \$9.0 million (DOI 2011a).

**Table 3.15-52. Potentially Affected and Affected Parcels by Land Use in Siskiyou County**

Land Use Category	Potentially Affected Private Parcels (<50 acres)	Affected Parcels
Agricultural	7	0
Commercial	5	5
Rural Single-Family Residential*	3	0
Rural*	5	3
Single-Family Residential	163	127
Timber	1	0
Vacant Commercial	4	2
Vacant Residential Land	1,246	518
Vacant Rural Land*	33	13
<b>Total Parcels</b>	<b>1,467</b>	<b>668</b>

Source: DOI 2011a  
1. 20 acre minimum

In the short term, property values would be adversely affected by changing parcels from a reservoir view to a river view and eliminating access to a reservoir. It is also clear that dam removal would affect property values over the long-term. However, the net magnitude of these changes is difficult to forecast. In the long-term, land values of parcels downstream of Iron Gate Dam with river views could increase because of restoration of the river, including improved water quality and more robust anadromous fish runs. Land that currently has reservoir views could decline in value. However, any declines could be at least partially offset by improvements in water quality. It is difficult to evaluate the magnitude of the net changes under the Proposed Action in the long term.

*Changes in real estate values around Copco 1 and Iron Gate Reservoirs could affect property tax revenues to Siskiyou County.* In the short term, if property values are reduced, there could be adverse effects to property tax revenues to Siskiyou County. In the long term, if some land values are permanently reduced and there are no offsetting increases in other property values, Siskiyou County property tax revenues might decline relative to the No Action/No Project Alternative, assuming nothing else changes that might impact property tax revenues (e.g., tax rates). If property values increase in the long term, tax revenues to Siskiyou County could increase. Effects to property values are uncertain in the long term; therefore, it is unknown how property tax revenues would be affected.

*Removal of the Four Facilities could affect property tax revenues to Siskiyou and Klamath Counties from PacifiCorp.* PacifiCorp owns property around the reservoirs and pays property taxes annually to Siskiyou and Klamath Counties. PacifiCorp pays in the range of \$290,000 to \$305,000 in property taxes on land attributable to hydroelectric facilities at Copco and Iron Gate Dams and about \$132,000 in property taxes for land attributable to hydroelectric facilities at J.C. Boyle Dam. Under the Proposed Action, the states would assume ownership of these lands and PacifiCorp would not pay property taxes on the relinquished land to the counties.

The states of California and Oregon would pay in-lieu payments on the transferred land. In California, in-lieu fees would be equivalent to the current assessment paid by PacifiCorp for hydroelectric properties, as required by California Fish and Game Code Section 1504. To make in-lieu payments to counties, the California legislature has to authorize payments. It is unknown if the California legislature would authorize payments in future years. Lost tax revenues to Siskiyou County would be an adverse economic effect. Similar to California, Oregon law (State Wildlife Fund Section 496.340) requires the state to pay the current assessed value on transferred lands. The State Department of Revenue can review and revise assessed values if it is determined substantially incorrect.

The loss in tax revenue from PacifiCorp owned lands would impact the regional economy. However, if Siskiyou and Klamath Counties receive in-lieu payments of equal value to PacifiCorp property tax payment, there would be no net effect to county revenues under the Proposed Action relative to the No Action/No Project Alternative.

*Construction worker spending could increase sales and use tax receipts in Siskiyou and Klamath Counties.* Construction crews for dam removal in Siskiyou and Klamath Counties would purchase goods and services from local restaurants and stores, which would increase sales tax revenues for the counties. Sales and use tax revenues are an important receipt for Siskiyou County to fund general government, health, and social programs. In 2010, sales tax in Siskiyou County was 8.25 percent (BOE 2010a). Some workers that are brought to the area would stay in hotels, motels, or campgrounds, which could also produce additional sales tax for the county. For workers staying in hotels or motels, the county could receive additional hotel-motel tax. From 2000 through 2010, hotel-motel tax made up an average of 2.7 percent of Siskiyou County tax receipts. As a result of construction worker spending, county sales tax revenues would increase during the construction period. Similar positive tax effects as described for Siskiyou County would accrue to Klamath County during the construction period. Construction worker spending would be a temporary and positive effect to Siskiyou and Klamath Counties under the Proposed Action relative to the No Action/No Project Alternative.

*Changes in visitation for recreation activities could affect sales tax revenues.* Similar to construction worker spending, increased visitation to the counties offering recreation activities would increase sale tax revenues within the counties. Any adverse effects on visitation expenditures would decrease sales tax revenues. Changes in sales tax revenues would affect funding for county programs, such as health, education, social services and other programs funded through sales taxes. For increases in in-river recreation activities

and ocean fishing, increases in sales tax revenues would be a long-term and positive effect. Decreases in reservoir recreation in Siskiyou and Klamath Counties could reduce sales tax revenues, which would be a long-term and adverse effect of the Proposed Action relative to the No Action/No Project Alternative. Reductions in whitewater boating expenditures would also be a long term, adverse effect to county sales tax. The net effect to sales tax revenues from changes in recreation expenditures is unknown.

### ***KBRA***

The KBRA has several programs that could have socioeconomic effects. Specific KBRA programs potentially affecting socioeconomics include:

- Phases I and II Fisheries Restoration Plans
- Fisheries Monitoring Plan
- Fisheries Reintroduction and Management Plan
- Agency Lake and Barnes Ranches
- Wood River Wetland Restoration
- Water Diversion Limitations
- On-Project Plan
- Future Storage Opportunities
- Water Use Retirement Program
- Power for Water Management
- Off-Project Water Settlement
- Off-Project Water Reliance Program
- Emergency Response Plan
- Climate Change Assessment and Adaptive Management
- Interim Flow and Lake Level Program
- Fish Entrainment Reduction
- Upper Klamath Lake and Keno Nutrient Reduction
- Tribal Fisheries and Conservation Management Program
- Tribal Programs Economic Revitalization
- Klamath River Tribes Interim Fishing Site
- Mazama Forest Project
- Klamath County Economic Development Plan
- California Water Bond Legislation
- Drought Plan

### **Fisheries Program**

*Fish habitat restoration for the Fisheries Program could affect employment, labor income, and output in the regional economy.* The KBRA includes fishery restoration, reintroduction and monitoring actions in the Upper and Lower Basin. Restoration activities would involve some degree of construction including floodplain rehabilitation, large woody debris placement/replacement, fish passage correction, cattle exclusion fencing, and riparian vegetation planting. It is likely that much of the construction could be done by local construction workers from the region. The KBRA also includes construction of new fish facilities, which may require more out of region contractors. State and local government workers in the region would likely implement many actions,

including monitoring and administration. KBRA actions would provide new jobs and increase labor income within the region during the implementation period. Table 3.15-53 summarizes regional economic effects from implementation of the Fishery Program actions under the KBRA relative to the No Action/No Project Alternative. These effects are incremental to base funding being implemented under the No Action/No Project Alternative. Effects are based on funding levels identified by federal agencies in a revised Table C-2 of the KBRA. Effects would occur over the KBRA implementation period (2012-2026) and would vary year-by-year proportionate to actual expenditures. Some actions would be completed in less than 15 years. Table C-2 (included in Appendix O) identified the timeline for action implementation.

Implementation of Fishery Program actions would increase employment, labor income, and output in the regional economy relative to the No Action/No Project Alternative. Effects would only last during the implementation period for each action. The increases in employment, labor income, and output in the regional economy generated by Fishery Program actions would add to economic effects generated by hydroelectric facility removal that are analyzed above during the years that the project implementation overlaps.

*In the long-term, the Fisheries Program could support increased fish abundance in the Klamath River and tributaries and improve regional economic conditions.* The increased abundance could allow for increased catch limits and fewer catch-and-release requirements, and could decrease the potential for closures of entire fishing seasons. This would attract anglers to the region and increase economic activity. An increase in fish abundance would generate additional jobs, labor income and output and would be a long-term and positive economic effect. The increases in fish abundance generated by Fishery Program actions would be expected to build upon the fish abundance improvements generated by hydroelectric facility removal that are analyzed above.

**Table 3.15-53. Regional Economic Effects of KBRA Fishery Program Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (does not include Base Funds)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
1	Coordination and Oversight	\$117	3	\$90	\$142
2	Planning & Implementation--Phase I and II Restoration Plans	\$1,211	20	\$918	\$1,456
3	Williamson River aquatic habitat restoration	\$890	12	\$568	\$1,258
4	Sprague River aquatic habitat restoration	\$41,994	546	\$26,206	\$60,228
5	Wood River Valley aquatic habitat restoration	\$10,777	136	\$6,476	\$15,892
6	Williamson Sprague Wood Screening Diversion	\$2,232	28	\$1,334	\$3,306
7	Williamson & Sprague USFS uplands	\$4,886	64	\$3,049	\$7,007
8	Upper Klamath Lake aquatic habitat restoration	\$10,785	134	\$6,365	\$16,105

**Table 3.15-53. Regional Economic Effects of KBRA Fishery Program Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (does not include Base Funds)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
9	Screening of UKL pumps	\$425	6	\$255	\$632
10	UKL watershed USFS uplands	\$1,641	23	\$1,024	\$2,354
11	Keno Impoundment water quality studies & remediation actions	\$29,647	366	\$17,443	\$44,360
12	Keno Impoundment wetlands restoration	\$1,008	13	\$594	\$1,508
13	Keno to Iron Gate upland private & BLM	\$0	0	\$0	\$0
14	Keno to Iron Gate upland USFS	\$713	10	\$440	\$1,036
15	Keno to Iron Gate mainstem restoration	\$951	13	\$620	\$1,321
16	Keno to Iron Gate tributaries - diversions & riparian	\$1,141	16	\$744	\$1,585
17	Shasta River aquatic habitat restoration	\$0	0	\$0	\$0
18	Shasta River USFS uplands	\$0	0	\$0	\$0
19	Scott River aquatic habitat restoration	\$0	0	\$0	\$0
20	Scott River USFS uplands	\$460	6	\$284	\$668
21	Scott River private uplands	\$0	0	\$0	\$0
22	Mid Klamath River & tributaries aquatic habitat restoration	\$0	0	\$0	\$0
23	Mid Klamath tributaries USFS upland	\$4,574	59	\$2,815	\$6,631
24	Mid Klamath tributaries private upland	\$1,887	25	\$1,162	\$2,736
25	Lower Klamath River & tributaries aquatic habitat restoration	\$0	0	\$0	\$0
26	Lower Klamath private uplands	\$25,428	326	\$15,641	\$36,863
27	Salmon River aquatic habitat restoration	\$1,959	26	\$1,206	\$2,840
28	Salmon River USFS upland	\$2,701	35	\$1,662	\$3,916
29	Reintroduction Plan	\$1,631	26	\$1,236	\$1,960
30	Collection Facility	\$6,014	78	\$3,700	\$8,719
31	Production Facility	\$6,113	79	\$3,762	\$8,865
32	Acclimation Facility	\$4,709	61	\$2,898	\$6,827
33	Transport	\$826	13	\$627	\$994
34	Monitoring and Evaluation – Oregon	\$29,828	461	\$22,601	\$35,828
35	Monitoring and Evaluation – California	\$2,995	47	\$2,270	\$3,599
36	New Hatchery	\$5,546	72	\$3,412	\$8,041
37	Adult Salmonids	\$9,952	154	\$7,542	\$11,954
38	Juvenile Salmonids	\$14,630	227	\$11,086	\$17,573
39	Genetics Otololith	\$0	0	\$0	\$0
40	Hatchery Tagging	\$0	0	\$0	\$0
41	Disease	\$5,214	82	\$3,952	\$6,264
42	Green Sturgeon	\$0	0	\$0	\$0
43	Lamprey	\$1,837	29	\$1,393	\$2,208
44	Geomorphology	\$1,608	26	\$1,219	\$1,933
45	Habitat Monitoring	\$2,641	42	\$2,002	\$3,173
46	Water Quality	\$86	2	\$65	\$110
47	UKL bloom dynamics	\$0	0	\$0	\$0
48	UKL water quality/phytoplankton/zooplankton	\$4,143	68	\$3,153	\$5,324
49	UKL internal load/bloom dynamics	\$1,244	21	\$947	\$1,599

**Table 3.15-53. Regional Economic Effects of KBRA Fishery Program Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (does not include Base Funds)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
50	UKL external nutrient loading	\$3,881	64	\$2,952	\$4,985
51	UKL analysis of long-term data sets	\$652	11	\$497	\$838
52	UKL listed suckers	\$4,331	71	\$3,294	\$5,564
53	Tributaries water quality/nutrients/sediment	\$4,718	77	\$3,589	\$6,061
54	Tributaries geomorphology/riparian vegetation	\$3,637	60	\$2,767	\$4,672
55	Tributaries physical habitat	\$3,241	53	\$2,466	\$4,164
56	Tributaries listed suckers	\$4,777	77	\$3,634	\$6,136
57	Keno Impoundment water quality/algae/nutrients	\$6,048	99	\$4,601	\$7,770
58	Keno Impoundment to Tributaries: Meteorology (weather stations)	\$3,044	50	\$2,316	\$3,911
59	Remote Sensing acquisition and analysis	--	No in-region spending, no regional economic effects		

Source: Barry 2011; Bird 2011; Hicks 2011; Mahan 2011; Nota 2011; Radford 2011; Stopher 2011; Wise 2011

2012 dollars as estimated using IMPLAN

UKL: Upper Klamath Lake

USFS: United States Forest Service

BLM: Bureau of Land Management

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

### Water Resource Program

*Construction, analysis, and monitoring activities under the Water Resources Program could affect employment, labor income, and output in the regional economy. The KBRA includes water resource actions to improve water supply reliability in Reclamation's Klamath Project. Actions include monitoring, analysis, and construction. It is likely that much of the construction could be done by local construction workers from the region. State and local government workers in the region would likely implement many actions, including monitoring, analysis, and administration. KBRA actions would provide new jobs and increase labor income within the region during the implementation period. Table 3.15-54 summarizes regional economic effects from implementation of the Water Resources Program actions under the KBRA relative to the No Action/No Project Alternative. Some actions could affect irrigated agriculture or refuge recreation; these programs are evaluated below.*

**Table 3.15-54. Regional Economic Effects of KBRA Water Resources Program Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (not including base funding)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
60	Keno Dam fish passage	--	No in-region spending, no regional economic effects		
61	Data Analysis and evaluation	\$168	3	\$126	\$197
62	Development of predictive techniques	\$391	7	\$298	\$471
63	Klamath Basin Wildlife Refuges: O&M North and P Canals	--	No funding identified in C2		
64	Klamath Basin Wildlife Refuges: Walking Wetland Construction	\$2,500	40	\$1,955	\$3,799
65	Klamath Basin Wildlife Refuges: Big Pond Dike Construction	--	No funding identified in C2		
66	On Project water plan	--	Evaluated in Irrigated Agriculture		
67	Groundwater Technical Investigation	--	No in-region spending, no regional economic effects		
68	Costs Associated with Remedy for Adverse Impact	--	No funding identified in C2		
69	D Pumping Plant	--	Transfer of funds, no regional economic effects		
70	Water Use Retirement Plan	\$0	Evaluated in Irrigated Agriculture		
71	Off Project Plan and Program: Use of 30,000 ac ft above UKL	\$0	Evaluated in Irrigated Agriculture		
72	Interim Power Sustainability	\$0	Evaluated in Irrigated Agriculture		
73	Federal Power	--	Transfer of funds, no regional economic effects		
74	Energy Efficiency and Renewable Resources	\$4,402	54	\$2,278	\$6,211
75	Renewable Power Program Financial and Engineering Plan	--	No in-region spending, no regional economic effects		
76	UKL Wetlands Restoration: Agency/Barnes	\$2,717	34	\$1,576	\$4,108
77	UKL Wetlands Restoration: Wood River	\$2,717	34	\$1,576	\$4,108
78	Drought Plan Development	--	No funding identified in C2		
79	Drought Plan Restoration Agreement Fund	--	Evaluated in Irrigated Agriculture		
80	Emergency Response Plan	--	No funding identified in C2		
81	Emergency Response Fund	--	No funding identified in C2		
82	Technical Assessment of Climate Change	--	No in-region spending, no regional economic effects		
83	Off-Project Reliance Program	--	Evaluated in Irrigated Agriculture		
84	Real Time Water Management	--	No funding identified in C2		
85	Real Time Water Management: Water Flow Monitoring and Gauges	\$3,239	51	\$2,455	\$3,892
86	Snowpack Gauges	--	No funding identified in C2		
87	Adaptive Management: Science and Analysis	\$1,087	17	\$824	\$1,307
88	Real Time Management: Calibration and improvements to KLAMSIM or other modeling and predictions	\$109	3	\$84	\$131
89	Interim Flow and Lake Level Program	--	Evaluated in Irrigated Agriculture		

Source: Barry 2011; Hicks 2011

2012 dollars as estimated using IMPLAN

UKL: Upper Klamath Lake

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed

**Table 3.15-54. Regional Economic Effects of KBRA Water Resources Program Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (not including base funding)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)

<sup>1</sup> individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

Regional economic effects would be in addition to base funding being implemented under the No Action/No Project Alternative. Effects are based on funding levels identified by federal agencies in a revised Table C-2 of the KBRA. Effects would occur over the KBRA implementation period (2012-2026) and would vary year-by-year proportionate to actual expenditures. Some actions would be completed in less than 15 years.

Implementation of Water Resource Program actions would increase employment, labor income, and output in the regional economy relative to the No Action/No Project Alternative. Effects would only last during the implementation period. The increases in employment, labor income, and output in the regional economy generated by Water Resource actions would add to economic effects generated by hydroelectric facility removal that are analyzed above during the years that the project implementation overlaps.

Irrigated Agriculture

*Changes in the Reclamation's Klamath Project hydrology could affect gross farm revenue and the regional economy.* Model results indicated gross farm revenue would be equal in all years under the Proposed Action relative to the No Action/No Project Alternative except for five drought years 2027, 2043, 2045, 2051, and 2059 which correspond to the years 1975, 1992, 1994, 2001, and 2008 in the historical period of record. For the five drought years 2027, 2043, 2045, 2051, and 2059, the gross farm revenue increased under the Proposed Action from the No Action/No Project Alternative. Table 3.15-55 shows gross farm revenue under the Proposed Action and the change relative to the No Action/No Project Alternative. For all drought years, regional employment, labor income and output increase over the No Action/No Project Alternative, shown in Table 3.15-56. This would be a long term, positive effect of the Proposed Action relative to the No Action/No Project Alternative. The increases in gross farm revenue and output in the regional economy would change hydroelectric facility removal effects because facility removal does not affect irrigated agriculture.

**Table 3.15-55. Gross Farm Revenue by IMPLAN crop sectors between the No Action/No Project Alternative and Alternative 2, the Proposed Action for Drought Years (1,000 \$)**

Drought Years	Grains		Vegetables		Other (Hay & Pasture)		Total	
	Proposed Action	Change from No Action	Proposed Action	Change from No Action	Proposed Action	Change from No Action	Proposed Action	Change from No Action
2027	21,857	2,667	60,993	319	65,688	7,301	148,537	10,287
2043	21,664	17,145	60,966	5,000	64,439	36,798	147,069	58,944
2045	21,857	10,394	60,993	2,432	65,688	18,438	148,537	31,263
2052	21,857	4,779	60,993	866	65,688	9,872	148,537	15,517
2059	21,857	1,556	60,993	203	65,688	5,231	148,537	6,990

Source: KB\_HEM estimated gross farm revenue by IMPLAN crop sectors as cited in Reclamation 2011b.

**Table 3.15-56. Regional Economic Effects from Gross Farm Revenue between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

Modeled Drought Years	Total Effects <sup>1</sup>					
	Employment <sup>2</sup>		Labor income <sup>3</sup>		Output <sup>4</sup>	
	Jobs	% Change from No Action	\$ millions	% Change from No Action	\$ millions	% Change from No Action
2027	112	8.2	2.3	5.2	13.0	7.3
2043	695	90.6	11.2	33.8	84.0	71.4
2045	397	36.9	7.3	18.1	41.0	26.0
2052	187	14.5	3.6	8.1	20.0	11.4
2059	70	5.0	1.6	3.5	9.0	4.8

Source: Reclamation 2011b data presented in 2012 dollars.

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

*Increases in on-farm pumping costs could affect household income and reduce employment, labor income, and output in the regional economy.* Regional employment, labor income, and output under the Proposed Action are equal to the No Action/No Project Alternative in all non-drought years. The regional effects are the same in all drought years due to groundwater substitution. Irrigators are pumping more groundwater in the Proposed Action compared to No Action/No Project Alternative and therefore are paying more for electricity under the Proposed Action even with a decrease in electricity rates assumed in the Proposed Action (Reclamation 2011b and Reclamation 2011b). The average annual cost of pumping groundwater would be \$178,000 per year.

Table 3.15-57 shows the regional economic effects as result of increased pumping costs. Because farmers are paying more for electricity to pump groundwater under the Proposed Action household income would reduce by the additional money spent to pump groundwater. A reduced household income due to increased pumping costs would have a

relatively small negative impact on the regional economy. The increased pumping costs under the Proposed Action would not change effects of hydroelectric facility removal because facility removal does not affect irrigated agriculture.

**Table 3.15-57. Regional Economic Effects from Increased Pumping Costs between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

Impact type	Employment <sup>1</sup> (Jobs)	Labor income <sup>2</sup> (\$)	Output <sup>3</sup> (\$)
Total effect <sup>4</sup>	-1	-40,907	-120,933

Source: Reclamation 2011 data presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

*Water acquisitions via permanent, voluntary water rights sales could affect farm revenues and reduce employment, labor income, and output in the regional economy.* The water acquisition programs, including the Water Use Retirement Program (WURP) and the Off-Project Reliance programs, could result in a negative regional impact. WURP would be implemented to generate on an average annual basis an additional 30,000 acre-feet of inflow to Upper Klamath Lake. The KBRA states that WURP would provide for increased stream flow and inflow into Upper Klamath Lake through actions that could include the voluntary retirement of water rights or water uses. The KBRA states that “acquisition of water rights or uses to achieve the WURP purpose will be compensated, as applicable, through market mechanisms based upon values mutually agreed to by purchaser and seller, as informed by appraisals.”

Water right transfers proposed as part of WURP could affect the regional economy. The land once irrigated with the surface water right would be converted to either dryland production or fallow. If all or part of the land is converted to dryland and/or fallow, the losses to economy would be the gross revenue produced on this land.

The second aspect of WURP that could potentially affect the regional economy is the compensation for the water right. Water right holders, or the growers, would be compensated for the value of the water right. However, no compensation would be paid to those in the regional economy who do not own the water right but are affected by the grower’s activities. Farm workers, agribusiness firms such as fertilizer and chemical dealers, wholesale and agricultural service providers are examples of those who do not receive compensation but would be affected by the water right sale.

The land currently being irrigated by the water rights proposed to be acquired under the WURP program are off project in the Sprague River sub-basin, the Sycan River, the Williamson River sub-basin, and the Wood River sub-basin. This land is mostly used to grow irrigated pasture to support local livestock operations.

Table 3.15-58 presents the combined impact of the lost irrigated pasture production and the associated livestock forward linkage from the 30,000 acre-foot water right sale proposed under the WURP. However, it should be noted that a portion of these effects would be offset from household induced effects resulting from household wages that are spent as a result of the compensation made to the water right holder.

**Table 3.15-58. Regional Economic Effects from Lost Agricultural Production for the WURP**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	34	0.86	5.85

Source: Reclamation 2011b, results presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

More information is needed to measure the direct effect on household spending of payments for water purchases proposed in the KBRA. The direct household spending is determined after accounting for debt retirement and leakages related to outside investments, household savings, and household tax payments. It is unknown how much to account for debt retirement and leakages. It can be assumed that a small amount of the regional effects shown in Table 3.15-67 would be offset by household spending (Howe and Goemans 2003). The water purchases proposed in the KBRA would not change any effects generated by hydroelectric facility removal given that facility removal does not affect irrigated agriculture.

*Water acquisitions via short-term water leasing could decrease farm revenues and reduce employment, labor income, and output in the regional economy.* Other programs in KBRA, like the Off-Project Reliance Program and the Interim Flow and Lake Level Program, suggest the use of water lease programs in drought years. Water lease programs are short term programs that may have negative effects to the regional economy during water short years. The programs allow farmers to sell or lease their water for fisheries programs on a short term basis when sufficient water is unavailable for fish. The regional economy would be affected by the loss in gross farm revenue generated on the land idled by farmers who voluntarily lease water. Some of these regional effects would be offset by household induced effects when farmers spend a portion of the

compensation in the local area. Since the KBRA does not specify what crops would be idled, is not possible to use IMPLAN to measure these effects. Short-term water leasing is expected to have a short term, adverse effect on the regional economy. The short-term water leasing proposed in the KBRA would not change any effects generated by hydroelectric facility removal given that facility removal does not affect irrigated agriculture.

Refuge Recreation

*Changes in water supply could affect refuge recreation expenditures and employment, labor income, and output in the regional economy.* Additional water supply could improve hunting and wildlife viewing, which could attract more visitors to the area. Under the Proposed Action, there would be an additional 193,830 waterfowl and 3,634 hunting trips. The addition of these trips would result in a total of \$255,500 in direct expenditures within the local economies. As shown in Table 3.15-59, the Proposed Action would create an estimated 5 additional jobs, increase labor income by \$0.12 million and output by \$0.27 million compared to the No Action/No Project Alternative. Increased refuge water supply under the Proposed Action would improve or maintain current recreational expenditures and would positively affect the regional economy relative to the No Action/No Project Alternative.

**Table 3.15-59. Regional Economic Effects from Refuge Recreation between the No Action/No Project Alternative and Alternative 2, the Proposed Action**

	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	% Change from No Action	\$ millions	% Change from No Action	\$ millions	% Change from No Action
Total effect <sup>4</sup>	5	47.2	0.12	47.0	0.27	47.0

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

Regulatory Assurances

*Implementation of regulatory assurances under the KBRA could support employment, labor income, and output in the regional economy.* The KBRA includes regulatory assurance actions that generally include planning and construction. State and local government workers in the region would likely develop plans. There would be some local construction for the Keno Impoundment Screening action. Actions would provide new jobs and increase labor income within the region during the implementation period. Table 3.15-60 summarizes regional economic effects from implementation of Regulatory Assurance action under the KBRA relative to the No Action/No Project Alternative.

Regional economic effects would be in addition to base funding being implemented under the No Action/No Project Alternative. Effects are based on funding levels identified by federal agencies in a revised Table C-2 of the KBRA. Effects would occur

over the KBRA implementation period (2012-2026) and would vary year-by-year proportionate to actual expenditures. The Keno Impoundment Screening action would be complete in 4 years and the Federal General Conservation Plans/Habitat Conservation Plans would be implemented over 8 years. The regulatory assurance actions proposed in the KBRA would add to the effects generated by hydroelectric facility removal on employment, labor income, and output in the regional economy during years that the projects overlap.

**Table 3.15-60. Regional Economic Effects of KBRA Regulatory Assurance Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (not including base funding)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
90	Keno Impoundment Screening	\$5,470	67	\$3,170	\$8,270
91	Federal GCP/HCP	\$5,082	79	\$3,851	\$6,105

Source: Barry 2011 ; Hicks 2011

2012 dollars as estimated using IMPLAN

GCP/HCP: General Conservation Plan/Habitat Conservation Plan

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

The KBRA identified actions to develop laws for California and Oregon. The states would be responsible for implementing these actions. These actions would provide some local employment to state government staff in the region. Much of the work would occur by state workers outside of the region, which would not affect the regional economy.

### County Programs

*Implementation of the Klamath County Economic Development Plan could support long-term economic growth in Klamath County.* The Klamath County Economic Development Plan would include a study and implementation of projects for economic development associated with fisheries restoration and reintroduction, tourism and recreational development, agricultural development, alternative energy development, and The Klamath Tribes economic development (KBRA 27.3.1). Appendix C-2 of the KBRA indicates \$3.2 million of funding for the plan in 2016. Implementation of these actions would support long-term economic growth in Klamath County, by providing jobs, attracting visitors, attracting new businesses to establish in the area, supporting the agricultural economy, and supporting economic growth of tribes.

The Klamath County Development Plan also calls for Klamath County to be compensated for the loss of property tax revenues from reduced agricultural land values in Reclamation's Klamath Project due to a reduction of water deliveries and reduced agricultural land values in the areas upstream of Upper Klamath Lake due to the

surrender of significant water rights. Compensation of property tax losses would allow Klamath County to continue funding county programs, including education, social services, emergency services, and to put money into the general fund. The Klamath County Development Plan would positively impact the regional economy and would allow the County to continue funding county programs. The long-term effects of implementation of the Klamath County Economic Development Plan proposed in the KBRA would add to the effects generated by hydroelectric facility removal on employment, labor income, and output in the regional economy.

*Funds from the California Water Bond Legislation could be used by Siskiyou County to improve economic conditions in the County and to support future economic growth.* California legislation passed in 2009 proposes a bond measure to fund an economic development plan for Siskiyou County and for hydroelectric facilities removal. The bond measure, if passed, would also fund other mitigation measures to reduce the potential effect of dam removal. The California Water Bond funding legislation is scheduled for a vote in 2012. If approved, bond funds would be used for economic development in Siskiyou County (\$20 million) and for hydroelectric facilities removal including mitigation for CEQA effects and protection of City of Yreka water supply (\$250 million). Humboldt and Del Norte Counties are not included in the economic development fund. Remaining funds may be used for fisheries restoration projects in Siskiyou, Humboldt and Del Norte Counties, including removal or improvement of bridges, culverts, diversions, or other obstructions to fish passage.

The economic downturn that began in 2008 has adversely affected Siskiyou County. Appendix O presents economic measures and trends for Siskiyou County. Siskiyou County's 2009 and 2010 unemployment rates are the highest in the county since the early 1990s, and unemployment and poverty rates are consistently well above state averages.

It cannot be determined at this time how Siskiyou would distribute funds from the California Water Bond Legislation; this is a general discussion. However, the bond funds could assist Siskiyou County in addressing unemployment, poverty, bankruptcy, and social problems and continuing funding for other county programs. Typical programs to address economic stressors include adult education programs, job opportunity and skills services, financial support programs, and childcare subsidy programs. Some funds could be used for programs to address social problems, such as substance abuse prevention and treatment, teen pregnancy prevention, and crime prevention.

Funding could also be used for programs that have had recent budget cuts, including library, fire, museum, and farm advisor. Other county programs that have struggled with funding include public health, child support services, human services, and behavioral health. Special districts would also likely receive some additional funding. More teachers could be hired, fire stations could be upgraded, or fire staff could increase. Siskiyou County could also invest in redevelopment of commercial areas and improve recreation facilities to attract more tourism to the area. Increased tourism would bring additional money into the county's economy. Siskiyou County could spend the California Water Bond Legislation funds in many ways to improve economic conditions

in the county and support future economic growth. Spending would likely increase employment opportunities and labor incomes in the county. This would be a long-term, positive economic effect. The long-term effects of the California Water Bond funding proposed in the KBRA would add to the effects generated by hydroelectric facility removal on employment, labor income, and output in the regional economy.

Some funds from the California Water Legislation may be left over for fishery restoration projects in Siskiyou, Humboldt and Del Norte Counties. Implementation of these projects would result in similar economic effects described for the Fisheries Restoration Program. Fishery restoration projects implemented by the California Water Legislation would result in a long-term and positive economic effect.

#### Tribal Program

This section describes effects of KBRA actions defined under the Tribal Program. Socioeconomic effects to tribes related to increased fish abundance and harvest are described above in the Indian Tribes Effects section.

*Construction and monitoring activities associated with Tribal Program actions would increase jobs, labor income, and output for The Klamath Tribes, Karuk Tribe, and Yurok Tribe.* Federal agencies have identified funding for fisheries and conservation management actions to be implemented by tribes under the Proposed Action. Table 3.15-61 summarizes in-region spending and regional economic effects of tribal program actions under the KBRA. Effects would occur in Klamath, Siskiyou, Humboldt and Del Norte Counties where tribes are located. The regional economic impacts associated with Fisheries and Conservation Management actions would be spread over the 2012-2026 period and would vary year-by-year proportionate to actual expenditures. Some actions would not be implemented in each year of the 15-year period. For example, the Economic Development actions would be completed in one year.

**Table 3.15-61. Regional Economic Effects of KBRA Tribal Program Actions Relative to No Action/No Project Alternative over a 15-year period ( 2012 dollars)**

Table C-2 Line #	KBRA Action	15 year KBRA In Region Spending (1000 \$)	Total Effects <sup>1</sup> of KBRA Funding (not including base funding)		
			Employment <sup>2</sup> (Jobs)	Labor Income <sup>3</sup> (1000\$)	Output <sup>4</sup> (1000\$)
100	Fisheries Management Karuk	\$4,032	66	\$2,891	\$4,485
101	Fisheries Management Klamath	\$5,503	73	\$3,630	\$5,943
102	Fisheries Management Yurok	\$5,566	89	\$4,252	\$7,581
104	Conservation Management Karuk	\$3,050	50	\$2,187	\$3,393
105	Conservation Management Klamath	\$3,050	41	\$2,013	\$3,296
106	Conservation Management Yurok	\$3,050	49	\$2,315	\$4,156
108	Economic Development Study Karuk	\$250	6	\$197	\$406
109	Economic Development Study Klamath	\$250	6	\$197	\$406
110	Economic Development Study Yurok	\$250	6	\$197	\$406
111	Klamath Tribes: Mazama Forest Project	--	Transfer of funds to private owner for land purchase for tribe. Regional effects not quantified. Tribes would benefit in future from use of forest lands.		
112	Fishing Sites	--	No funding in KBRA		

Source: Source: Dunsmoor 2011; Tucker 2011; Hillemeier 2011

2012 dollars as estimated using IMPLAN

<sup>1</sup> Total Effect = Direct + Indirect + Induced Effects

<sup>2</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>3</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>4</sup> Output represents the dollar value of industry production.

Spending on local actions would affect employment, labor income, and output in the regional economy. Most actions would be implemented by tribal staff and would positively affect the economic conditions of the tribes. A portion of the funding would result in positive effects in the construction sector and professional and technical services sector. Implementation of the Tribal Program actions would increase employment, labor income, and output in the regional economy relative to the No Action/No Project Alternative. The Tribal Program actions could add to the effects of the hydroelectric facility removal actions analyzed above if tribal members are employed for dam deconstruction activities. The additive effects would only occur in years that project implementation overlaps.

### **Alternative 3: Partial Facilities Removal of Four Dams**

#### ***Four Facilities***

*Construction activities could increase jobs, labor income, and output in the regional economy during the construction period in Klamath and Siskiyou Counties. Partial facilities removal is estimated to cost approximately \$135.4 million<sup>3</sup> in 2012 dollars*

<sup>3</sup> Dam removal as described in this EIS/R would occur from May 2019 through December 2020. For this socioeconomic analysis all effects have been described in 2012 dollars to allow comparison between economic effects and alternatives. These costs for facilities removal should not be considered a most probable cost estimate for dam removal in 2020. For a more detailed analysis of the cost of dam removal please see Detailed Plan for Dam Removal – Klamath River Dams, June 2011.

(Reclamation 2011). Expenditures associated with the Partial Facilities Removal of Four Dams Alternative spent within the region were estimated to be \$84.7 million (Reclamation 2011).

The effects of partial facility removal on employment, labor income, and output are shown in Table 3.15-62. Effects would be short-term and occur only during dam decommissioning, which would occur in 2020 for the duration of one year. Most economic effects would be in the sector where the direct impact occurs. For dam deconstruction expenditures, this analysis assumes direct effects would mostly occur in the construction sector. Employment created in this sector could be full time or part time and include various types of jobs, similar to those described for the Proposed Action.

**Table 3.15-62. Regional Economic Effects from Dam Decommissioning for Alternative 3**

	<b>Employment<sup>1</sup></b> (Jobs)	<b>Labor income<sup>2</sup></b> (\$ millions)	<b>Output<sup>3</sup></b> (\$ millions)
Total effect <sup>4</sup>	1,138	48.11	131.84

Source: Reclamation 2011 data presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

*Changes in annual O&M expenditures for the Partial Facilities Removal of Four Dams Alternative could reduce jobs, labor income, and output in the regional economy. Annual O&M expenditures for the Partial Facilities Removal of Four Dams Alternative were estimated at \$129,000. These annual O&M expenditures would partially offset the lost O&M expenditures under the No Action/No Project Alternative. However, under the Partial Facilities Removal of Four Dams Alternative annual O&M expenditures would result in a long term loss to the regional economy compared to the No Action/No Project Alternative, shown in Table 3.15-63. For reduced O&M expenditures, this analysis assumes direct effects would occur in the construction sector. Economic effects under Partial Facilities Removal of Four Dams Alternative would be long term and adverse relative to the No Action/No Project Alternative.*

**Table 3.15-63. Regional Economic Effects from O&M Expenditures between the No Action/No Project Alternative and Alternative 3**

	Employment <sup>1</sup>		Labor income <sup>2</sup>		Output <sup>3</sup>	
	Jobs	% Change from No Action	\$ millions	% Change from No Action	\$ millions	% Change from No Action
Total effect <sup>4</sup>	-47.4	-96.0	-1.98	-96.0	-5.00	-96.0

Source: Reclamation 2011 presented in 2012 dollars.

<sup>1</sup> Employment is measured in number of jobs.

<sup>2</sup> Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.

<sup>3</sup> Output represents the dollar value of industry production.

<sup>4</sup> Total Effect = Direct + Indirect + Induced Effects

*Mitigation spending after the deconstruction period could increase economic output, employment, and labor income.* Effects from mitigation spending would be temporary, short-term effects and would vary year by year from 2018-2025. Partial facility mitigation costs by facility and year are shown in Table 3.15-64.

**Table 3.15-64. Mitigation Costs by Facility Year (2012 \$) for Alternative 3**

Year	J.C. Boyle	Copco 1	Copco 2	Iron Gate	Yreka Water Supply	Total
2018	1,520,000	0	0	2,910,000	0	4,430,000
2019	1,790,000	3,800,000	2,020,000	6,500,000	0	14,110,000
2020	2,780,000	9,050,000	580,000	6,040,000	1,000,000	19,450,000
2021	1,970,000	4,250,000	0	3,360,000	0	9,580,000
2022	240,000	0	0	470,000	0	710,000
2023	240,000	0	0	470,000	0	710,000
2024	240,000	0	0	470,000	0	710,000
2025	240,000	0	0	470,000	0	710,000
					Total	50,410,000

Source: Reclamation 2011

The regional economic effects related to dam decommissioning mitigation for the Partial Facilities Removal of Four Dams Alternative were assumed to be the same as the Proposed Action. For mitigation expenditures, this analysis assumes direct effects would occur in the construction sector. Economic effects under Partial Facilities Removal of Four Dams Alternative would be positive and short term relative to the No Action/No Project Alternative.

***Commercial Fishing, Recreation, Indian Tribe, PacifiCorp Hydroelectric Service, Property Values and Local Government Revenues, PacifiCorp Property Taxes, and KBRA***

Economic effects of the Partial Facilities Removal of Four Dams Alternative would be the same as the Proposed Action.

#### **Alternative 4: Fish Passage at Four Dams**

The KHSA Section 3.2.1(iii), signed by Secretary of the Interior Ken Salazar on February 18, 2010, directs the Secretary to undertake environmental review in support of the Secretarial Determination. All alternatives carried forward for further analysis in the EIS/EIR were analyzed using existing studies and other appropriate data as suggested in KHSA Section 3.2.1 (i), where such analysis met criteria in (40 CFR 1502.22 and 43 CFR 46.125) to incorporate available information. As part of developing the basis for the Secretarial Determination, the KHSA requires in Section 3.3.2 that the Secretary prepare a Detailed Plan, including the identification, qualifications, management, and oversight of a non-federal DRE, if any, that the Secretary may designate. KHSA Section 3.3.4.D requires that an estimate of costs be prepared as part of the Detailed Plan. The Detailed Plan analysis provides most of the information for the project description for Alternatives 2 and 3, and this information was used to analyze these two action alternatives. As described in KHSA Section 3.2.1(i), the FERC record is used to form the project description for Alternatives 4 and 5. Alternatives 4 and 5 were analyzed to ensure that the review of reasonable fish passage alternatives was comprehensive. In addition, at the time of developing a reasonable range of alternatives, the lead agencies recognized that the inclusion of Alternatives 4 and 5 would provide an assessment of the short- and long-term effects from a broader range of reasonable alternatives. Alternatives 4 and 5 are outside the authority of the DOI, the four facilities proposed for removal are privately owned structures, and there was no provision in the KHSA to include them in the Detailed Plan. The result is differing levels of available information for alternatives carried forward in the EIS/EIR consistent with the elements of each action alternative.

Regional economic effects were quantified for the No Action/No Project Alternative, the Proposed Action, and the Partial Facilities Removal of Four Dams Alternative. These regional economic effects provide the broadest range of economic impacts expected from implementation of any of the alternatives and bookend the expected economic impact to the area of analysis. Once that information was developed, a comparative analysis of the Fish Passage at Four Dams Alternative and Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative provide the information required to evaluate the relative impacts of each action alternative within the identified range of economic effects. Specific economic effects for construction and changes in commercial fishing, recreation, and irrigated agriculture were not individually quantified for Fish Passage at Four Dams Alternative and Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative. The missing data is relevant to reasonable foreseeable significant adverse human effects on the environment. However that unavailable data is not essential to a reasoned choice among alternatives because potential impacts can be compared to the data developed for the No Action/No Project Alternative, the Proposed Action, and Partial Facilities Removal of Four Dams Alternative. The range of impacts anticipated for the two alternatives for which data is missing falls within the range of impacts analyzed and data developed for the remaining alternatives, though the ratio of expenditures to impacts might not have the same proportional effect across the various economic sectors. The comparative analysis required by NEPA is achieved using this qualitative method.

### ***Four Facilities***

*Construction of fish passage facilities, O&M expenditures, and mitigation spending could increase jobs, labor income, and output in the regional economy during the construction period.* Expenditures would occur in the region to support construction of fish passage facilities. In-region spending would increase jobs, labor income and output in Klamath and Siskiyou Counties relative to the No Action/No Project Alternative. Positive regional economic effects would only occur during the construction period. Hydroelectric facilities would continue to operate under this alternative; therefore, O&M annual expenditures would continue similar to the No Action/No Project Alternative. Some mitigation would be required for this alternative, which would result in increased in-region spending relative to the No Action/No Project Alternative.

### ***Commercial Fishing***

*Changes in commercial fishing harvests could change fishing revenues and affect employment, labor income and output in the regional economy.* Construction of fish passage facilities would increase migratory fish habitat availability above Iron Gate Dam, and as described in Section 3.3, Aquatic Resources, would result in increased commercial fishery populations when compared to existing conditions. Positive effects related to increased fish harvests would increase relative to the No Action/No Project Alternative, but these effects would not be as great as Alternative 2 or 3.

### ***Recreation (Reservoir, In-River Sport Fishing, Ocean Sport Fishing, Whitewater Boating)***

*Changes in recreational opportunities could affect the regional economy.* The dams would remain in place and visitors could use the reservoirs for existing activities, including boating, water skiing, and fishing. Spending in the region related to reservoir recreation would continue at existing levels.

The development of fish passage facilities may also have a positive effect on visitation levels and expenditures for ocean sport fishing trips relative to the No Action/No Project Alternative, but these effects would not be as great as Alternatives 2 or 3.

The fish passage facilities may also have a positive effect on visitation levels and expenditures for ocean sport fishing trips relative to the No Action/No Project Alternative, but these effects would not be as great as Alternatives 2 or 3.

Implementation of the Fish Passage at Four Dams Alternative would result in a loss of acceptable flows for whitewater boating opportunities in the Hell's Corner Reach as compared to existing conditions. The flow conditions and prescriptions outlined in Chapter 2 would reduce the current daily peaking flows, which support whitewater rafting in the Hell's Corner Reach, to a minimum streamflow of 1,500 cfs, which must be provided no more than once per week. This would result in an adverse reduction in rafting trips and recreation expenditures.

### ***Indian Tribes***

*Fish passage at the four dams could affect the existing economic conditions of Indian Tribes in the area of analysis.* Implementation of the Fish Passage at Four Dams

Alternative would generate a positive effect on fish populations and tribal harvests for subsistence, cultural practices and commercial uses relative to the No Action/No Project Alternative. The positive economic effects generated by the KBRA for the tribes would not be realized under this alternative, and the positive economic effects generated by the development of fish passage facilities would be smaller than the effects anticipated under the Proposed Action as a result. However, increased fish harvest for subsistence, cultural practices and commercial uses would represent an economically positive effect for Indian Tribes, although this effect would not be as great as under Alternatives 2 or 3.

***PacifiCorp Hydroelectric Service***

*Fish passage at four dams could result in increased energy rates for PacifiCorp customers.* PacifiCorp estimated that costs to develop fish passage at the Four Facilities consistent with the Mandatory Conditions imposed by the DOI and the United States Department of Commerce (DOC) would cost more than implementation of the KHSA (OPUC 2010). In its ruling to approve KHSA surcharges, the OPUC concluded that PacifiCorp “has demonstrated that customer costs under the KHSA are capped below projected costs to relicense and continue operation of the Klamath dams.” Further, the OPUC concluded the following:

“Ratepayers will be responsible for significant future costs for the Klamath Project (regardless of the disposition of the dams). The nature and scope of these costs has been unclear, however, since 2000 when Pacific Power [PacifiCorp] first provided notice of the Company's need to seek federal relicensing of the Project. We are persuaded that continued pursuit of the relicensing option would pose significant risks to ratepayers. The nature and scope of the costs involved with relicensing would remain uncertain and subject to significant escalation for a considerable period of time.

The KHSA in contrast, offers a more certain path for the Project's future, providing a timeline for continued operation until December 31, 2010, followed by transfer of the facilities to a third party responsible for removing the dams. The KHSA also caps customer costs and liabilities for Klamath dam removal and the environmental restoration of the Klamath River at a reasonable level, while providing customers with renewable replacement power. Further, we believe that Pacific Power has reasonably estimated the cost of replacement power if the Klamath dams are decommissioned. Due to significant tangible and intangible benefits associated with the KHSA, we conclude it is in the best interest of customers and find the KHSA surcharges to be fair, just and reasonable.

We reviewed the detailed economic studies of the KHSA surcharges, we analyzed the projected costs of both relicensing and decommissioning of the dams, and we asked specific questions of Pacific Power, Staff and the parties at a workshop. We considered both the quantifiable and unquantifiable benefits and risks of the KHSA and relicensing options.

We are persuaded that Pacific Power carefully analyzed the nature and scope of projected costs for both futures for the dams. As Staff and others do, we believe that there are substantial unquantified risks associated with continued pursuit of a FERC license that is not captured in the economic analysis. Pacific Power and parties deeply involved in the relicensing process, such as the Intervenor State Agencies and the Joint Parties, all testified that the relicensing option analysis significantly underestimates the true cost of relicensing.

These parties indicate that the projected relicensing costs are subject to significant risk of escalation with no guarantee that a FERC license will ever be issued due, in particular, to great uncertainty about water quality certification. Yet, even though the full expected costs of the relicensing option is not captured in Pacific Power's analysis, the analysis still shows that the KHSA results in lower rates for Oregon customers, as well as all customers of Pacific Power. If the risks associated with the relicensing scenario could be quantified, we believe that the relative economic benefits of the KHSA would likely be great.

We observe that no party testified that the relicensing option would likely result in lower rates and better service for customers. Industrial Customers of Northwest Utilities (ICNU) criticizes the KHSA surcharge rates, but does so in comparison to hypothesized "normal" ratemaking for costs associated with removing a hydroelectric dam. Ten years into a process to resolve the future of the Reclamation's Klamath Project with no "normal" resolution in sight, we conclude that it's not reasonable to compare proposed solutions to so-called "normal" ratemaking scenarios.

Because the KHSA limits costs and manages risk better than relicensing, we find the KHSA to be in the best interest of customers, and we determine that the KHSA surcharges are, therefore, fair, just and reasonable.” (OPUC 2010).

Therefore, it is assumed that, under the Fish Passage at Four Dams Alternative, customer rates would likely increase above the existing surcharges as a direct result of construction, operations and maintenance costs for fish passage facilities. The degree to which the cost could be passed to the ratepayers is not known and would be subject to Oregon and CPUCs.

***Property Values and Local Government Revenues***

*Property values could be affected by the fish passage at four dams near Copco I and Iron Gate Reservoir.* The dams would remain in place under this alternative; therefore, the property values of parcels with full or partial reservoir views would not change. Land values would be the same as the No Action/No Project Alternative. Property tax revenues to Klamath and Siskiyou Counties would also not change relative to the No Action/No Project Alternative.

*Fish passage at four dams could affect property tax revenues to Siskiyou and Klamath Counties from PacifiCorp.* PacifiCorp would continue to own and operate hydroelectric

facilities and would continue to pay property taxes. County tax revenues would not change relative to the No Action/No Project Alternative.

### ***KBRA***

Under this alternative, the KBRA would not be fully implemented, and the socioeconomic effects related to implementation of ongoing resource management plans would be similar to those for the No Action/No Project Alternative.

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

Analysis of Alternative 5 was conducted in a similar approach to Alternative 4. See discussion of effects analysis approach under Alternative 4 above.

### ***Four Facilities***

*Construction of fish passage facilities, O&M expenditures, and mitigation spending could increase jobs, labor income, and output in the regional economy during the construction period.* Expenditures would occur in the region to support construction of fish passage facilities. In-region spending would increase jobs, labor income and output in Klamath and Siskiyou Counties relative to the No Action/No Project Alternative. Positive regional economic effects would only occur during the construction period. Hydroelectric facilities at J.C. Boyle and Copco 2 Reservoirs would continue to operate under this alternative; therefore, O&M annual expenditures would continue for these sites. Positive regional economic effects would increase relative to the No Action/No Project Alternative, but be less than the Proposed Action. Some mitigation would be required for this alternative, which would result in increased in-region spending relative to the No Action/No Project Alternative.

### ***Commercial Fishing***

*Changes in commercial fishing harvests could change fishing revenues and affect employment, labor income and output in the regional economy.* Removal of the Copco 1 and Iron Gate dams and the construction of fish passage facilities at J.C. Boyle and Copco 2 dams would increase migratory fish habitat availability above Iron Gate Dam, and as described in Section 3.3, Aquatic Resources, would result in increased commercial fishery populations when compared to existing conditions. Positive effects related to increased fish harvests would increase relative to the No Action/No Project Alternative, although this effect would not be as large as Alternatives 2 or 3.

### ***Recreation (Reservoir, In-River Sport Fishing, Ocean Sport Fishing, Whitewater Boating)***

*Changes in recreational opportunities could affect the regional economy.* Iron Gate and Copco 1 Facilities would be removed, eliminating in-reservoir recreation at these sites. Effects would be similar to the Proposed Action. Reservoir recreation at J.C. Boyle Reservoir would continue, which would have economic effects similar to the No Action/No Project Alternative.

Visitation levels and expenditures for in-river fishing would increase because of increased fish populations under this alternative relative to the No Action/No Project Alternative, although this effect would not be as great as Alternatives 2 or 3.

Ocean sport fishing trips could also increase relative to the No Action/No Project Alternative, which would increase employment, labor income, and output in the regional economy; however, this effect would not be as great as Alternatives 2 or 3.

The loss of peaking flows in the Hell’s Corner Reach would result in the river returning to natural flow conditions, with no ability to re-regulate peaking flows. Thus, there would be diminished whitewater boating opportunities in this reach. This would result in fewer rafting trips and reduced recreation expenditures and be a long-term adverse effect.

### ***Indian Tribes***

*Alternative 5 could affect the existing economic conditions of Indian Tribes in the area of analysis.* Implementation of Alternative 5 would generate a positive effect on fish populations and tribal harvests for subsistence, cultural practices and commercial uses relative to the No Action/No Project Alternative. The positive economic effects generated by the KBRA for the tribes would not be realized under this alternative, and the positive economic effects to tribes would be smaller than the effects anticipated under the Proposed Action as a result. However, increased fish harvest for subsistence, cultural practices and commercial uses would represent an economically positive effect for Indian Tribes, although this effect would not be as great as with Alternatives 2 or 3.

### ***PacifiCorp Hydroelectric Service***

*Removal of two dams and fish passage at two dams could result in increased energy rates for PacifiCorp customers.* The costs for the removal of two dams and fish ladders would not be covered under the KHSA agreement and would likely become the responsibility of PacifiCorp and its ratepayers. The cost for removal of the Iron Gate and Copco 1 Dams is approximately \$124 million<sup>4</sup> in 2012 dollars, as estimated for removal of these two dams for the Proposed Action (Reclamation 2011a). As described above for Alternative 4, PacifiCorp has estimated that fish passage would be more costly than dam removal; therefore, it is assumed that fish passage at Copco 2 and J.C. Boyle Dams would be more than dam removal costs. Therefore, under this alternative, customer rates would likely increase above the existing surcharges as a direct result of construction, operations and maintenance costs for fish passage facilities at two dams and the removal of Iron Gate and Copco 1 Dams. The degree to which the cost could be passed to the ratepayers is not known and would be subject to Oregon and California PUCs.

### ***Property Values and Local Government Revenues***

*Property values could be affected by the fish passage at four dams near Copco 1 and Iron Gate Reservoir.* Parcels with views of Copco 2 Reservoir would not be affected under

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<sup>4</sup> Dam removal as described in this EIS/R would occur from May 2019 through December 2020. For this socioeconomic analysis, all effects have been described in 2012 dollars to compare economic effects of alternatives. These costs for facilities removal should not be considered a most probable cost estimate for dam removal in 2020. For a more detailed analysis of the cost of dam removal please see Detailed Plan for Dam Removal – Klamath River Dams, June 2011.

this alternative. As described in the affected environment, there are no parcels with views of J.C. Boyle Reservoir. Property tax payments to Siskiyou County from affected parcels around Copco 1 and Iron Gate Reservoirs would decrease relative to the No Action/No Project Alternative. In the long-term, river views associated with the parcels could increase property values.

*Alternative 5 could affect property tax revenues to Siskiyou and Klamath Counties from PacifiCorp Changes in ownership of hydroelectric facilities could reduce county property tax revenues. PacifiCorp property tax payments to Siskiyou County from land ownership of Copco 1 and Iron Gate Reservoirs would discontinue relative to the No Action/No Project Alternative. Effects would be similar in magnitude to the Proposed Action.*

***KBRA***

Under this alternative, the KBRA would not be fully implemented. Under this alternative, socioeconomic effects related to implementation of ongoing resource management plans would be similar to those for the No Action/No Project Alternative.

**Summary of Economic Effects**

Table 3.15-65 summarizes economic effects quantified in this section. Table 3.15-66 summarize effects of ongoing restoration actions and the KBRA under each alternative.

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

<b>Category</b>	<b>Alternative 1 - No Action</b>	<b>Alternative 2 - Full Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 3 - Partial Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 4 - Fish Passage at Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate</b> Incremental changes from Alternative 1
<p><b>Dam Decommissioning</b></p> <p><b>Economic Region:</b> Klamath County OR Siskiyou County CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 48,204 Labor Income: \$1,928 million Output: \$5,139 million</p>	<p>No dam decommissioning under Alternative 1.</p>	<p>Short-term effects during the one year decommissioning. Increase of approximately 1,400 jobs, \$60 million in labor income, and \$163 million in output.</p>	<p>Short-term effects during the one year decommissioning. Increase of approximately 1,100 jobs, \$48 million in labor income, and \$132 million in output.</p>	<p>Short-term effects during the construction period. Would increase jobs, labor income, and output relative to Alternative 1.</p>	<p>Short-term effects during the construction period. Would increase jobs, labor income, and output relative to Alternative 1.</p>
<p><b>Operation and Maintenance</b></p> <p><b>Economic Region:</b> Klamath County OR Siskiyou County CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 48,204 Labor Income: \$1,928 million Output: \$5,139 million</p>	<p>O&amp;M expenditures would support 49 jobs, \$2 million in labor income and \$5 million in output.</p>	<p>No long-term annual O&amp;M expenditures. Decrease of approximately 49 jobs, \$2 million of labor income, and \$5 million in output.</p>	<p>Decrease of approximately 2 jobs. Labor income and output would remain the same compared to Alternative 1</p>	<p>O&amp;M expenditures and effect on regional economy would be similar to Alternative 1.</p>	<p>Decrease O&amp;M expenditures and adversely affect the regional economy.</p>

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

<b>Category</b>	<b>Alternative 1 - No Action</b>	<b>Alternative 2 - Full Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 3 - Partial Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 4 - Fish Passage at Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate</b> Incremental changes from Alternative 1
<p><b>Mitigation</b></p> <p><b>Economic Region:</b> Klamath County OR Siskiyou County CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 48,204 Labor Income: \$1,928 million Output: \$5,139 million</p>	None mitigation under Alternative 1.	Temporary, short-term effects from 2018-2025. Increase of approximately 220 jobs, \$10 million in labor income, and \$31 million in output.	Same as Alternative 2.	Some mitigation would be required. Increase relative to Alternative 1.	Some mitigation would be required. Increase relative to Alternative 1.

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

<b>Category</b>	<b>Alternative 1 - No Action</b>	<b>Alternative 2 - Full Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 3 - Partial Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 4 - Fish Passage at Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate</b> Incremental changes from Alternative 1
<p><b>Irrigated Agriculture</b></p> <p><b>Economic Region:</b> Klamath County OR Siskiyou and Modoc Counties CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 52,141 Labor Income: \$2,083 million Output: \$5,497 million</p>	<p>Effects equal for all years except drought years of 1975, 1992, 1994, 2001, and 2008.</p> <p>2027 — Jobs 1,361 Labor Income \$45 million Output \$184 million</p> <p>2043 — Jobs 766 Labor Income \$33 million Output \$118 million</p> <p>2045 — Jobs 1,076 Labor Income \$40 million Output \$156 million</p> <p>2051 — Jobs 1,286 Labor Income \$44 million Output \$177 million</p> <p>2059 — Jobs 1,403 Labor Income \$46 million Output \$188 million</p>	<p>Effects equal for all years except drought years. Increased job, labor income, and employment in drought years relative to Alternative 1.</p> <p>2027 — Jobs +112 Labor Income +\$2 million Output +\$13 million</p> <p>2043 — Jobs +695 Labor Income +\$11 million Output +\$84 million</p> <p>2045 — Jobs +397 Labor Income +\$7 million Output +\$41 million</p> <p>2051 — Jobs +187 Labor Income +\$4 million Output \$20 million</p> <p>2059 — Jobs +70 Labor Income +\$2 million Output +\$9 million</p>	<p>Same as Alternative 2</p>	<p>Same as Alternative 1.</p>	<p>Same as Alternative 1.</p>

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams Incremental changes from Alternative 1	Alternative 3 - Partial Facilities Removal of Four Dams Incremental changes from Alternative 1	Alternative 4 - Fish Passage at Four Dams Incremental changes from Alternative 1	Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Incremental changes from Alternative 1
<p><b>Commercial Fishing</b></p> <p><b>San Francisco Management Area</b> Employment (Jobs): 3,060,366 Labor Income: \$204,685 million Output: \$599,164 million</p> <p><b>Fort Bragg Management Area</b> Employment (Jobs): 40,117 Labor Income: \$1,731 million Output: \$4,814 million</p> <p><b>KMZ-CA</b> Employment (Jobs): 71,633 Labor Income: \$2,983 million Output: \$7,360 million</p> <p><b>KMZ-OR</b> Employment (Jobs): 8,656 Labor Income: \$311 million Output: \$859 million</p> <p><b>Central Oregon Management Area</b> Employment (Jobs): 258,047 Labor Income: \$10,170 million Output: \$27,815 million</p>	<p>Regional economic effects supported by ocean commercial fishing</p> <p><b>San Francisco Management Area</b> Jobs: 510 Labor Income: \$6.10 million Output: \$15.52 million</p> <p><b>Fort Bragg Management Area</b> Jobs: 162 Labor Income: \$2.45 million Output: \$5.62 million</p> <p><b>KMZ-CA</b> Jobs: 44 Labor Income: \$0.19 million Output: \$0.45 million</p> <p><b>KMZ-OR</b> Jobs: 26 Labor Income: \$0.15 million Output: \$0.33 million</p> <p><b>Central Oregon Management Area</b> Jobs: 319 Labor Income: \$4.15 million Output: \$9.55 million</p>	<p>Increased job, labor income, and employment relative to Alternative 1.</p> <p><b>San Francisco Management Area</b> Jobs: +218 Labor Income: +\$2.56 million Output: +\$6.6 million</p> <p><b>Fort Bragg Management Area</b> Jobs: +69 Labor Income: +\$1.05 million Output: +\$2.41 million</p> <p><b>KMZ-CA</b> Jobs: +19 Labor Income: +\$0.07 million Output: +\$0.19 million</p> <p><b>KMZ-OR</b> Jobs: +11 Labor Income: +\$0.06 million Output: +\$0.13 million</p> <p><b>Central Oregon Management Area</b> Jobs: +136 Labor Income: +\$1.74 million Output: +\$4.07 million</p>	<p>Same as Alternative 2.</p>	<p>Positive, long-term effects. Increase relative to Alternative 1, but less than the Proposed Action and Alternative 3.</p>	<p>Positive, long-term effects. Increase relative to Alternative 1, but less than the Proposed Action and Alternative 3.</p>

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

<b>Category</b>	<b>Alternative 1 - No Action</b>	<b>Alternative 2 - Full Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 3 - Partial Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 4 - Fish Passage at Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate</b> Incremental changes from Alternative 1
<p><b>In-River Sport Fishing</b></p> <p><b>Economic Region:</b> Klamath County OR Del Norte, Humboldt, and Siskiyou Counties CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 119,837 Labor Income: \$4,911 million Output: \$12,499 million</p>	<p><b>Recreational Salmon Fishery</b> In river salmon fishing trip expenditures support 34 jobs, \$0.93 million of labor income and \$2.01 million in output.</p> <p><b>Recreational Steelhead Fishery</b> In river salmon fishing trip expenditures support 20 jobs, \$0.62 million of labor income and \$1.31 million in output.</p> <p><b>Recreational Redband Trout Fishery</b> Non-resident angler trips likely to remain similar to Existing Conditions. Insufficient data to quantify regional economic impacts.</p>	<p><b>Recreational Salmon Fishery</b> Increase of 3 jobs and \$0.07 million of labor income and \$0.15 million in output.</p> <p><b>Recreational Steelhead Fishery</b> Possible increase in steelhead abundance. Insufficient data to quantify regional economic impacts.</p> <p><b>Recreational Redband Trout Fishery</b> Probable increase in Redband abundance and distribution. Insufficient data to quantify regional economic impacts.</p>	<p>Same as Alternative 2</p>	<p>Positive, long-term effects. Increase relative to Alternative 1, but less than the Proposed Action and Alternative 3.</p>	<p>Positive, long-term effects. Increase relative to Alternative 1, but less than the Proposed Action and Alternative 3.</p>

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

<b>Category</b>	<b>Alternative 1 - No Action</b>	<b>Alternative 2 - Full Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 3 - Partial Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 4 - Fish Passage at Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate</b> Incremental changes from Alternative 1
<p><b>Ocean Sport Fishing</b></p> <p><b>KMZ-OR</b> Ocean sport fishing supports 3 jobs, \$0.08 million of labor income, and \$0.21 million in output.</p> <p><b>KMZ-CA</b> Ocean sport fishing supports 13 jobs, \$0.42 million of labor income, and \$1.12 million in output.</p> <p><b>KMZ-OR</b> Employment (Jobs): 8,656 Labor Income: \$311 million Output: \$859 million</p> <p><b>KMZ-CA</b> Employment (Jobs): 71,633 Labor Income: \$2,983 million Output: \$7,360 million</p>	<p><b>KMZ-OR</b> Ocean sport fishing supports 3 jobs, \$0.08 million of labor income, and \$0.21 million in output.</p> <p><b>KMZ-CA</b> Ocean sport fishing supports 13 jobs, \$0.42 million of labor income, and \$1.12 million in output.</p>	<p><b>KMZ-OR</b> Increase of approximately 1 job, \$0.02 million in labor income, and \$0.09 million.</p> <p><b>KMZ-CA</b> Increase of 5 jobs, \$0.18 million of labor income, and \$0.48 million in output.</p>	<p>Same as Alternative 2.</p>	<p>Positive, long-term effects. Increase relative to Alternative 1, but less than the Proposed Action and Alternative 3.</p>	<p>Positive, long-term effects. Increase relative to Alternative 1, but less than the Proposed Action and Alternative 3.</p>
<p><b>Refuge Recreation</b></p> <p><b>Economic Region:</b> Klamath County OR Siskiyou County CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 48,204 Labor Income: \$1,928 million Output: \$5,139 million</p>	<p>Refuge hunting expenditures supports 11 jobs, \$0.26 million of labor income and \$0.62 million in output.</p>	<p>Increase of 5 jobs, \$0.12 million in labor income, and \$0.27 million in output.</p>	<p>Same as Alternative 2.</p>	<p>Similar to Alternative 1.</p>	<p>Similar to Alternative 1.</p>

**Table 3.15-65. Summary of Regional Economic Effects for Each Alternative**

<b>Category</b>	<b>Alternative 1 - No Action</b>	<b>Alternative 2 - Full Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 3 - Partial Facilities Removal of Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 4 - Fish Passage at Four Dams</b> Incremental changes from Alternative 1	<b>Alternative 5 - Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate</b> Incremental changes from Alternative 1
<p><b>Reservoir Recreation</b></p> <p><b>Economic Region:</b> Klamath County OR Siskiyou County CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 48,204 Labor Income: \$1,928 million Output: \$5,139 million</p>	<p>Reservoir recreation expenditures supports 7 jobs, \$0.22 million in labor income and \$0.54 million in output.</p>	<p>Decrease of approximately 4 jobs, \$0.13 million in labor income and \$0.31 in output.</p>	<p>Same as Alternative 2.</p>	<p>Same as Alternative 1.</p>	<p>Same as Alternative 2 for recreation losses at Iron Gate and Copco 1 Reservoirs. Same as Alternative 1 because of maintained recreation at J.C. Boyle Reservoir.</p>
<p><b>Whitewater Recreation</b></p> <p><b>Economic Region:</b> Klamath, Jackson Humboldt, and Siskiyou counties</p> <p><b>Regional Economy:</b> Employment (Jobs): 224,667 Labor Income:\$8,682 million Output: \$23,330 million</p>	<p>Whitewater boating expenditures supports 56 jobs, \$1.56 million in labor income and \$4.31 million in output.</p>	<p>Decrease of approximately 14 jobs, \$0.43 million in labor income and \$0.89 million in output.</p>	<p>Same as Alternative 2.</p>	<p>Negative, long-term effects on the regional economy. Decrease relative to Alternative 1.</p>	<p>Negative, long-term effects on the regional economy. Decrease relative to Alternative 1.</p>

Source: Reclamation 2011 for Alternatives 1, 2, and 3

**Table 3.15-66. Summary of Regional Economic Effects over 15 Years of Ongoing Restoration Activities and KBRA Implementation**

KBRA Program	Alternative 1 - No Action/No Project Alternative	Alternative 2, Proposed Action, Incremental Changes to Alternative 1	Alternative 3 Incremental Changes to Alternative 1	Alternative 4 Incremental Changes to Alternative 1	Alternative 5 Incremental Changes to Alternative 1
<p><b>Fisheries Program</b></p> <p><b>Economic Region:</b> Klamath County OR Del Norte, Humboldt, and Siskiyou Counties CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 119,837 Labor Income: \$4,911 million Output: \$12,499 million</p>	<p>Fishery restoration, reintroduction and monitoring expenditures supports 2,015 jobs, \$95 million in labor income and \$203 million in output.</p>	<p>Increase of approximately 3,917 jobs, \$186.8 million in labor income and \$380 million in output.</p>	<p>Same as Alternative 2.</p>	<p>Similar to Alternative 1.</p>	<p>Similar to Alternative 1.</p>
<p><b>Water Resources Program</b></p> <p><b>Economic Region:</b> Klamath County OR Del Norte, Humboldt, and Siskiyou Counties CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 119,837 Labor Income: \$4,911 million Output: \$12,499 million</p> <p><b>Economic Region (related to Klamath Project):</b> Klamath County OR Modoc and Siskiyou Counties CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 52,140 Labor Income: \$2,082 million Output: \$5,498 million</p>	<p>No ongoing activities under the water resources program.</p>	<p>Water resources program expenditures supports 243 jobs, \$11.2 million in labor income and \$24.2 million in output.</p> <p>See for Irrigated Agriculture and Refuge Recreation Table 3.15-65 for effects of KBRA actions.</p>	<p>Same as Alternative 2.</p>	<p>Similar to Alternative 1.</p>	<p>Similar to Alternative 1.</p>

**Table 3.15-66. Summary of Regional Economic Effects over 15 Years of Ongoing Restoration Activities and KBRA Implementation**

KBRA Program	Alternative 1 - No Action/No Project Alternative	Alternative 2, Proposed Action, Incremental Changes to Alternative 1	Alternative 3 Incremental Changes to Alternative 1	Alternative 4 Incremental Changes to Alternative 1	Alternative 5 Incremental Changes to Alternative 1
<p><b>Regulatory Assurances:</b></p> <p><b>Economic Region:</b> Klamath County OR Del Norte, Humboldt, and Siskiyou Counties CA</p> <p><b>Regional Economy:</b> Employment (Jobs): 119,837 Labor Income: \$4,911 million Output: \$12,499 million</p>	No ongoing activities	Implementation of regulatory assurances would support 146 jobs, \$7 million in labor income and \$14.4 million in output.	Same as Alternative 2.	Similar to Alternative 1.	Similar to Alternative 1.
<p><b>County Program:</b></p> <p><b>Siskiyou County CA</b> Employment (Jobs): 17,679 Labor Income: \$755 million Output: \$2,107 million</p> <p><b>Klamath County OR</b> Employment (Jobs): 30,525 Labor Income: \$1,174 million Output: \$3,032 million</p>	No ongoing activities	<p>\$20 million of funding for Siskiyou County would increase jobs, labor income and output.</p> <p>\$3.2 million of funding for Klamath County would increase jobs, labor income and output.</p>	Same as Alternative 2.	Similar to Alternative 1.	Similar to Alternative 1.

**Table 3.15-66. Summary of Regional Economic Effects over 15 Years of Ongoing Restoration Activities and KBRA Implementation**

KBRA Program	Alternative 1 - No Action/No Project Alternative	Alternative 2, Proposed Action, Incremental Changes to Alternative 1	Alternative 3 Incremental Changes to Alternative 1	Alternative 4 Incremental Changes to Alternative 1	Alternative 5 Incremental Changes to Alternative 1
<p><b>Tribal Program:</b></p> <p><b>Karuk Tribes:</b> Siskiyou County CA Employment (Jobs): 17,679 Labor Income: \$755 million Output: \$2,107 million</p> <p><b>Klamath Tribes:</b> Klamath County OR Employment (Jobs): 30,525 Labor Income: \$1,174 million Output: \$3,032 million</p> <p><b>Yurok Tribes:</b> Humboldt County CA Employment (Jobs): 60,789 Labor Income: \$2,529 million Output: \$6,388 million</p>	<p>Karuk Tribal Program expenditures supports 237 jobs, \$10.5 million in labor income and \$16.3 million in output.</p> <p>Klamath Tribal Program expenditures supports 174 jobs, \$8.7 million in labor income and \$14.3 million in output.</p> <p>Yurok Tribal Program expenditures supports 208 jobs, \$10 million in labor income and \$17.8 million in output.</p>	<p>Increase of approximately 122 jobs, \$5.2 million in labor income and \$8.3 million in output.</p> <p>Increase of approximately 120 jobs, \$5.8 million in labor income and \$9.6 million in output.</p> <p>Increase of approximately 144 jobs, \$6.8 million in labor income and \$12.1 million in output.</p>	<p>Same as Alternative 2.</p>	<p>Similar to Alternative 1.</p>	<p>Similar to Alternative 1.</p>

Source: Barry 2011; Bird 2011; Dunsmoor 2011; Hicks 2011; Hillemeier 2011; Lynch 2011; Mahan. L et al. 2011; Nota 2011; Radford 2011; Stopher 2011; Tucker 2011; Wise 2011

**Summary of Positive Economic Effects**

Table 3.15-67 summarizes the positive economic effects of the Proposed Action and alternatives.

**Table 3.15-67. Positive Effects of the Proposed Action and Alternatives**

Effect	Alternatives				
	1	2	3	4	5
Changes in commercial fishing harvests could change fishing revenues and personal incomes.	NE	PE <sup>2</sup> (long-term effect)	PE <sup>3</sup> (long-term effect)	PE (long-term effect)	PE (long-term effect)
Changes in tribal fishing commercial harvests could affect tribal revenues.	NE	PE <sup>2</sup> (long-term effect)	PE <sup>3</sup> (long-term effect)	PE (long-term effect)	PE (long-term effect)
Changes to recreational in-river fishing opportunities could affect recreational expenditures in the regional economy.	NE	PE <sup>2</sup> (long-term effect)	PE <sup>3</sup> (long-term effect)	PE (long-term effect)	PE (long-term effect)
Changes to recreational ocean fishing opportunities associated with dam removal could affect recreational expenditures in the regional economy.	NE	PE <sup>2</sup> (long-term effect)	PE <sup>3</sup> (long-term effect)	PE (long-term effect)	PE (long-term effect)
Construction activities associated with dam removal would increase economic output, employment, and labor income during the construction period in Klamath and Siskiyou Counties.	NE	PE (temporary effect)	PE (temporary effect)	PE (temporary effect)	PE (temporary effect)
Mitigation spending after the deconstruction period could increase economic output, employment, and labor income.	NE	PE (temporary effect)	PE (temporary effect)	PE (temporary effect)	PE (temporary effect)
Removal of Four Facilities could increase property values of parcels near Copco 1 and Iron Gate Reservoirs.	NE	PE <sup>1</sup> (long-term effect)	PE <sup>1</sup> (long-term effect)	NE	PE <sup>1</sup> (long-term effect)
Changes in real estate values around Copco 1 and Iron Gate Reservoirs could increase property tax revenues to Siskiyou County.	NE	PE <sup>1</sup> (long-term effect)	PE <sup>1</sup> (long-term effect)	NE	PE <sup>1</sup> (long-term effect)
Construction worker spending could increase sales and use tax receipts in Siskiyou and Klamath Counties.	NE	PE (temporary effect)	PE (temporary effect)	PE (temporary effect)	PE (temporary effect)
KBRA actions could increase employment, labor income, and output in the regional economy.	NE	PE (temporary effect)	PE (temporary effect)	NE	NE
KBRA Water Resource Program actions could increase farm revenues to irrigators	NE	PE (long-term effect)	PE (long-term effect)	NE	NE
KBRA Water Resource Program actions could increase recreational expenditures at refuges	NE	PE (long-term effect)	PE (long-term effect)	NE	NE

Key:

Alternative 1 = No Action/No Project Alternative

Alternative 2 = Full Facilities Removal of Four Dams (Proposed Action)

Alternative 3 = Partial Facilities Removal of Four Dams Alternative

Alternative 4 = Fish Passage at Four Dams Alternative

Alternative 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

PE = Positive Effect

NE = No effect

1- Positive effects possible in future years, may be adverse effects in the short term.

2- Relative to Alternative 1, the long term positive effects of Alternative 2 are larger than the positive effect of Alternatives 4 and 5.

3- Same as Alternative 2.

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### **3.16 Environmental Justice**

This section identifies minority and low income populations that exist within the Klamath Basin and evaluates whether the environmental impacts of each alternative would result in a disproportionately high and adverse impact on minority and low income populations (Executive Order 12898, February 11, 1994). See Section 3.12, Tribal Trust, for a detailed description of tribal history, and Section 3.13, Cultural and Historic Resources, for additional discussion of other cultural, tribal, and religious freedom issues. See Section 3.8, Water Supply/Water Rights, for a discussion of water rights in the area of analysis.

This section examines, consistent with National Environmental Policy Act (NEPA) regulations and guidelines, the Proposed Action's potential impacts on minority and low income people. As described in the Effects Determination Methods (Section 3.16.4.1), impacts were assessed to determine if any community would bear a disproportionate share of the adverse environmental consequences resulting from the Proposed Action.

The U.S. Environmental Protection Agency (USEPA) Office of Environmental Justice defines environmental justice as the following:

The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies (USEPA 2011).

#### **3.16.1 Area of Analysis**

The area of analysis includes Del Norte, Humboldt, and Siskiyou Counties in northern California and Klamath County in southern Oregon. In addition, all six of the federally recognized tribes with territory within the four counties are included in the area of analysis, specifically The Klamath Tribes, Quartz Valley Indian Reservation Community, Karuk Tribe, Hoopa Valley Indian Tribe, Yurok Tribe, and the Resighini Rancheria. Environmental justice impacts from the Proposed Action and alternatives, including activities associated with implementation of the Klamath Hydroelectric Settlement Agreement (KHSA) and Klamath Basin Restoration Agreement (KBRA) would be limited to these areas.

#### **3.16.2 Regulatory Framework**

Environmental justice resources within the area of analysis are regulated by several federal, state, and local laws and policies, which are listed below.

### **3.16.2.1 Federal Authorities and Regulations**

- Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (59 FR 7629)
- Department of Interior (DOI) Environmental Justice Strategic Plan, 1995
- USEPA Environmental Justice Implementation Plan, 1996

### **3.16.2.2 State Authorities and Regulations**

- California Government Code section 65040.12 (G.C. §65040.12)
- California Working Group on Environmental Justice, Senate Bill 89 (2000)
- California Interagency Environmental Justice Strategy, Senate Bill 828 (2001)
- California Environmental Protection Indicators for California, Assembly Bill 1360 (2003)
- Oregon Environmental Justice Task Force, Senate Bill 420 (2007)

### **3.16.2.3 Local Authorities and Regulations**

- Siskiyou County General Plan (1973)
- Humboldt County General Plan (1984)
- Del Norte County General Plan (2003)
- Klamath County Comprehensive Plan (2010)

## **3.16.3 Existing Conditions/Affected Environment**

### **3.16.3.1 Demographics, Income, and Employment**

This section provides demographic information for the analysis of environmental effects and identifies low income and minority populations in the area of analysis.

#### **Race and Ethnicity**

Siskiyou, Humboldt, Del Norte, and Klamath Counties constitute the area that could experience direct or indirect effects from implementation of the Proposed Action and alternatives. While cities within these counties would also experience effects of the Proposed Action, demographic information from the counties is generally representative of the cities. Population, race, and ethnicity data from the Census 2005-2009 American Community Survey for California, Oregon, and the four counties are detailed in Table 3.16-1.

**Table 3.16-1. Population, Race, and Ethnicity, 2005-2009 American Community Survey**

Geographic Area	Total Population	White (percent)	Black or African American (percent)	American Indian and Alaska Native (percent)	Asian (percent)	Native Hawaiian and Other Pacific Islander (percent)	Some Other Race (percent)	Two Races Including Some Other Race (percent)	Two Races Excluding Some Other Race, and Three or More Races (percent)	Hispanic or Latino (of any race) (percent)
<b>California</b>	<b>36,308,527</b>	<b>61.3</b>	<b>6.2</b>	<b>0.8</b>	<b>12.3</b>	<b>0.4</b>	<b>15.5</b>	<b>1.1</b>	<b>2.4</b>	<b>36.1</b>
Del Norte County	28,729	74.1	3.4	5.1	2.9	0.6	7.7	2.6	0.5	16.1
Humboldt County	129,003	83.0	1.1	5.3	2.2	0.3	2.9	1.0	4.1	8.3
Siskiyou County	44,404	87.1	1.4	2.7	1.5	0.2	1.6	0.8	4.9	9.7
<b>Oregon</b>	<b>3,727,407</b>	<b>86.2</b>	<b>1.7</b>	<b>1.6</b>	<b>3.5</b>	<b>0.3</b>	<b>3.3</b>	<b>0.4</b>	<b>2.9</b>	<b>10.6</b>
Klamath County	66,170	88.9	0.5	3.6	0.9	0.2	1.8	0.4	3.8	9.4

Source: U.S. Census Bureau 2009a.

Caucasians (white) represent the highest percentage of the population in Siskiyou, Humboldt, Del Norte, and Klamath Counties. Black or African American, American Indian or Alaska Native, Asian, Pacific Islanders, other races and two or more races combined make a small percentage each county’s population relative to white and are minority populations. The counties in the area of analysis all have greater percentages of American Indians than California and Oregon as a whole. Data indicate that any impacts from the Proposed Action and alternatives could disproportionately affect Indian Tribes in the area of analysis.

Table 3.16-2 shows the tribes in the area of analysis and the total tribal enrollment as of 2005. Tribal enrollment does not mean that all members live within the area of analysis, but it is still useful information for comparison purposes. The Yurok Tribe has the greatest number of tribal members, while the Resighini Rancheria has the fewest number enrolled.

**Table 3.16-2. Tribal Enrollment within the Area of Analysis, 2005**

Tribe	Tribal Enrollment (number of people)
The Klamath Tribes	3,579
Quartz Valley Indian Reservation Community	222
Karuk Tribe	3,427
Hoop Valley Indian Tribe	1,893
Yurok Tribe	4,912
Resighini Rancheria	111

Source: Bureau of Indian Affairs 2005.

### **Low Income**

Low income populations in the area are identified by several socioeconomic characteristics. Specific characteristics used in this description of the existing environment, as categorized by Census 2000, are income (per capita and median family), percentage of the population below the poverty level (all persons and families), substandard housing, and unemployment rate. Census 2010 data for these categories had not been released at the time of this writing.

As shown in Table 3.16-3, based on income in 1999, as reported in Census 2000, all three California counties have greater percentages of persons and families living below the poverty level than the State of California. Klamath County also has higher percentages of persons and families living below the poverty line than the State of Oregon. All three California counties in the analysis area have lower per capita and median family incomes than the State of California. Similarly, Klamath County has lower per capita and median family incomes than Oregon.

Siskiyou and Klamath Counties output and income have also declined due to reductions in timber harvesting. During the past 10 years, there has been a sharp decline in the Siskiyou County timber industry, which has been an economic base for the county historically. In 2009, the total value of the timber harvest in Siskiyou County was \$11.6 million, about a \$52 million decrease from 2000 (Board of Equalization [BOE] 2010). Timber harvesting also decreased and was at its lowest value in 2009 over the 10-year period. Reductions in timber harvesting have also reduced employment opportunities in the county. Similar to Siskiyou County, timber harvests in Klamath County have been declining in recent years. Timber harvests in 2008 and 2009 showed substantial decreases relative to previous years (Oregon Department of Forestry 2010). Appendix O further describes economic conditions in Siskiyou and Klamath Counties.

**Table 3.16-3. Income and Poverty, 1999**

Area	Per Capita Money Income (dollars)	Median Family Income (dollars)	Persons Below Poverty Level (percent)	Families Below Poverty Level (percent)
<b>California</b>	<b>22,711</b>	<b>53,025</b>	<b>14.2</b>	<b>10.6</b>
Del Norte County	14,573	36,056	20.2	16.4
Humboldt County	17,203	39,370	19.5	12.9
Siskiyou County	17,570	36,890	18.6	14.0
<b>Oregon</b>	<b>20,940</b>	<b>48,680</b>	<b>11.6</b>	<b>7.9</b>
Klamath County	16,719	38,171	16.8	12.0

Source: U.S. Census Bureau 2000a.

Table 3.16-4 shows census tract data of residents living around the Copco Reservoir in Siskiyou County. The data shows that a lower percentage of people living around the reservoir live below the poverty level relative to the county and state. As such, it is assumed that people living below the poverty level are not disproportionately represented in the areas directly around the reservoirs.

**Table 3.16-4. Poverty in Siskiyou County**

	Siskiyou County		Block Group 1, Census Tract 3. Siskiyou County	
Total Population	43,699		1,618	
Number of Persons with Income below poverty level in 1999	8,109	18.6%	198	12.24%

Source: U.S. Census Bureau 2000a

In 1989, 85 percent of The Klamath Tribes' population lived below the national poverty level, with a median family income of \$8,750, compared to Klamath County's median family income of \$27,000 (Tribal Council of Klamath Tribes, 2000). Table 3.16-5 shows families living below the poverty level within the other five tribes included in the area of analysis. Except for the Resighini Rancheria, the median household income of the tribes is less than the counties and states in the area of analysis. The tribes also have more families living below the poverty level relative to the counties and states of California and Oregon.

**Table 3.16-5. Income and Poverty in Tribes, 1999**

Tribes	Median Household Income (dollars)	Families below Poverty Level (percent)		
		All Families	Families with Children under 18 Years of Age	Families with Children under 5 Years of Age
Quartz Valley Indian Community	29,375	37.1	68.4	0.0
Karuk Tribe	18,000	60.0	62.1	73.0
Hoopa Valley Indian Reservation	23,384	29.0	36.9	40.5
Yurok Reservation	20,592	26.8	36.3	60.0
Resighini Rancheria	41,250	0.0	0.0	0.0

Source: U.S. Census Bureau 2000b and Federal Energy Regulatory Commission [FERC] 2007.

Note: Income and Poverty Level information is not available for The Klamath Tribes in the 2000 Census; therefore, a different source was used and relevant data is discussed above.

Other measures of low income, such as substandard housing and unemployment rate, also characterize demographic data (see Table 3.16-6) in relation to environmental justice. Substandard housing units are those that are overcrowded and lacking complete plumbing facilities. As presented in Table 3.16-6, in the area of analysis, the California counties have a smaller percentage of overcrowded housing units and/or units lacking complete plumbing facilities than the State of California. Similarly, the data show that Klamath County has a lower percentage of substandard housing units than the State of Oregon. Consequently, substandard housing is not disproportionately concentrated in the area of analysis and is not an environmental justice concern.

**Table 3.16-6. Housing and Employment**

Area	Housing Units			Civilian Labor Force
	Total Occupied - 2009 (number of units)	Substandard (1.01 or more occupants/room) - 2009 (percent)	Substandard (incomplete plumbing) - 2009 (percent)	Unemployment Rate - January 2011 (percent)
<b>California</b>	<b>12,187,191</b>	<b>7.8</b>	<b>0.5</b>	<b>12.4</b>
Del Norte County	9,750	3	0.0	13.8
Humboldt County	52,520	2.6	0.8	12.3
Siskiyou County	19,838	2.8	0.7	21.0
<b>Oregon</b>	<b>1,464,196</b>	<b>2.6</b>	<b>0.6</b>	<b>10.4</b>
Klamath County	26,761	2.4	0.9	13.0

Source: U.S. Census Bureau 2009b; Employment Development Department 2011; and Oregon Employment Department 2011.

As presented in Table 3.16-6, the unemployment rate in Humboldt County was about the same as the State of California rate, while the rates in Del Norte and Siskiyou Counties were higher than those of the state. The unemployment rate in Siskiyou County was 21 percent in January 2011, which was much larger than California’s 12.4 percent rate (Employment Development Department [EDD] 2011). The unemployment rate in Klamath County was higher than the State of Oregon rate.

Table 3.16-7 includes labor force and unemployment rate data for each of the six tribes. All six tribes have a much higher unemployment rate than the counties and the states of California and Oregon. The counties in the study area have a substantially higher percentage of low-income population among the Indian population compared to the overall population.

**Table 3.16-7. Housing, Labor, and Employment, 2005**

Tribe	Available to Work (number of people)	Unemployment Rate (percent)
The Klamath Tribes	1,135	21
Quartz Valley Indian Reservation Community	45	49
Karuk Tribe	915	63
Hoopla Valley Indian Tribe	1,043	40
Yurok Tribe	1,096	74
Resighini Rancheria	45	60

Source: Bureau of Indian Affairs 2005.

Farm laborers, which are often minority and low income persons, could be disproportionately affected by potential effects to agricultural production. Table 3.16-8 includes information about the farm labor force in the area of analysis. Due to the use of undocumented workers during harvests throughout California and Oregon, it is likely that farm labor is actually higher than numbers officially reported in the Census. Data on undocumented workers is not available for the counties; therefore, Census data is used for comparison purposes.

**Table 3.16-8. Employment and Labor Force, 2005-2009, American Community Survey**

Area	Civilian Labor Force (number of people)	Farm Labor (percent)
<b>California</b>	<b>16,550,706</b>	<b>1.4</b>
Del Norte County	10,357	3.3
Humboldt County	58,877	2.0
Siskiyou County	17,455	3.4
<b>Oregon</b>	<b>1,765,814</b>	<b>1.9</b>
Klamath County	28,101	2.6

Source: U.S. Census Bureau 2009c.

The above data shows that Indian Tribes are minority and low income populations that could be disproportionately affected by the project alternatives. In addition, counties in the area of analysis have lower incomes, higher unemployment rates, and more people and families living in poverty than California and Oregon and could also be disproportionately affected by project alternatives.

**Social Programs**

Tribes within the area of analysis receive federal and state funds to run social programs, such as Medicaid, food stamps, and education. In addition, local county funds are available to tribal members for social programs, such as foster care and police protection. However, local county funds are not given directly to the tribal governments. Table 3.16-9 shows federal grants and direct payments made to individuals in each of the area of analysis counties. Table 3.16-10 shows the local funds that were distributed to social programs within each county in 2010. Data showing funds received by tribes in the area of analysis are not currently available.

**Table 3.16-9. Federal Funds Distribution for Social Programs, 2010**

Area	Grants (millions of dollars)				Direct Payments for Individuals (millions of dollars)		
	Medicaid and Other Health-Related	Nutrition and Family Welfare	Education	Other	Social Security and Government Retirement	Medicare	Food Stamps and Supplemental Security Income
<b>California</b>							
Del Norte County	36.5	7.0	2.2	29.4	81.7	41.3	14.5
Humboldt County	210.5	31.9	17.0	108.2	343.5	189.9	49.9
Siskiyou County	75.0	10.7	5.3	32.6	173.4	83.6	17.5
<b>Oregon</b>							
Klamath County	43.1	10.9	7.7	30.8	234.8	80.7	26.6

Source: Gaquin 2010.

**Table 3.16-10. Local Funds Distributed for Government Services, 2010**

Area	Education (millions of dollars)	Health and Hospitals (millions of dollars)	Police Protection (millions of dollars)	Public Welfare (millions of dollars)	Highways (millions of dollars)
<b>California</b>					
Del Norte County	42.8	6.9	4.2	13.6	4.1
Humboldt County	44.3	9.3	4.1	10.8	4.0
Siskiyou County	44.3	6.8	6.1	9.0	9.7
<b>Oregon</b>					
Klamath County	50.0	7.5	3.3	0.3	6.9

Source: Gaquin 2010.

Distribution of social services to tribal members varies greatly by tribe and geographic area. For instance, the Yurok Tribe provides social services of many types directly to its members, including general assistance, food distribution, Indian Child welfare, and other programs (Yurok Tribe 2011a); The Klamath Tribes provides health and wellness services, homeowner assistance, and drug and substance abuse programs, among other things (Klamath Tribe 2011). Other tribes may provide few or no services directly to their members. Social programs may be funded by the federal government and provided by the tribe, or members may receive assistance directly from their local governments. For example, members of the Yurok Tribe may choose to receive the Temporary Assistance for Needy Families program from the tribe or directly from the county in which they reside (Yurok Tribe 2011b). Therefore, no generalized data are available for social programs for tribal members.

**3.16.3.2 Tribal Environmental Justice Concerns**

Information about tribal history and environmental justice issues in the area of analysis has been derived from the DOI’s *Effects of PacifiCorp Dams on Indian Trust Resources and Cultural Values in the Klamath Basin: Background Technical Report* (DOI 2011a) also referred to as *Background Technical Report Informing the Secretarial Determination Overview Report: Current Effects of Implementing the KHSA and KBRA on Indian Trust Resources and Cultural Values*.

### **Prior to Dam Installation**

Six different tribal groups live within the area of analysis. Although the language groups and traditional practices vary among the tribes, all of them based their cultures, commerce, and subsistence primarily on the river and its aquatic and terrestrial resources. Salmon, steelhead, sturgeon, Lost River and shortnose suckers, and other fish (such as red band trout, eulachon and lampreys), as well as fresh water clams, fresh water mussels, and other aquatic species, occupy a central place in the diets and belief systems of the native people. Fish, particularly salmon, determined settlement patterns and have historically been the foundation of the daily and seasonal practices, subsistence, and culture of the native people (Federal Energy Regulatory Commission [FERC] 2007). The diverse indigenous peoples of the area of analysis have all retained close connections to the river and its resources and continue to rely on the river and its resources for cultural, economic and social survival (FERC 2007). Similarly, the suckers in Upper Klamath Lake, its tributaries, and nearby bodies of water are religiously and culturally important to The Klamath Tribes.

The Klamath River has the third most productive salmon run on the West Coast, a feature that native people ritually managed for thousands of years (Karuk Tribe 2010, as cited in DOI 2011a). The U.S. Court of Appeals for the Ninth Circuit recognized this importance when it concluded that the fish were “not much less necessary to the existence of the Indians than the atmosphere they breathed” (*Blake v. Arnett*, 663 F.2d 906, 909 (9<sup>th</sup> Cir. 1981), as cited in DOI 2011a). The abundance of salmon has always been a measure of tribal well being (Gunther 1926, as cited in DOI 2011a). Suckers were historically an important subsistence fish for The Klamath Tribes of the Upper Basin.

### **Installation of Dams**

Dams were put in place on the upper Klamath River to generate electrical power and to supply water for newly established farmland in the Upper Basin (DOI 2011a). Copco 1 Dam was completed in 1918, Copco 2 Dam in 1925, J.C. Boyle Dam in 1958, and Iron Gate Dam in 1962.

The tribes within the area of analysis were not consulted prior to dam construction at any of the four sites analyzed in this EIS/EIR and had no political ability at the time of dam construction to actively oppose the dams. Additionally, none of the affected tribes were beneficiaries of these hydroelectric facilities but were adversely affected by their construction through the impacts to the Klamath River fishery.

### **Effects of Dams – Subsistence (Fishing, Hunting, and Gathering)**

This section describes general effects of the dams that are similar across the tribes, then presents tribe-specific effects of the dams. Additional analysis of specific impacts of the dams to each tribe is presented in Section 3.12, Tribal Trust.

Tribes in the area of analysis have historically fished along the Klamath River and its tributaries for salmon and other anadromous fish at a subsistence level.<sup>1</sup> Due to a decline in fisheries, tribes are currently unable to fish at a subsistence level; however, tribes

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<sup>1</sup> Subsistence level means that fishers rely on fish as a major food source.

continue to fish for economic and ceremonial purposes. In addition to fish and other aquatic resources, tribes have historically relied on other plant and wildlife species for subsistence. Subsistence hunting has diminished over the decades, which can be attributed to many factors including the costs of hunting licenses required to comply with strict (state) regulations (Stercho 2006) and indirectly to dam construction. Tribal members still engage in traditional hunting, gathering, and resource management activities (DOI 2011a); however, the current low abundance of wildlife and plant resources do not meet subsistence needs.

Water management, particularly hydroelectric generation, has changed the patterns of water flows throughout the system, affecting the channel geomorphology and spawning and rearing habitat for salmonids, lamprey, and fresh water clams and mussels. The Klamath Hydroelectric Project dams block anadromous and native fish passage to and from the upper river and have converted portions of former riverine habitat to reservoir habitat, which has eliminated anadromous fish habitat and reduced the quality and quantity of salmonid habitat upstream from the dams. For example, although the magnitude of these anadromous fish migrations is unknown, historically, anadromous fish (such as fall and spring run Chinook salmon and winter and summer-run steelhead), lamprey, and Lost River and shortnose suckers could access the Klamath Basin all the way into the rivers that are tributary to Upper Klamath Lake. Currently they are limited to the area downstream of Iron Gate Dam.

The capacity of the mainstem Klamath River downstream of Iron Gate Dam to support the rearing and migration of anadromous species is limited by changes in river flow, high water temperatures, poor water quality, and disease outbreaks, especially during the summer months. The reduction in available habitat, impairment of water quality, increase in water temperatures, changes in channel geomorphology downstream from the dams, water diversions, and factors outside the current operations (e.g., unfavorable ocean conditions) have led to a substantial decrease in salmonid populations in the Klamath Basin (National Oceanic and Atmospheric Administration [NOAA Fisheries Service] 2010, as cited in DOI 2011a). See Section 3.3, Aquatic Resources, for additional information about current conditions and aquatic species found in the Klamath River and Section 3.2, Water Quality, for more information about water quality in the area of analysis.

Prior to construction of dams on the Klamath River, steelhead spawned freely not only in the Klamath and its tributaries, but in the Upper Klamath Lake and beyond. An estimated 650 miles of salmon habitat were lost with the construction of four dams in the Klamath River (Klamath Tribes and Yurok Tribe 2006). This is a significant amount of habitat no longer available for spawning and rearing. Furthermore, steelhead eat juvenile salmon; therefore, without a healthy salmon run, there will not be a healthy steelhead run.

Dam installation and operation has affected certain plant and wildlife species. Plant species in the Klamath/Trinity Region include the following: willow shoots, cottonwood, wild grape, bulrush, hazel sticks, tules, spearmint, and blackberries (Stercho 2006). An example of the affects of dam installation and operation on plant species includes, the

growth pattern of willow shoots along the river banks are different than before dam installation, and firsthand accounts from tribal members indicate that the new shoots are not suitable for traditional basket weaving (Salter 2003). Wildlife species include bear, for subsistence purposes and bald eagle, blue heron, mallards, fox, otter, and fisher for ceremonial purposes, as well as deer and elk for both subsistence and ceremonial purposes (Stercho 2006). Subsistence wildlife species potentially affected by reduced salmon and steelhead populations include the black bear (DOI 2011a). Other salmon and steelhead-dependent wildlife species significant to tribes beyond their subsistence value include the bald and golden eagles, coyote, and cougar (DOI 2011a).

### ***The Klamath Tribes***

Resources (such as hunting, fishing, gathering, trapping, and water rights), especially fish, have played a central role in the physical, social and spiritual well-being of the Klamath people for millennia. The Klamath Basin from Link River to Iron Gate once had an almost continuous geographical distribution of traditional sites and activities.

The Klamath Tribes relied heavily on upland game (e.g., deer, elk, and pronghorn antelope) and plant foods (e.g., yampah, wild plum, and many other fruits and berries), but riverine and especially marsh resources were of equal importance. Salmon and multiple species of sucker, trout, eel, lamprey, and other fish were dietary staples, while marsh and riparian plants such as the yellow pond lily (*Wocus*), tule, cattail, and willow provided staple foods and materials as essential tools and crafts. Salmon were numerous throughout much of The Klamath Tribes' traditional territory. Historically, The Klamath Tribes fished not only for salmon and steelhead, but also for mullet (suckers), eels, and lamprey.

The construction of Copco 1 Dam (1918) blocked anadromous fish runs into the Upper Basin and abruptly ended The Klamath Tribes' access to anadromous fish. Two other major fisheries, resident salmonids (trout) and catostomids, could still be used by The Klamath Tribes after the demise of the anadromous fisheries. The catostomid fishery consisted primarily of c'waam (Lost River sucker) and koptu (shortnose sucker) until the Tribes closed their fishery in 1986 to protect it in the face of severe population declines (DOI 2011a).

### ***Quartz Valley Indian Community***

The Indians of the Quartz Valley Reservation are related to Karuk people and thus share their cultural practices and values with the general culture described below for the Karuk Tribe (DOI 2011a).

### ***Karuk Reservation***

The Klamath and Salmon River fishery and other resources supported more than 100 ancestral Karuk villages along the Klamath and Salmon Rivers. Karuk established villages on regalia, practice of traditional religious ceremonies, and stewardship of natural resources through the use of fire and harvest management techniques.

The Karuk diet traditionally consisted mostly of salmon, deer, and acorns. Fish, especially salmon, have always been a major food resource and the focus of ceremonies for the tribe. Fish important to the Karuk include spring-run Chinook or king salmon, fall-run Chinook, out-migrating Chinook smolt, Coho, or silver salmon (also called dog salmon), steelhead, trout, sucker, bullhead, sturgeon, and Pacific lamprey. Freshwater mussels also have cultural significance for the Karuk not only for food, but also as important tools.

Since the construction of the dams on the Klamath River, the numbers of a variety of river species have plummeted. Some of these fish had traditionally been a source of food and cultural ceremonies and practices for the Karuk Tribe. Karuk believe one of the most significant impacts of the Klamath River dams is the way that the natural process of seasonal warming and cooling trends in the river is altered by the presence of reservoirs. For Karuk, this translates into a shorter fishing season in the fall. In addition to limiting the number of fishing days available in the fall, the opportunity to harvest spring Chinook salmon has been completely lost to the Karuk since construction of Iron Gate Dam (DOI 2011a).

#### ***Hoopa Valley Indian Reservation***

The Trinity River is of prime importance to the Hoopa Valley Tribe because it is the river that runs through the Hoopa Valley Indian Reservation. Fish destined for the Trinity River must pass through the lower Klamath River and are therefore affected by Klamath River conditions.

Uses of the Trinity River by the Hupa people are highlighted by maintenance of fisheries and religious ceremonies. Many natural foods were available to the Hupa, with salmon and acorns providing the bulk of the native diet. Other important fish include steelhead, sturgeon, and lamprey eels (DOI 2011a). The decline of the river, including decreased fisheries and water quality, has adversely affected the psychological health of the Hupa.

#### ***Yurok Reservation***

Deterioration of the Klamath River affects Yurok ceremonial and traditional practices. The lives of the Yurok people have always been intricately tied to the river. Historically, they depend on the river for sustenance, and much of their world was defined in terms of their physical relation to the river. Many of the Yurok cultural sites on the Klamath and lower Trinity rivers are traditional fishing spots owned by families. These are places where the Yurok have lived, fished, gathered, prayed, and buried their dead for centuries. Over time, as the rivers' flows have changed, so have the locations of these cultural sites.

As with all tribes that identify as salmon people, fish have been the Yurok Tribe's most valuable asset and a mainstay of their economy. With fish in abundance, the Yurok could not only feed themselves and their families all year long, but the surplus could be used to acquire products from outside their territory.

Since 1990, tribal commercial harvests have been marginal and have not provided a comfortable standard of livelihood. The decreased harvests have had a significant adverse

impact on the tribe's economies and health. Limited access to resources has restricted the ability of the Yurok to practice some of their most important traditions. This includes freely fishing the once-prolific semi-annual salmon runs and participating in the cycle of ceremonies initiated concurrently with salmon runs (DOI 2011a).

### ***Resighini Rancheria***

The Indians of the Resighini Rancheria are Yurok people; consequently they share their cultural practices and values with the general culture described above for the Yurok Tribe (DOI 2011a).

### **Effects of Dams – Water Quality**

Tribal needs for high quality water in the Klamath River are not limited to the biological needs of the fishery. Water quality plays a significant role for tribes in the Klamath Basin because it affects culturally relevant fish, and many tribes rely on the Klamath River for water supplies and use of water in ceremonial activities, such as drinking or bathing. Many tribal ceremonies must be practiced near the river and at times when water quality is at its lowest. Ceremonial practitioners must ritually bathe, submerge and at times even ingest the water from the River. Roots, materials and tribal medicinal plants, and other plants are gathered from the riverbank and require exposure to river water. For example, basketry often requires the weaver to use their teeth to strip bark pulled from the river, offering an avenue of direct exposure to water born toxins.

Under current conditions, water quality in the mainstem of the Klamath River has been listed as impaired due to the following caused or induced conditions (North Coast Regional Water Quality Control Board 2010, as cited in DOI 2011a): organic enrichment, low dissolved oxygen, water temperature impairment, nutrient impairment, and toxic algae (microcystin) impairment. There is a direct cause-and-effect link between current Klamath Hydroelectric Project dam operations and water quality; this link was established in the *Basin Plan for the Klamath River*, prepared by the North Coast Regional Water Quality Control Board (as cited in DOI 2011a). See Section 3.2, Water Quality, for additional information about the link between the Klamath Hydroelectric Project dams and degraded water quality.

Impoundment of water in the four reservoirs shifts the seasonal water temperature patterns, producing cooler than normal water temperatures in the springtime and warmer than normal temperatures in the fall. These water temperature shifts disrupt spawning cycles for salmon and at times can produce stressful or lethal water temperature conditions for aquatic resources. Water with high concentrations of nutrients and organic matter entering these reservoirs leads to low dissolved-oxygen concentrations as organic matter decomposes, algal populations bloom and crash, and organic matter settles to the deeper portions of the reservoirs. Release of this low-dissolved oxygen water from these reservoirs, particularly during the summer and fall, produces stressful or lethal conditions for aquatic resources, such as salmon.

These reservoir algal blooms include blue-green algae, such as *Microcystis aeruginosa*, which release a toxin that can cause skin irritation, sickness, or in extreme cases, death, to

exposed organisms, including humans (World Health Organization 1999). These toxins have been measured in the reservoirs and in the Klamath River for many miles downstream of Iron Gate Dam. Algal blooms have reached levels thousands of times higher than those the World Health Organization says are safe for recreation (DOI 2011a). A survey of aquatic resources (fish and mussels) in the Klamath River showed a bioaccumulation of microcystin in their tissue (Kann 2008).

In addition, preliminary evaluation of dioxin results from the 2009–2010 Klamath River sediment cores (DOI 2011b) indicates that dioxin is present at levels greater than screening levels for sediment disposal. In the J.C. Boyle and Copco 1 Reservoirs, levels are slightly above available national and western United States background values for fish and birds (USEPA 2010). However, dioxin levels indicate no current public health concerns from direct human exposure and the measured levels indicate no current bioaccumulatory concerns (DOI 2011b).

Additionally, PacifiCorp indicated that some of the fish tissue samples from Upper Klamath Lake, Keno Impoundment, J.C. Boyle Reservoir, and Copco 1 Reservoir exceed the suggested wildlife screening value for total dichlorodiphenyltrichloroethane (DDT). Samples also showed that total polychlorinated biphenyl (PCB) values exceed the screening level for subsistence fishing in black bullhead from Keno Impoundment and in largemouth bass from J.C. Boyle, Copco 1, and Iron Gate Reservoirs (PacifiCorp 2004). See Section 3.2, Water Quality, for additional discussion and Appendix Tables E-5 through E-7 for sediment values and screening levels.

Downstream from the hydroelectric facilities, water conditions are also ideal for promoting fish disease, in that they allow parasites to thrive. The stable flows and warm water on the Klamath River, especially between Iron Gate Dam and the Shasta River, contain elevated levels of the parasites that carry the fish diseases *Parvicapsula minibocornis* and *Ceratomyxas shasta* (California Department of Fish and Game 2004, as cited in DOI 2011a). About 80 percent of the juvenile fish in the Klamath River become infected and most die from these diseases (California Department of Fish and Game 2004, as cited in DOI 2011a).

Freshwater mussels have also been adversely affected by the degraded water quality in the Klamath River. Freshwater mussels are an important food source for the Klamath River tribes and an essential part of some tribal ceremonies. During the early 20th century, mussels were gathered for food and for use in rituals late in the season when the river flows were low; unfortunately, this is the time of year when the mussels are most contaminated. Even though there are few to be found, people continue to use freshwater mussels as a food source, but their use in ceremonial celebration has been greatly reduced (DOI 2011a).

### ***The Klamath Tribes***

Water quality and flows in the Klamath River and its tributaries associated with current dam operations are an important issue to The Klamath Tribes. Water conditions affect the ability of anadromous fish species to survive. A number of ritual traditions of The

Klamath Tribes depend on access to clean water from natural sources, which is used in ritual purification of people, places, and objects, as well as in rituals associated with drought abatement and other environmentally restorative activities. However, the Klamath River is widely viewed as inappropriate for these ritual uses because of the effects of the dams on water temperature, algae development, and other variables of water quality (DOI 2011a).

#### ***Quartz Valley Indian Community***

The Indians of the Quartz Valley Reservation are related to Karuk people and thus share their cultural practices and values with the general culture described below for the Karuk Tribe (DOI 2011a).

#### ***Karuk Reservation***

The Karuk Tribe only has two public water systems, one at Happy Camp and the other at Orleans, which requires most residents to rely on individual wells and/or surface waters for domestic use (Karuk Tribe 2001).

Water quality plays a very significant role in Karuk tribal culture because its effects on culturally relevant aquatic species. Water quality also affects the ability of *Fataveenan*, or World Renewal Priests, to conduct ceremonies. *Pikiavish* starts with the Spring Salmon Ceremony in early spring and continues throughout late summer into early fall. Key ceremonial participants bathe multiple times a day in the Klamath River for 10 days in a row. This is the time of year when the blooms of the toxic algae, *Microcystis aeruginosa*, are at their peak. Bathing in the river is an important part of most Karuk ceremonies. Bathing is also associated with funeral services, subsistence practices, recreational swimming, courtship, and individual hygiene.

Karuk tribal members collect willow roots, wild grape, cottonwood, and willow in the riparian zone along the Klamath River and use these materials to make baskets. Traditional collection of these basketry materials often involves wading in the water, and washing and cleaning the materials in the river. Willows are peeled by mouth following cleaning with river water, and plants are also collected for food, medicine, and other cultural functions. Given current degraded water quality conditions, ingestion of water as a result of traditional cultural activities or use of materials harvested from the river may pose a potential health risk (DOI 2011a).

#### ***Hoopa Valley Indian Reservation***

The Hoopa Valley Indian Reservation hosts a seasonal abundance of surface water for drinking water supply while in contrast, groundwater aquifers are quite limited. Increased areas of groundwater contamination are occurring, which makes it more difficult to use groundwater as a source of drinking water. The tribe is now faced with the challenge of meeting the increase demands for drinking water supply, while maintaining quality surface water in streams to protect fish, wildlife and other beneficial uses (Hoopa Valley Tribe 2008).

### ***Yurok Reservation***

Limited access to resources has restricted the ability of Yurok to practice some of their most important traditions. This includes freely fishing the once-prolific semi-annual salmon runs and participating in the cycle of ceremonies initiated concurrently. In the past, the Yurok were not inclined to leave their territory; currently, several factors, including an inability to meet subsistence needs from the fishery and a perception that the rivers are dirty, prompt younger tribal members to leave the area to find work (DOI 2011a).

### ***Resighini Rancheria***

The Indians of the Resighini Rancheria are Yurok people; consequently they share their cultural practices and values with the general culture described above for the Yurok Tribe.

Both the Yurok and the Yurok of the Resighini Rancheria bathe in the river and use its water for daily and ritualistic purposes. Because of their reliance on the river for so many aspects of their lives, they are concerned about the quality of its water. The Klamath Hydroelectric Project has effects on water quality and related environmental issues, such as watershed health, riparian habitats, erosion, sediment, turbidity, sources of pollution and temperature changes, algae blooms, low dissolved oxygen, high pH, and un-ionized ammonia. The cumulative effects may result in health problems, not just for the people who live on the Rancheria, but also for the tourists who come and camp in the area every year, and for people who use the water for business purposes or who work for those businesses (DOI 2011a)

### **Effects of Dams – Tribal Health**

Secondary, or indirect, effects of the Klamath Hydroelectric Project dams on tribes within the area of analysis include physical and emotional health issues.

The loss of naturally occurring resources, such as fish, lamprey, freshwater clams, and mussels, can leave tribal members with no other option than to supplement their diets with government-provided subsidies and/or store-bought food. Studies have found that supplementing or replacing traditional diets of Indian people is often detrimental to their health, contributing to the widespread occurrence of obesity and related diabetes in Indian populations today (Norgaard 2004; Yurok Tribe 2006, Acton et al. 2003; California Rural Indian Health Board 2004; Trafzer and Weiner 2001, as cited in DOI 2011a).

Poor water quality, as demonstrated in recurring toxic algal blooms in the Klamath River has the potential to affect human health, as water from the river plays a central role in tribal ceremonies. Poor water quality also affects drinking water, fish, freshwater clams, and mussels that the tribes eat as discussed above. Bioaccumulation screening levels for DDT and dioxins were exceeded in sediment samples taken from the Klamath River. While levels now indicate no current public health concerns from direct human exposure, there is the potential for bioaccumulation to occur in the Klamath Hydroelectric Project reservoirs.

Emotional and social health of the individuals in the tribes has also been affected indirectly by dam installation. When a people's identity and cultural practices are closely associated with a species that no longer thrives, a sense of connection and belonging is lost (Norgaard 2004, as cited in DOI 2011a). Young people may feel this loss of belonging because they have never experienced the Klamath River as previous generations once did. The decline of the resource makes seasonal celebrations of the salmon runs difficult to understand and to carry out. The Yurok and Hoopa Valley Tribes continue to perform down-river boat ceremonies; however, sometimes the water is so shallow it is necessary to call federal agencies to request water flow increases to perform the ceremony. These factors indirectly affect the emotional and social health of the tribes within the area of analysis (DOI 2011a).

### ***The Klamath Tribes***

Because salmon was the first dietary staple to be lost to The Klamath Tribes, its depletion was said to have initiated dramatic dietary shifts among tribal members. For a time, this fostered increased consumption of deer and mullet (suckers), which some tribal members believe resulted in localized overuse of these resources when taken in combination with fish and game management practices of the State of Oregon. For some, the loss of the salmon was the catalyst for a dietary transition that led to the ultimate dependence of The Klamath Tribes on the purchase of processed foods and the use of supplementary commodity goods.

Tribal members attribute a number of historical health problems to the loss of salmon. Recent Indian Health Service studies endorsed by The Klamath Tribes concluded that a host of physical ailments plaguing members of The Klamath Tribes have been linked to the demise of the aboriginal diet. Diabetes, hypertension, obesity, and related cardiovascular ailments are particularly widespread, reflecting dramatic changes in food consumption and procurement patterns (DOI 2011a).

### ***Quartz Valley Indian Community***

The members of the Quartz Valley Reservation refrained from making any comments regarding health effects (DOI 2011a).

### ***Karuk Reservation***

The Karuk have been denied traditional food sources such as salmon over the last 150 years, and have increasingly adopted western foods. The decrease in the availability of traditional foods, including salmon, trout, eel (various species of lamprey), mussels, and sturgeon, is responsible for many diet-related illnesses among Indians, including diabetes, obesity, heart disease, tuberculosis, hypertension, kidney problems, and strokes (Joe and Young [1993] as cited by Nogaard [2003] in Karuk Department of Natural Resources [2007]). The estimated diabetes rate for the Karuk Tribe is 21 percent, nearly four times the U.S. average, and the estimated rate of heart disease for the Karuk is 39.6 percent, three times the U.S. average. These conditions result from the lack of proper nutrient content in foods consumed without fishing and gathering food.

Difficulty in meeting basic needs can result in overwhelming physical and psychological stress. Traditionally, fishing is done by Karuk men. With the loss of the salmon comes a loss of a man's sense of pride in being able to provide food for his family and tribe. For a tribe that has called itself The People of the Fish, there is an indisputable loss of identity when there are no fish. For a people whose belief system includes their specific role on earth, that they have a predefined relationship with nature that needs to be honored, there is a sense of failure when they are unable to fulfill that role.

The changes that have caused wildlife to become scarce and the rivers to become polluted may make it hard for young people to understand the ways of their parents and grandparents. Never having seen it themselves, they do not understand that in the past there could be eight yearly runs of salmon in the Klamath when all they see is one-half of a fall run. Without tradition as an anchor, young people are sometimes drawn to gangs to establish a feeling of belonging, and leave Karuk territory for cities (DOI 2011).

#### ***Hoopa Valley Indian Reservation***

The secondary effects of the Klamath River dams on the people of the Hoopa Valley Tribe include emotional and physical health effects such as increased obesity, diabetes, heart disease due to loss of the traditional salmon diet, and depression, alienation, and suicide. Additionally, the tribal members experience a loss of opportunity for intergenerational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation for opportunity elsewhere (DOI 2011).

#### ***Yurok Reservation***

Secondary effects of the Klamath River dams on the Yurok Tribe include emotional and physical conditions such as increased obesity, diabetes, and heart disease due to loss of traditional salmon diet, and depression and alienation that can result in suicide (DOI 2011).

#### ***Resighini Rancheria***

Secondary effects of the Klamath River dams on the people of the Resighini Rancheria include emotional and physical health effects such as increased obesity, diabetes, heart disease due to loss of the traditional salmon diet, and depression, alienation, and suicide. Additionally, the tribal members experience a loss of opportunity for inter-generational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation for opportunities elsewhere (DOI 2011a).

#### **Effects of Dams – Economy (Commercial Fishing)**

Historically, and in contrast to the current situation, the commercial salmon fishery and the associated canneries were substantial components of the West Coast resource-based economies. The numerous local anadromous fisheries allowed tribes, such as the Karuk and Yurok, to develop subsistence economies highly specialized in fishing (Stercho 2006). The more recent history (1976 to the present) is characterized by poor ocean condition cycles, and adverse habitat alterations (including construction of hydroelectric

facilities) for all regions along the West Coast of North America (FERC 2007). These trends have caused substantial decreases in the amount of income and jobs in economies where salmon and steelhead fishing have historically been important. Coastal communities and tribes have experienced the greatest losses in this regard (FERC 2007).

### ***The Klamath Tribes***

The current operations of the dams have had a range of secondary effects on The Klamath Tribes. Among these effects are the decline in fish and wildlife other than anadromous fish (DOI 2011a). These declines have resulted in a diminished economy. The Klamath Tribes were forced to close their c'waam fishery in 1986 to protect it in the face of severe (fish) population declines (DOI 2001a).

The decline in fish populations has contributed to the decline of various fish dependent species. Several salmon-dependent wildlife species are of traditional cultural significance to members of The Klamath Tribes beyond their subsistence value. Many non-salmon species and ecologically linked plants are significant for the cultural and economic well-being of The Klamath Tribes. The Klamath Tribes members traditionally used pelts, feathers, and other body parts from some of these animals in ceremonial regalia, traditional crafts, and for other purposes. In a few cases, tribal members relied on the sale of pelts from some of these species for supplemental income.

Large gatherings associated with the fish harvest once served as a venue for economic exchanges. The demise of the fish population has interrupted the performance of the important economic, social and cultural functions.

Although The Klamath Tribes have the most direct interest in resources upstream from the four hydroelectric dams, the current operations of the Klamath Hydroelectric Project have affected The Klamath Tribes' (through a complete end to the anadromous fishery) in the upper Basin and resource interest in the footprint of the dams and impoundments, and downstream from the dams in lands ceded to The Klamath Tribes. Plants, animals, soil, and rocks are all of concern to The Klamath Tribes members, both economically and environmentally (DOI 2011a).

### ***Quartz Valley Indian Community***

The Indians of the Quartz Valley Reservation are related to Karuk people and thus share their cultural practices and values with the general cultural described for the Karuk Tribe below.

### ***Karuk Reservation***

The lack of fish in the local economy has secondary effects on general (Karuk) tribal health and cultural wellbeing. Since the construction of the dams on the Klamath River, the numbers of a variety of river species have plummeted. Some of these fish had traditionally been a source of food and cultural ceremonies and practices for the Karuk Tribe, as well as a means of trade and income.

The lack of migratory steelhead affects the local economy and the wellbeing of the Karuk Tribe. Steelhead fisherman from outside the area used to pay for the privilege of fishing for the Klamath steelhead, bringing money into the local economy to the benefit of the Karuk Tribe. Today, the number of steelhead is so low that the sport is no longer viable (DOI 2011a).

#### ***Hoopa Valley Indian Reservation***

The Hoopa Valley Tribe maintains a modest commercial fishery program (DOI 2011a). The Trinity River, like most West Coast Rivers, has experienced a decline in Chinook salmon, steelhead, and Coho runs. The Trinity's Coho salmon is currently listed as threatened under the Endangered Species Act (Hoopa Valley Tribal Fisheries).

#### ***Yurok Reservation***

Fish are the Yurok Tribe's most valuable asset and a mainstay of their economy. Abundant fish allow Yurok to feed themselves and their families and to acquire products from outside their territory through trade. Fish was a trading commodity available to any enterprising man. A young man who diligently fished and successfully traded fish for other items could amass sufficient wealth to buy a boat, travel to collect all of the necessary items to fashion intricate ceremonial regalia, and to allow him to marry. Fish were the baseline resource that facilitated the acquisition of wealth and upward social mobility in Yurok culture.

The Yurok Tribe voluntarily closes its commercial fishery in critical years out of concern for the survival of Klamath River salmon. These closures adversely affect the tribal community which relies heavily on income from the short commercial season for harvesting fall Chinook salmon. In general, declines in total numbers of fish stocks have adversely affected the ability of the Yurok Tribe to harvest for commercial purposes. In the past, the Yurok were not inclined to leave their territory; currently, several factors, including an inability to meet subsistence needs from the fishery prompt younger tribal members to leave the area to find work (DOI 2011a).

#### ***Resighini Rancheria***

The original "Merin" proposal to create the Resighini Rancheria described the tract of land as "agricultural" with conditions that are "ideal for farming or dairying." However, the value of the land as agricultural was directly connected to the loss of traditional fisheries. In past years, commercial and subsistence fishing was a primary means of economic and subsistence support for the Yurok including the Resighini along the Klamath River. However, with the closure and restrictions on tribal fishing, this means of support was lost. While the "fish wars" and accompanying litigation of the 1970s and 1980s reinstated Yurok fishing rights and the Hoopa-Yurok Settlement Act further confirmed that the Yurok Tribe had fishing rights, Rancheria members were left out of that settlement.

#### **Effects of the Dams – Electricity Distribution**

On February 24, 1917, the California Oregon Power Company (now PacifiCorp) entered into an agreement with the Klamath Water Users Protective Association (irrigators) to

extend to the water users of the Klamath Hydroelectric Project certain preferential power rates (Klamath Water Users Association 2004). This agreement was amended and further extended for a 50-year period on April 16, 1956 (Klamath Water Users Association 2004). No similar power agreement was extended to the tribes located within the area of analysis because preferential power rates are normally provided only for on-farm agricultural use. To date, non-farm irrigating Tribes in the area of analysis still do not receive energy benefits from the Klamath Hydroelectric Project operations.

### **Summary of Environmental Justice Issues**

Although many other historic and current factors, such as mining, timber extraction, agricultural production, and cattle grazing, affect the environmental integrity of the Klamath Basin, the current operations of the four Klamath Hydroelectric Project dams also substantially affect water quality and fishing resources of the Klamath Basin tribes and, by extension, their way of life. Due to tribes' resource-based economy, culture and disproportionate representation of tribal members in consultation, dam installation has directly and indirectly resulted in environmental concerns related to fishing, water quality, health, and the economy that disproportionately affects tribes in comparison to the general population in the area of analysis. While the tribes experienced disproportionately greater adverse effects of dam installation and operation, they did not receive any benefits of the project, including fixed-price electricity.

Current dam operations substantially contribute to compromised water quality, loss of habitat for anadromous and other aquatic species, and altered riverine ecosystem functions. These contributing factors have led to the decline of the anadromous fishery and other inter-related aquatic populations important to the continuance of an Indian river-based way of life. The decline of the anadromous fishery is directly and indirectly linked to the decline and scattering of the people, culture and language of the "Salmon People" of the Klamath Basin. The decline is manifested particularly in physical illness, mental illness, the loss of traditional knowledge, and social conflict among native peoples and between native peoples and non-natives also residing in the Klamath Basin (DOI 2011a).

### **Summary of Tribal Involvement in KHSA and KBRA**

As described in Chapter 1 (Introduction), the KHSA and the KBRA were signed in February 2010 by representatives of 45 organizations, including three tribes: Karuk Tribe, the Klamath Tribes, and Yurok Tribe.

In addition, comments from the tribes were solicited during the scoping period for the EIS/EIR. Comment letters were received from the following tribes: The Klamath Tribes; Karuk Tribe; Hoopa Valley Tribe; Yurok Tribe; Resighini Rancheria; and Modoc Nation. Applicable scoping comments from the tribes have been addressed throughout the EIS/EIR.

The Klamath Tribes, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe and Resighini Rancheria have all signed a Memorandum of Understanding as a Cooperating Agency. As Cooperating Agencies they were all afforded a review of a Cooperating Agency Draft

EIS/EIR. Comment letters were received and those comments are addressed in this Draft EIS/EIR.

### **3.16.4 Environmental Consequences**

#### **3.16.4.1 Effects Determination Methods**

This discussion of environmental consequences focuses on evaluating potential disproportionate adverse effects (including social, health, economic, or other environmental impacts) on low income or minority populations. This section also identifies potential benefits to low income and minority populations. The analysis relies on demographic and income data obtained from the federal and local governments to identify disproportionate low income and minority populations in the area of analysis. The analysis does not examine alternative locations for the Proposed Action that would reduce environmental justice effects on such populations because the dams are already in place and thus the Proposed Action to remove the dams cannot take place elsewhere.

Four factors were used to determine if there were a disproportionate number of low-income individuals in the area of analysis: income, poverty, substandard housing, and unemployment. It was found that the area of analysis does not have disproportionately more substandard housing than Oregon or California; therefore no low income individuals were identified on this basis. Data does show that there are disproportionately more individuals with low incomes, living in poverty, or unemployed at a county level relative to the state(s). As shown in Table 3.16-4, within Siskiyou County, there are not disproportionately more people living below the poverty level in the Census tract that contains the Copco Reservoir (the area adjacent to the potential project deconstruction activities). These data suggest that low income individuals are not represented in the immediate area of dam deconstruction and there would be no disproportionate effects. Therefore, this analysis instead focuses on potential environmental justice effects on county residents as a whole where there are a high proportion of low income and minority individuals relative to the state.

The Lead Agencies did determine that the percentage of persons identifying as Indian reflected minority and low income populations that could be disproportionately affected. Due to minority and low income status, as well as the past Klamath watershed history, existing qualitative reports (DOI 2011b), and information gathered during scoping, it was determined that tribal communities might experience disproportionate impacts from the Proposed Action that might raise environmental justice concerns. While the area of analysis examines specific tribes located within the four counties, there is the potential for members of other tribal groups to live along the Klamath River.

The area of analysis also has a substantial population of farm workers, which are mostly minority and low income individuals. Because actions related to KBRA might disproportionately affect farmers, an analysis of potential environmental justice impacts on farm workers was conducted.

The analysis of social concerns, including environmental justice, is based on an understanding of how the resources in the area of analysis are used (e.g., for fishing, ceremonies, and cultural practices) and by whom, as well as the indirect economic effects on the local community. This includes the dependence of individuals and businesses on the Klamath River resources. Based on these parameters, a qualitative analysis of social and environmental justice concerns was conducted.

NEPA requires an analysis of social, economic, and environmental justice effects; however, there is no standard set of criteria for evaluating environmental justice impacts. According to CEQA, economic and social impacts are not considered significant effects on the environment. Therefore, there is no guidance in the Initial Study Checklist included in the CEQA Guidelines (California Code of Regulations, Title 14, Division 6, Chapter 3, Sections 15000-15387), and no significance determinations are made or mitigation measures required in the impact analyses.

For the purposes of this EIS/EIR, the No Action/No Project Alternative is the basis of comparison, as required by NEPA. The No Action/No Project Alternative also represents the continuation of past environmental justice issues for tribal people that occurred since the dams were constructed.

#### **3.16.4.2 Effects Determinations**

##### **Alternative 1: No Action/No Project Alternative**

*Continued impoundment of water at the reservoir and decline in fisheries could disproportionately affect tribal people.* The issue of dam removal has been brought forward by the affected Indian Tribes in response to the long-standing environmental concerns that are a direct result of the construction and continued operation of the four Klamath Hydroelectric Project dams. In the short and long term, the four subject dams would continue to operate along the Klamath River, thus continuing the historical environmental justice impacts to tribes resulting from dam construction and operation.

The river and its aquatic resources are a central part of cultural heritages of tribal communities. As such, tribes in the area of analysis have been disproportionately affected by the Four Facilities along the Klamath River. Under this alternative, an increase in salmonid populations and improvements in water quality and aquatic species populations in the Klamath Basin would not be likely. The Klamath Tribes would continue to suffer from lack of a salmon and steelhead fishery in the Upper Basin, which would prolong disproportionate adverse impacts to The Klamath Tribes' culture, subsistence and income. The Lost River and shortnose sucker fishery would also remain closed to protect severely decreased populations in the Upper Basin. This would also continue existing environmental injustices to The Klamath Tribes.

The Quartz Valley Indian Community, Karuk, Hoopa Valley, Yurok, and Resighini Rancheria Tribes in the Lower Basin would continue to experience a declined salmon and steelhead fishery in the Klamath River under the No Action/No Project Alternative. There would be continued disproportionate adverse effect on tribes' cultural and ceremonial practices with limited access to resources. Because of decreased fisheries and

shorter or no fishing seasons, Indian Tribes would be unable to meet subsistence needs and tribal incomes would remain low from reduced fishing opportunities.

Therefore, in the long term, tribes in the area of analysis would continue to be disproportionately affected by the dams, and their situation would remain an environmental concern under this alternative.

*Increased traffic, air quality emissions, and noise associated with construction could disproportionately affect county residents and tribal people.* Under the No Action/No Project Alternative, no deconstruction or construction would be required. Therefore, no short term deconstruction- or construction-related impacts, such as increased traffic on local roads, air pollutants, or noise, would disproportionately affect county residents or tribal people in the area of analysis.

*Release of sediment from reservoirs could cause disproportionate short term impacts on county residents and tribal people.* Under the No Action/No Project Alternative, sediment would not be released from the reservoirs and there would be no disproportionate short term impacts on county residents and tribal people.

*Continued impoundment of water at the reservoirs could cause disproportionate long term water quality impacts on county residents and tribal people.* Under the No Action/No Project Alternative, water quality in the reservoirs and Klamath River would continue to degrade with ongoing operation of the Klamath Hydroelectric Project facilities. Degraded water quality would affect recreation opportunities for county residents and tribal people, if there is reduced access to the reservoirs and rivers. All residents and out-of-region visitors would be affected equally by loss of access to recreation. As described in Section 3.20, Recreation, there are many other recreation sites within the region that could substitute for river and reservoir recreation activities. There would be no disproportionate effects to county residents and tribal people by long-term water quality impacts to recreation.

Degraded water quality under the No Action/No Project Alternative would extend an existing environmental justice impact on the tribal communities. Poor water quality would continue to affect culturally relevant fish, water supplies, and use of water in ceremonial activities that include drinking or bathing for all tribes in the area of analysis. For example, The Klamath Tribes would continue to not be able to perform rituals that rely on clean water from natural sources because of high water temperatures and algal development. Toxic algal blooms during the summer would also continue to affect annual work renewal ceremonies for the Karuk, Hoopa Valley, and Yurok Tribes. Similarly, the Resighini Rancheria would also be unable to bathe in the river and use its water for daily and ritualistic purposes under the No Action/No Project Alternative. Degraded water quality also affects salmon, steelhead, freshwater mussels, and other aquatic species that provide subsistence or commercial fishing revenues for the tribes. Continued seasonal and annual toxic algal blooms, high water temperatures, and other water quality impairments under the No Action Alternative would continue disproportionate effects and environmental justice concerns on the tribes in the Klamath Basin.

*Changes in county revenues could decrease county funding of social programs used by county residents.* The reservoirs and Klamath River would not be altered under the No Action/No Project Alternative. As such, no short or long term changes to property values or local tax revenues would occur under this alternative associated with dam removal. County residents would not be disproportionately affected.

*Continued impoundment of water could disproportionately impact tribal health and social wellbeing in the long term.* Under the No Action/No Project Alternative, the dams would remain and current conditions in the Klamath River would continue in the short and long term. Under this alternative, the ecosystem would not be improved and aquatic species populations would not increase. Consequently, tribes would not have increased access to fish and other aquatic resources. Without access to these traditional diets, tribal members would be required to continue supplementing their diets with store-bought food or government-provided subsidies, most of which have high concentrations of sodium, sugar, and unhealthy fats. As such, high levels of diet-related diseases, such as diabetes, obesity, and heart disease in the tribal community have the potential to continue in the long term (Norgaard 2004; Yurok Tribe 2006, Acton et al. 2003; California Rural Indian Health Board 2004; Trafzer and Weiner 2001, as cited in DOI 2011a). For example, a host of physical ailments plaguing members of The Klamath Tribes have been linked to the demise of the aboriginal diet. Diabetes, hypertension, obesity, and related cardiovascular ailments are particularly widespread, reflecting dramatic changes in food consumption and procurement patterns (DOI 2011a). Reduced tribal health would likely reduce social wellbeing of tribes because of increased sickness, disease, and stress.

In addition, aquatic resources are a critical component of traditional culture, and without any improvement to these resources, tribal members could continue to suffer from emotional and social health issues due to a loss of access to traditional resources required for continued ceremonial and cultural lifestyle and practices in the long term.

Additionally, the No Action/No Project Alternative would not result in short term concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses or are toxic to humans in the area of analysis. However, there is the potential for continued long term bioaccumulation of dioxins and DDT to occur (see Section 3.2, Water Quality, for additional bioaccumulation discussion). Therefore, under the No Action/No Project Alternative, long term improvements in tribal health and social well being would not likely occur.

### **Alternative 2: Full Facilities Removal of Four Dams (the Proposed Action)**

*Dam removal activities could affect fisheries and disproportionately affect tribal people.* Dam removal would occur in 2020. Effects until the dams are removed would be similar to the No Action/No Project Alternative. After 2020, dam removal would improve anadromous fisheries in the Klamath River and help recovery of the endangered sucker fisheries. Restored fisheries would help reverse the environmental justice impacts to the tribes that the dams created. The tribes would be able to rely on the river to provide fish for subsistence and some tribes could resume commercial fishing operations to increase revenues. The tribes would also be able to perform cultural practices and ceremonies

without restrictions because of decreased fish populations. The Proposed Action would be a benefit relative to environmental justice compared to the No Action/No Project Alternative.

*Increased air pollutants and noise associated with dam removal activities could disproportionately affect county residents and tribal people.* Full removal of all Four Facilities in a single year would require a large amount of construction equipment and personnel. Construction crews would be housed in towns near the reservoirs and staging of equipment would need to occur in the months leading up to the removal. The Proposed Action would require a build-up of equipment and personnel prior to reservoir drawdown and a post-construction period after the removal is complete. Equipment, personnel, and activities directly related to the drawdown and removal could be needed for months before and after actual dam removal. Temporary, short term air quality and noise impacts from deconstruction would occur (See Sections 3.9, Air Quality, and 3.23, Noise and Vibration) that would disproportionately affect Siskiyou and Klamath County residents and tribal people, which as a whole are low income relative to California and Oregon. Implementation of mitigation measures in Sections 3.9, Air Quality, and 3.23, Noise and Vibrations, would reduce the severity of these short term construction impacts. Environmental justice effects on county residents and tribal people from deconstruction would be greater under the Proposed Action relative to the No Action/No Project Alternative.

*The traffic on the associated haul roads could disproportionately affect county residents and tribal people.* The Proposed Action would require heavy equipment, such as large excavators, bulldozers, large dump trucks, cranes, and support equipment, to be brought to the construction area. Construction workers driving to and from the deconstruction area would also increase traffic along local roads. Section 3.22, Traffic and Transportation, identifies short term traffic impacts along haul roads that would occur as a result of deconstruction activities. These impacts include traffic flow and safety impacts. Residents in Siskiyou and Klamath Counties would be disproportionately affected by increased traffic on local roads during the construction period. Residents would be subject to short term impacts, such as increased congestion, potential traffic delays, slow moving trucks and potential safety hazards. Section 3.22, Traffic and Transportation, identifies measures to be taken to reduce traffic effects of the Proposed Action.

Tribes could be similarly affected by increased traffic. Figure 3.16-1 shows haul routes relative to tribal lands. The Klamath Tribes are the only tribe within relative distance to any of the identified haul routes; however, they are not within close enough proximity to cause a disproportionate effect. Section 3.22, Traffic and Transportation, identifies measures to be taken to reduce traffic effects of the Proposed Action. There would be no adverse environmental justice effects from traffic on tribes within the area of analysis.

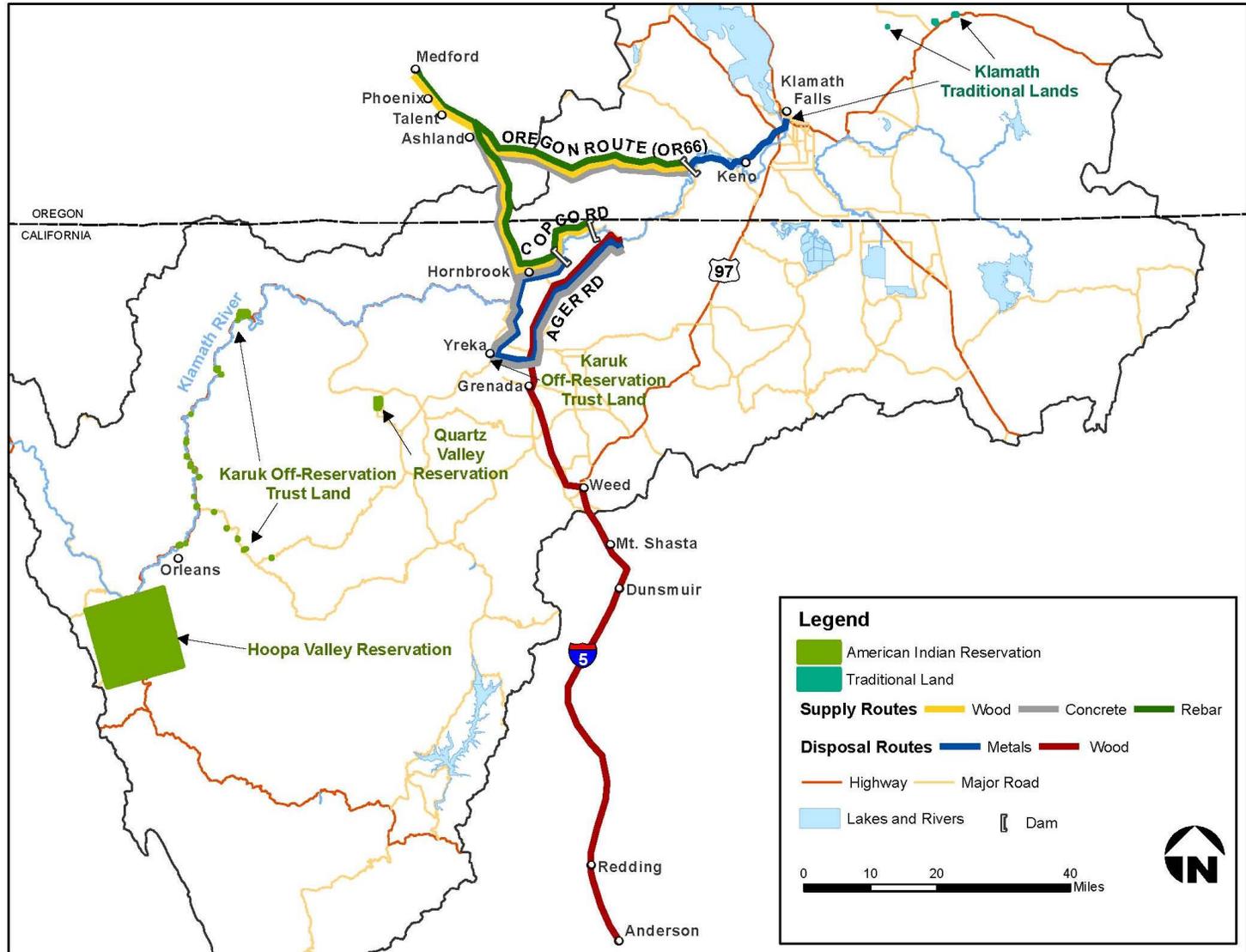


Figure 3.16-1. Tribal Lands near Haul Routes

*Dam removal activities could provide jobs for county residents and tribal people that are low income and minority.* Deconstruction activities would generate jobs in the area of analysis. Approximately 90 construction workers would be hired locally during peak deconstruction period and about 60 workers would be hired locally on average during the deconstruction period from Klamath or Siskiyou Counties. Increased employment would support low income individuals, resulting in a beneficial effect. This short-term benefit of the Proposed Action would be greater than under the No Action/No Project Alternative, which would not create any new jobs in the area of analysis.

*Release of sediment from reservoirs could cause disproportionate short term impacts on county residents and tribal people.* The Proposed Action would release sediment into the Klamath River during dam removal. Results from chemistry analysis and tests, discussed in Section 3.2, Water Quality, indicate that short term sediment release associated with the Proposed Action would not cause increases in concentrations of inorganic and organic contaminants that would adversely affect beneficial uses, be toxic to humans, or result in bioaccumulation in the Lower Klamath Basin. As such, county residents and tribal people would not be disproportionately affected by the release of sediment in the short term.

As described in Section 3.3, Aquatic Resources, the Proposed Action could reduce mussel populations in the short term as a result of sediment release. This would continue to affect subsistence for tribes that rely on freshwater mussels as a food source. Specifically, the Karuk Tribe depends on freshwater mussels for not only substance, but also for cultural and economical value (DOI 2011a). This would be a disproportionate adverse effect to the food source of tribal people in the short term. As described in Section 3.3, Aquatic Resources, implementation of Mitigation Measure AR-7 would reduce the short- and long-term effects of the Proposed Action on freshwater mussels. With implementation of Mitigation Measure AR-7 there would still be adverse affects on a portion of the freshwater mussel population and the disproportionate adverse effect to the food source of tribal people in the short term would be reduced but not completely avoided.

*Dam removal activities could cause disproportionate long term water quality impacts on county residents and tribal people.* Dam removal would occur in 2020. Effects until the dams are removed would be similar to the No Action/No Project Alternative. After dam removal, water quality would be expected to improve in the Hydroelectric Reach over the long term. Additionally, there would be long term beneficial effects on dissolved oxygen concentrations and decreased water temperatures downstream of Iron Gate Dam. Similar to improved fisheries, improved water quality would help reduce some of the environmental injustices that the dams have caused to Klamath Basin tribes. Improved water quality would further support restoration of anadromous and sucker fisheries, which would benefits tribes' cultural practices, subsistence, and economies. Based on proposed increased habitat availability and habitat quality, the Proposed Action would also have beneficial effects on mussels in the long term, further supporting subsistence for tribes. Reduced algal blooms would allow for contact recreation during the summer months, which would benefit tribes and county residents. The Proposed Action would be

a benefit relative to environmental justice compared to the No Action/No Project Alternative.

*Changes in county revenues associated with dam removal could decrease county funding of social programs.* As described in Section 3.15, Socioeconomics, the Proposed Action could cause a short and long term decline in tax revenue to the counties associated with a discontinuation of tax revenue from PacifiCorp and a potential decrease in property values near the reservoirs. There could be an additional long term increase in property tax revenues resulting from increased property values near and adjacent to the Klamath River due to improved water quality. Counties use tax revenues to support programs for public health, public welfare, education and various other services. Decreases in tax receipts could reduce funding for these programs and adversely affect individuals in Siskiyou and Klamath Counties that rely on government support. Conversely increases in tax receipts could improve funding for these programs improving conditions for individuals in Siskiyou and Klamath Counties who rely on government support. It is speculative to quantify short- and long-term impacts on county social programs because many of these programs receive funding from the state and federal governments in addition to county funds. If funding to social programs is reduced, effects would disproportionately affect low income county residents.

*Dam removal activities could disproportionately impact tribal health and social wellbeing in the long term.* The Proposed Action would be beneficial to fall- and spring-run Chinook salmon, Coho salmon, and summer and winter steelhead, as described in Section 3.3, Aquatic Resources, in the long term. Fish population increases would allow the tribes to increase subsistence fishing and once again make fish a larger component of their diet and ceremonies. Improved water quality would reduce effects to mussels, which could allow tribes to increase consumption of mussels. Consequently, they could rely less on store-bought and/or government-subsidized food (DOI 2011b). In the long term, greater access to their traditional diet has the potential to positively affect the emotional, physical, and social health of the tribes (DOI 2011b). Improved water quality and fish populations would also improve recreation on the Klamath River and potentially allow the Tribes to take advantage of potential recreation-tourism opportunities to improve economic welfare.

The increased flows in the Klamath River and increased fish populations could also allow ceremonies to become more relevant to younger tribe members, allow a greater sense of community within the tribe, and eventually positively affect the social wellbeing of the tribe. As such, implementation of the Proposed Action could beneficially affect tribal health in the long term. The Proposed Action could allow tribal people to gain increased self-reliance and self-sufficiency through increased subsistence and the restoration of the tribal commercial fishery.

*The installation of the Yreka water supply pipeline could disproportionately affect county residents or tribal people.* The existing water supply pipeline for the City of Yreka would be relocated prior to the decommissioning of the Iron Gate Reservoir. This relocation effort would not require major construction efforts and would not disproportionately impact tribes or county residents. There would be no environmental justice impacts as a result of the Yreka pipeline relocation.

*Relocation of existing recreation facilities from the banks of the existing reservoirs down slope to the new river bed could disproportionately affect county residents or tribal people.* Recreation facilities, such as campgrounds and boat ramps, currently located on the reservoir banks will need to be relocated down slope to be near the new river bed once the reservoir is removed. Impacts specific to the relocation of the recreation facilities are discussed in Section 3.20, Recreation. There would be no environmental justice impacts as a result of the relocation of the recreation facilities.

#### **Keno Transfer**

*The Keno Transfer could have adverse effects on environmental justice issues.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the Bureau of Reclamation. This transfer would not result in the generation of new environmental justice effects impacts compared with existing facility operations. Following transfer of title, Bureau of Reclamation would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). Therefore, the Keno Transfer would have no effect on environmental justice.

#### **East and West Side Facilities**

*The East and West Side Facilities decommissioning could have adverse effects on environmental justice issues.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. Therefore, the decommissioning of these facilities would have no effect on environmental justice issues.

#### **KBRA**

The KBRA has several programs that could disproportionately affect low income and minority populations. Specific KBRA programs potentially affecting environmental justice include:

- Phases I and II Fisheries Restoration Plans
- Fisheries Monitoring Plan
- Fisheries Reintroduction and Management Plan
- Water Use Retirement Program
- Off-Project Water Reliance Program
- Interim Flow and Lake Level Program
- Tribal Fisheries and Conservation Management Program

- Tribal Programs Economic Revitalization
- Klamath River Tribes Interim Fishing Site
- Mazama Forest Project
- Klamath County Economic Development Plan
- California Water Bond Legislation

*Implementation of the Phases I and II Fisheries Restoration Plans, the Fisheries Monitoring Plan, the Fisheries Reintroduction and Management Plan, and the Klamath River Tribes Interim Fishing Site could disproportionately affect tribal populations.* The Fishery Programs of the KBRA include restoration, monitoring, and reintroduction projects. Similar to dam removal, projects under the Fishery Programs would help restore anadromous fisheries and the sucker fishery in the Klamath Basin. Additionally the improvements in anadromous fisheries and the sucker fishery generated by the restoration, monitoring, and reintroduction projects would contribute to the effects of hydroelectric facility removal analyzed above. Tribes would be able to fish for cultural, subsistence, and commercial purposes similar to condition before the dams were installed. Fisheries restoration would help reverse past environmental injustices to the tribes.

*Implementation of the Water Use Retirement Program, Off-Project Reliance Program, and Interim Flow and Lake Level Program could disproportionately affect low income and minority farm workers.* The KBRA proposes voluntary land fallowing and permanent water right sales which could disproportionately affect farm workers in Klamath, Siskiyou and Modoc Counties. Loss of farm labor jobs could disproportionately affect low-income, minority farm workers, who could lose a portion of their income if farms no longer required their labor. This would be a disproportionate effect on farm workers. Actions associated with hydroelectric facilities removal would not be expected to generate any farm labor jobs and would not be expected to contribute to this short term disproportionate effect. The loss of farm jobs as a result of voluntary land fallowing and permanent water right sales would not be influenced by hydroelectric facility removal above given that facility removal does not affect irrigated agriculture and would not cause any farm job losses.

However, the core of the KBRA is to provide water reliability to farmers, which would ensure continuation of agricultural jobs in the area of analysis. In the long term, the KBRA has the potential to offset the loss of agricultural jobs and would not result in a long term environmental justice issue for farm workers.

*Implementation of the Tribal Fisheries and Conservation Management Program could disproportionately affect the tribes.* Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the tribes in developing their capacity to participate in resource management activities within the basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. The program would provide job opportunities to tribal members, which could help reduce unemployment and increase income. Fisheries and conservation projects would also support fisheries restoration to increase fish abundance.

Restored fisheries would help reverse the environmental justice impacts to the tribes that the dams created. The tribes would be able to rely on the river to provide fish for subsistence and some tribes could resume commercial fishing operations to increase revenues. The tribes would also be able to perform cultural practices and ceremonies without restrictions. The timing of and specific locations where these resource management actions could be undertaken is not certain but they would contribute to environmental justice benefits related to hydroelectric facility removal. This would benefit tribes relative to environmental justice.

*Implementation of the Tribal Programs Economic Revitalization could disproportionately affect the tribes.* This action includes funding for the Klamath, Karuk, and Yurok Tribes to develop economic revitalization plans, programs and projects. Implementation of the plan could potentially increase jobs and income for the Tribes. This would help reduce high poverty and unemployment rates among the Tribes. The timing of and specific locations where these economic revitalization plans, programs and projects could be undertaken is not certain but the improvements they are anticipated to support relative to environmental justice would contribute to the positive effects of hydroelectric facility removal. This would be a benefit relative to environmental justice.

*Implementation of the Mazama Forest Project could disproportionately affect the tribes.* The Mazama Forest Project would transfer 90,000 acres of privately owned timberland, which were formerly owned by the Klamath Tribes, back to the Klamath Tribes. With ownership of the lands, the tribe could hunt, harvest timber, or use the land for other purposes. The improvement in environmental justice generated by the Mazama Forest Project would contribute to the effects of hydroelectric facility removal. This would be a beneficial effect to the Klamath Tribes relative to environmental justice concerns.

*Implementation of the Klamath County Economic Development Plan could disproportionately affect low income and minority people in Klamath County.* This action would provide \$3.2 million of funding to Klamath County. Funding would support long-term economic growth in Klamath County and could create new job opportunities and improve public programs for county residents. The improvement in environmental justice generated by the Klamath County Economic Development Plan would contribute to the effects of construction activities associated with the hydroelectric facility removal activities. Depending on how funding is used within the county, this action could benefit low income and minority populations.

*Implementation of the California Water Bond Legislation could disproportionately affect low income and minority people in Siskiyou County.* If approved, bond funds would provide \$20 million to Siskiyou County to use for economic development. It cannot be determined at this time how Siskiyou would distribute funds from the California Water Bond Legislation; this is a general discussion. The bond funds could assist Siskiyou County in addressing unemployment, poverty, bankruptcy, and social problems and continuing funding for other county programs. The improvement in environmental justice generated by the California Water Bond Legislation would contribute to the effects of

construction activities associated with the hydroelectric facility removal activities. Programs could benefit low income and minority populations in Siskiyou County.

**Alternative 3: Partial Facilities Removal of Four Dams**

Short and long term impacts under the Partial Facilities Removal of Four Dams Alternative would be the same as those described under the Full Facilities Removal Alternative. This alternative would include the full implementation of the KBRA, the Keno Transfer, and the East and West Side Facilities decommissioning. Environmental justice effects of KBRA would be the same as described for the Proposed Action.

**Alternative 4: Fish Passage at Four Dams**

This alternative does not include implementation of the KBRA.

*Fish passage at the four dams could affect fisheries and disproportionately affect tribal people.* Tribes would benefit from increased anadromous and native fish populations as a result of this alternative. Restored fisheries would help reverse the environmental justice impacts to the tribes that the dams created. This alternative would not result in disproportionate effects to tribal people relative to the No Action/No Project Alternative.

*Increased air pollutants and noise associated with fish passage construction activities could disproportionately affect county residents and tribal people.* Environmental justice impacts to county residents and tribal people associated with increased air pollutants associated with dam removal would be similar to those discussed under the Proposed Action. Environmental justice impacts on county residents and tribal people would be greater under the Fish Passage at Four Dams Alternative relative to the No Action/No Project Alternative.

*The traffic on the associated haul roads could disproportionately affect county residents and tribal people.* Environmental justice impacts to county residents or tribal people associated with traffic on associated haul roads would be similar to those discussed under the Proposed Action. Fish Passage at Four Dams Alternative would not result in adverse long term environmental justice impacts from traffic on county residents or tribes within the area of analysis.

*Construction of fish passage could provide jobs for county residents and tribal people that are low income and minority.* Construction activities would generate jobs in the area of analysis. Increased employment would support low income individuals, resulting in a beneficial effect. This short-term benefit to low income and minority populations of the Fish Passage at Four Dams Alternative would be greater than under the No Action/No Project Alternative.

*Continued impoundment of water at the reservoirs could cause disproportionate long term water quality impacts on county residents and tribal people.* Environmental justice impacts to county residents and tribal people associated with continued impoundment of water at the reservoirs causing disproportionate long-term water quality impacts would be similar to those discussed under the No Action/No Project Alternative. Fish Passage at

Four Dams would degrade water quality for aquatic species that provide subsistence or commercial fishing revenues for tribes, and would continue to create disproportionate effects and environmental justice concerns on the tribes in the Klamath Basin.

*Changes in county revenues could decrease county funding of social programs used by county residents.* Environmental justice impacts to county residents associated with county revenues and funding for social programs would be similar to those discussed in the No Action/No Project Alternative. Fish Passage at Four Dams would not create short or long term changes to property values or local tax revenues relative to the No Action/No Project Alternative, thus county residents would not be disproportionately affected.

*Fish passage and continued impoundment of water could disproportionately impact tribal health and social wellbeing in the long term.* Fish passage would increase fish abundance for tribes to practice cultural traditions and to catch fish for commercial and subsistence purposes. Fish passage would improve tribal health and social wellbeing relative to the No Action/No Project Alternative. However, continued impoundment of water under the Fish Passage at Four Dams Alternative would not improve water quality in the long term, which would result in ongoing effects to fish, mussels, and habitat. Continued impoundment of water in the reservoir would not improve tribal health and social well being. Therefore, fish passage combined with continued impoundment of water would continue existing environmental injustices to the tribes and the tribes would continue to be disproportionately affected relative to the No Action/No Project Alternative.

**Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

This alternative does not include implementation of the KBRA.

*Dam removal activities could affect fisheries and disproportionately affect tribal people.* Tribes would benefit from increased anadromous and native fish populations as a result of this alternative. Restored fisheries would help reverse the environmental justice impacts to the tribes that the dams created. This alternative would not result in disproportionate effects to tribal people relative to the No Action/No Project Alternative.

*Increased air pollutants and noise associated with fish passage and dam removal activities could disproportionately affect county residents and tribal people.* Environmental justice impacts to county residents and tribal people associated with increased air pollutants associated with dam removal would be similar to those discussed under the Proposed Action. Environmental justice impacts on county residents and tribal people would be greater under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative relative to the No Action/No Project Alternative.

*The traffic on the associated haul roads could disproportionately affect county residents and tribal people.* Environmental justice impacts to county residents or tribal people associated with traffic on associated haul roads would be similar to those discussed under the Proposed Action. Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Alternative would not result in adverse long term environmental justice impacts from traffic on county residents or tribes within the area of analysis.

*Construction of fish passage could provide jobs for county residents and tribal people that are low income and minority.* Construction activities would generate jobs in the area of analysis. Increased employment would support low income individuals, resulting in a beneficial effect. This short-term benefit to low income and minority populations of the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would be greater than under the No Action/No Project Alternative.

*Continued impoundment of water at the reservoirs could cause disproportionate long term water quality impacts on county residents and tribal people.* Continued impoundment of water under the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would degrade water quality for aquatic species that provide subsistence or commercial fishing revenues for tribes, and would continue to create disproportionate effects and environmental justice concerns on the tribes in the Klamath Basin.

*Changes in county revenues could decrease county funding of social programs used by county residents.* Environmental justice impacts to county residents or tribal people associated with changes in county revenues associated with dam removal would be the same as discussed under the Proposed Action. Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative would disproportionately affect low income county residents, if funding to social programs is reduced.

*Fish passage and continued impoundment of water could disproportionately impact tribal health and social wellbeing in the long term.* Fish passage would increase fish abundance for tribes to practice cultural traditions and to catch fish for commercial and subsistence purposes. Fish passage would improve tribal health and social wellbeing relative to the No Action/No Project Alternative. However, continued impoundment of water under the Fish Passage at Four Dams Alternative would not improve water quality in the long term, which would result in ongoing effects to fish, mussels, and habitat. Continued impoundment of water in the reservoir would not improve tribal health and social well being. Therefore, fish passage combined with continued impoundment of water would continue existing environmental injustices to the tribes and the tribes would continue to be disproportionately affected relative to the No Action/No Project Alternative.

#### **3.16.4.3 Mitigation Measure Analysis** **Mitigation Measure by Consequence Summary**

Implementation of mitigation measures in Section 3.9, Air Quality, and Section 3.23, Noise and Vibration, would reduce environmental justice effects related to construction.

#### **3.16.4.4 Mitigation Measures Associated with other Resources**

*Mitigation measure REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam.* Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near

the new river channel once the reservoir is removed. These developments would take place on lands that are currently inundated and would not create environmental justice issues for tribal members or farm workers. There would be no impact to environmental justice as a result of implementing REC-1.

**3.16.4.5 Summary of Beneficial Effects**

Table 3.16-11 summarizes the beneficial effects of the Proposed Action and alternatives.

**Table 3.16-11. Beneficial Effects of the Proposed Action and Alternatives**

Effect	Alternatives				
	1	2	3	4	5
Dam removal could improve fisheries and benefit tribes’ cultural practices, subsistence and commercial fishing	NE	B	B	B	B
Construction could create jobs for county residents and tribal people	NE	B	B	B	B
Dam removal could reverse long term water quality impacts on tribal people	NE	B	B	NE	B (partial)
Dam removal could decrease disproportionate effects to tribal health and social well being	NE	B	B	NE	B (partial)
Fisheries restoration could improve fisheries and benefit tribes’ cultural practices, subsistence and commercial fishing	NE	B	B	NE	NE
Improve water supply reliability to agriculture could increase farm revenues	NE	B	B	NE	NE
Funding to Klamath and Siskiyou Counties could improve county economic and social conditions	NE	B	B	NE	NE
Funding to tribes for conservation management, fisheries management, and economic revitalization would improve economic and social conditions of tribes	NE	B	B	NE	NE

Key:

- Alternative 1 = No Action/No Project Alternative
- Alternative 2 = Full Facilities Removal of Four Dams (Proposed Action)
- Alternative 3 = Partial Facilities Removal of Four Dams Alternative
- Alternative 4 = Fish Passage at Four Dams Alternative
- Alternative 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- B = Beneficial
- NE = No effect

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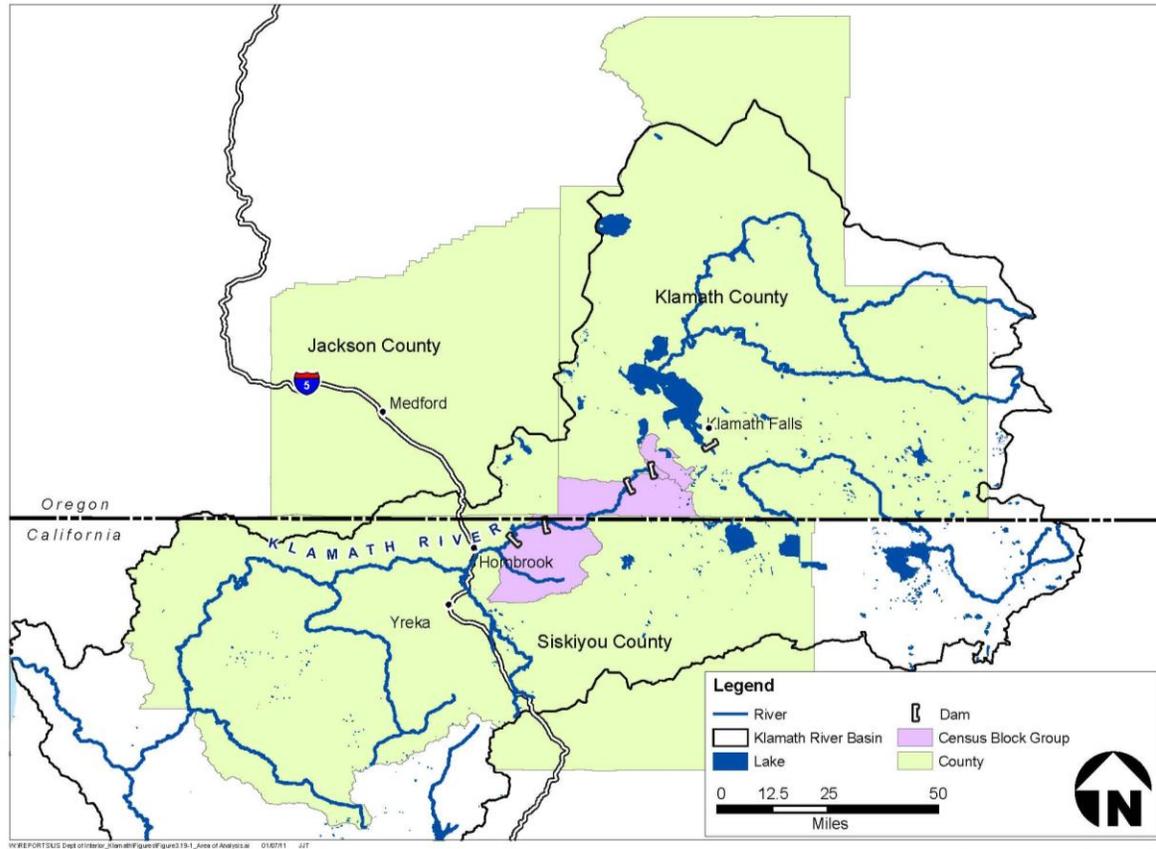
## 3.17 Population and Housing

The population and housing section of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) assesses the potential effects of the temporary worker population required for construction activities of the Proposed Action and action alternatives on housing in the Klamath Basin. The effect of the Klamath Hydroelectric Settlement Agreement (KHSA) on population and housing is determined by comparing projected housing needs with projected housing availability. No displacement of existing housing units would be anticipated from any of the alternatives. This analysis uses data from the U.S. Census, county and city plans, and other sources for projected housing availability.

No impacts on population and housing are anticipated as a result of the transfer of Keno Dam's ownership to the Department of the Interior (DOI). Potential relocation of PacifiCorp employees as a result of the alternatives is not discussed in the population and housing section. This effect to PacifiCorp employees is not anticipated to take place until 2020 and would be at the discretion of PacifiCorp. Thus, any impact is too speculative to evaluate at this time. The population and housing section of this EIS/EIR does not discuss relocation of PacifiCorp employees that would occur as a result of the alternatives. As described in Section 3.15, Socioeconomics, dam removal could result in the loss of PacifiCorp jobs. It is assumed that PacifiCorp may transfer some employees to other positions within or outside of Klamath and Siskiyou Counties. This section also excludes discussion of potential indirect economic impacts that the alternatives could have on population and housing, as any such discussion would be speculative. For an assessment of potential effects on property values and employment resulting from the alternatives, see Section 3.15, Socioeconomics.

### 3.17.1 Area of Analysis

The area of analysis for the population and housing section consists of communities with the potential to house workers migrating into the area for construction activities of the action alternatives. The area of analysis includes a combination of urban and rural communities: Hornbrook and Yreka in California and Klamath Falls and Medford in Oregon. The area of analysis also includes the residential rural areas immediately near the Copco 1 and 2 Dams and just upstream of the J.C. Boyle Dam. The Lead Agencies analyzed these communities for their potential to temporarily house workers using California Department of Finance housing and population data where available, in addition to city level and Census Block Group level 2000 U.S. Census data (U.S. Census Bureau 2000) and 2006-2008 American Community Survey (ACS) data (U.S. Census Bureau 2008), and county and city plans where available. Table 3.17-1 lists all communities included in the population and housing area of analysis. Figure 3.17-1 depicts the counties and cities/communities within the analysis scope.



**Figure 3.17-1. Population and Housing Area of Analysis**

**Table 3.17-1. Cities Included for Analysis**

Community	County	State
Yreka	Siskiyou	CA
Hornbrook	Siskiyou	CA
Siskiyou County Unincorporated Areas	Siskiyou	CA
Klamath County Unincorporated Areas	Klamath	CA
Klamath Falls	Klamath	OR
Medford	Jackson	OR

### 3.17.2 Regulatory Framework

Regulations at the Federal, State, and local levels regarding housing are generally concerned with the proper construction, provision, and siting of housing for a variety of incomes. The Proposed Action and alternatives do not call for the construction of new homes, or the demolition of existing homes, and therefore the regulations pertaining to housing do not apply.

### **3.17.3 Existing Conditions/Affected Environment**

The affected environment for population and housing reflects the existing populations and housing conditions within the area of analysis. This section presents the available data on population characteristics, including trends in in-migrations and demographics. The housing characteristics presented indicate the overall economic health of the housing market in the area of analysis, which helps assess the capacity for communities in the area of analysis to accommodate population growth that could result from the alternatives. This section presents demographic and housing information from the 2000 U.S. Census at the city and Census block group level, and from the ACS at the county and state level. While more recent data is available for many locales, the 2000 Census dataset remains the most comprehensive data available at the community level for all cities in the area of analysis. More recent data, where available, are included in the discussions.

This discussion presents data for all Census-designated communities and counties included in the area of analysis by county. Unincorporated areas immediately near the dams are discussed separately. Demographic, economic and housing data are discussed on a community, county and state level. County sections include Siskiyou County in California and Klamath and Jackson Counties in Oregon.

#### **3.17.3.1 Klamath County, Oregon**

Klamath County is in the area of analysis because the unincorporated area near J.C. Boyle Dam and Klamath Falls could temporarily house workers needed for construction associated with the alternatives. The City of Klamath Falls data are presented along with data for Klamath County. Data representing the unincorporated area near J.C. Boyle Dam, which includes the community of Keno, a small unincorporated community approximately 12 miles upstream of the J.C. Boyle Reservoir, are discussed in Section 3.17.3.4. While Keno lies within Klamath County, the data are presented separately because it represents a non-census designated community.

According to the 2009 Klamath Falls Economic Opportunities Analysis (Johnson and Gardner 2009), about two thirds of Klamath County's population is within the Klamath Falls Urban Growth Boundary (UGB). Klamath Falls proper (not including rural areas in the UGB) is a city of almost 20,000 people. Housing statistics presented in this section for Klamath Falls *exclude* the unincorporated areas in the Klamath Falls UGB. Including the unincorporated areas in the UGB approximately doubles the total population of Klamath Falls. Klamath County's annual average unemployment rate in 2009 was 13.9 percent (Bureau of Labor Statistics (BLS) 2011a).

#### **Demographic Data**

Klamath County age demographics are consistent with the State of Oregon. In Klamath County, 26.5 percent of the population was under 19 years of age according to the ACS, and 43.6 percent is over 45. Similarly, in the State of Oregon 25.6 percent of the population was below 19 years of age, with 40.3 percent over 45.

### **Housing Data**

The ACS reported 26,908 housing units in Klamath County with 86 percent occupied and 14 percent vacant. In Klamath Falls proper, 51 out of 806 vacant units were for seasonal use in the 2000 Census. Table 3.17-2 contains housing estimates for Klamath Falls and Klamath County. In 2000, median monthly rent in Klamath Falls was \$471, compared with Klamath County's median rent of \$475 in 2000.

**Table 3.17-2. Klamath Falls and County Housing Estimates**

	Klamath Falls		Klamath County	
	Estimate	Percent	Estimate	Percent
<b>Total Housing Units</b>	<b>8,722</b>		<b>31,184</b>	
Occupied Housing Units	7,916	90.8%	26,908	86.3%
Owner-Occupied	3,906	49.3%	18,524	68.8%
Renter-Occupied	4,010	50.7%	8,384	31.2%
Vacant Housing	806	9.2%	4,276	13.0%

#### **3.17.3.2 Jackson County, Oregon**

The City of Medford could temporarily house workers needed for construction associated with the alternatives. Medford's estimated population was 75,700 in 2007 (City of Medford 2010). This population estimate accounts for more than a third of the population of Jackson County. The City of Ashland is not explicitly included in the area of analysis due to uncertainties of housing availability during the Ashland Shakespeare Festival's peak season in the summer and early fall (Oregon Shakespeare Festival 2011); however, it is possible that some workers could find housing in Ashland, as well.

The Medford Metropolitan Statistical Area had an unemployment rate of 11.6 percent in December 2009 (BLS 2011b). Jackson County's annual average unemployment rate in 2009 was only 6.7 percent (BLS 2001b).

### **Demographic Data**

Like Klamath County and Oregon overall, Jackson County has a high older age population. According to the ACS, 44.7 percent of the population in Jackson County was reported as over the age of 45. Only 24.3 percent of the population in Jackson County is under 19 years of age.

### **Housing Data**

Estimates show that housing units in Medford increased by approximately 5,000 units between 2000 and 2006 to 31,205 housing units. However, there is still a shortage of affordable housing in Medford (City of Medford 2010). The city is composed of mostly single-family housing, with pockets of higher density and multi-family units. A walk-by was completed in 2004 (City of Medford 2010). There are neighborhoods in Medford with more than 50 percent renter-occupied units. The 2000 Census reports a housing vacancy rate in Medford of 4.9 percent, but in 2007, the vacancy rate was only

2.7 percent (City of Medford 2010). Table 3.17-3 contains housing estimates for Medford and Jackson County.

**Table 3.17-3. Medford and Jackson County Housing Estimates**

	Medford		Jackson County	
	Estimate	Percent	Estimate	Percent
<b>Total Housing Units</b>	<b>26,310</b>		<b>87,338</b>	
Occupied Housing Units	25,141	95.4%	81,559	93.4%
Owner-Occupied	14,372	57.3%	51,654	63.3%
Renter-Occupied	10,721	42.7%	29,905	36.7%
Vacant Housing	1,204	4.6%	5,779	6.6%

There is a lack of affordable housing in the City of Medford, which contributes to an elevated homelessness rate (City of Medford 2010). In 2000, 46 percent of all renters in Medford were cost-burdened (U.S. Census Bureau 2000). The median monthly rent in Medford was 605 dollars, compared with 471 dollars in Klamath Falls. Barriers to developing affordable housing in Medford include permitting constraints, lack of land properly zoned for low-income housing, development codes that discourage mixed-use development, among others (City of Medford 2010).

**3.17.3.3 Siskiyou County, CA**

Siskiyou County data is presented along with data for the City of Yreka and the community of Hornbrook. Yreka and Hornbrook could temporarily house workers required for construction associated with the alternatives. Section 3.17.3.4 covers other unincorporated residential areas near the dams. While the residential area surrounding Copco 1 Reservoir, referred to as Copco Village, lies within Siskiyou County, Census Block Group Data more specifically representing Copco Village is presented separately (see Section 3.17.3.4) because it represents a non-census designated community.

Yreka was a city of nearly 7,300 people at the time of the 2000 Census, and Hornbrook was a community of approximately 300. Since the 2000 Census, the population of Yreka has gone up to 7,415 (Department of Finance 2010). Siskiyou County’s annual average unemployment rate in 2009 was 14.8 percent, higher than either Klamath or Jackson Counties (BLS 2011a).

**Demographic Data**

Similar to Jackson and Klamath Counties, Siskiyou County has a high older population. In 2000, both Hornbrook and Yreka had populations of which more than 40 percent were over 45 years of age. In the ACS, Siskiyou County had a population where almost 50 percent were over 45 years of age.

**Housing Data**

Table 3.17-4 shows housing and occupancy estimates for Siskiyou County. Siskiyou County’s overall vacancy rate is higher than most other counties in the area of analysis. Hornbrook has a high vacancy rate, at 19 percent, out of 148 total units in 2000.

However, because the absolute number of housing units in Hornbrook is so small (148), the total number of vacant units (28) is also small. Yreka and its surrounding area has a relatively low housing availability; at the time of the 2008 housing costs survey conducted by the City of Yreka only 41 housing units were available for rent in the City of Yreka and its surrounding area (City of Yreka 2009). Siskiyou County's gross vacancy rate in 2010 was 15.5 percent and Yreka's gross vacancy rate was 5.7 percent (Department of Finance 2010).

**Table 3.17-4. Siskiyou County Housing Estimates**

	Hornbrook		Yreka		Siskiyou County	
	Number	Percent	Number	Percent	Number	Percent
<b>Total Housing Units</b>	<b>148</b>		<b>3,303</b>		<b>23,506</b>	
Occupied Housing Units	120	81.1%	3,114	94.3%	20,021	85.2%
Owner-Occupied	84	70.0%	1,797	57.7%	13,252	66.2%
Renter-Occupied	36	30.0%	1,317	42.3%	6,769	33.8%
Vacant Housing	28	18.9%	189	5.7%	3,485	14.8%

The Yreka Housing Element reports 2008 rental costs ranging from \$525 to \$900 per month (City of Yreka 2009).

#### **3.17.3.4 Unincorporated Areas**

The unincorporated areas discussed in this section represent Keno (12 miles from Klamath Falls) and the residential areas surrounding Copco 1 Reservoir (26 miles from Yreka). These two communities are closest to the Four Facilities, and could have possible housing impacts from worker displacement. The affected environment for Keno is presented as a compilation of the U.S. 2000 Census results from Oregon Census Tract 9703, Block Groups 2, 3, and 4. Because these block groups include Keno and also its surrounding area, this discussion refers to them as the Klamath unincorporated area. The Copco 1 Reservoir Area is described using U.S. 2000 Census results from California Census Tract 3, Block Group 1. Because this block group encompasses not only the residential area around Copco 1 Reservoir, but also other unincorporated areas around the Iron Gate Dam and surrounding areas, including the communities of Ager and Logan, this block group is referred to as the Siskiyou unincorporated area. The geographic areas encompassed by these census block groups are shown in Figure 3.17-2. Statistics presented on unincorporated areas are from U.S. Census 2000 Summary File 3.

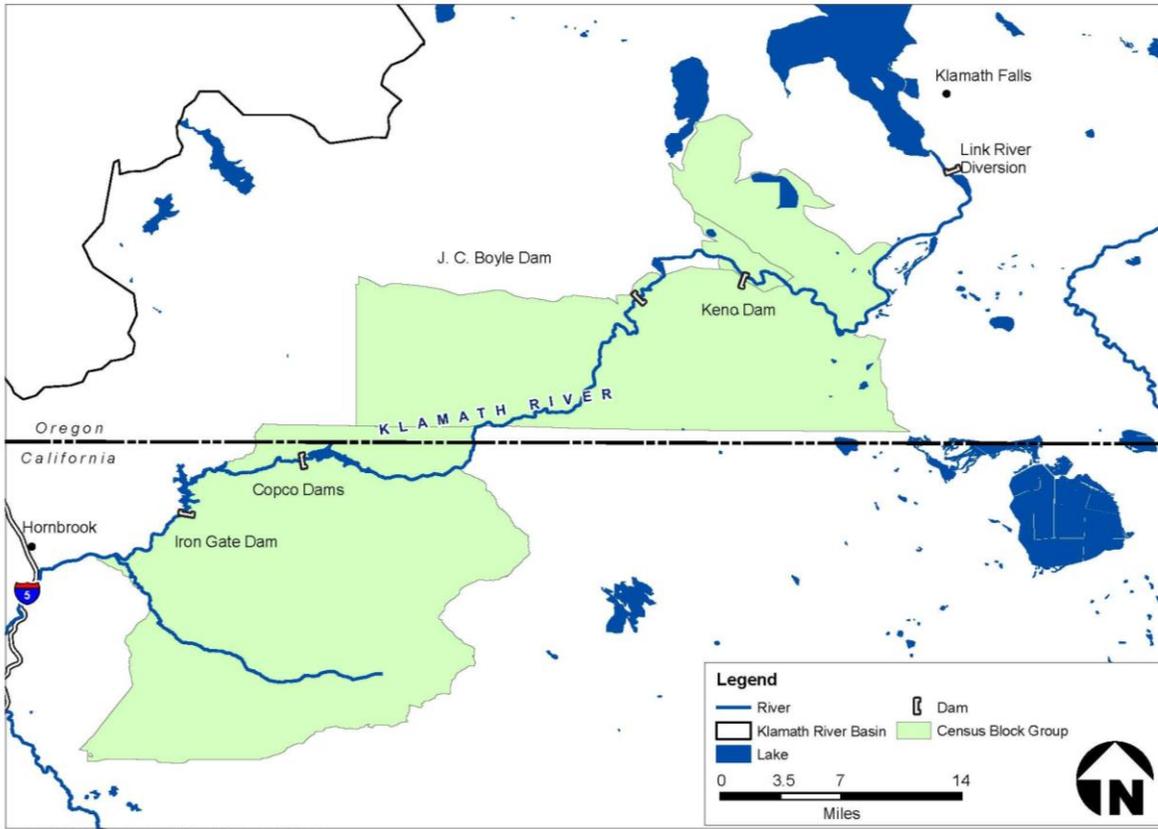


Figure 3.17-2. Census Block Groups

### **Demographic Data**

Like Klamath and Siskiyou Counties overall, both the Oregon and California unincorporated areas have large populations over 45 years in age. In the Klamath unincorporated area, 44 percent of the population is over 45 years of age, and in the Siskiyou unincorporated area 49 percent of the population is over 45 years of age.

### **Housing Data**

Table 3.17-5 contains housing estimates for the unincorporated areas. While the Siskiyou unincorporated area vacancy rate in 2000 was fairly large (20 percent, or 163 units), only 11 were for rent and 37 were for sale. Roughly half of the vacant units, or 82 units, were for seasonal, recreational or occasional use. The vacancy rate in the Klamath unincorporated area was much lower, at 8.5 percent or 101 units. Of these, only 10 were for rent and 31 were for sale. Only 22 units were for seasonal, recreational or occasional use.

**Table 3.17-5. Unincorporated Areas Housing Estimates**

	Siskiyou Unincorporated Area		Klamath Unincorporated Area	
	Estimate	Percent of Total	Estimate	Percent of Total
<b>Total Housing Units</b>	<b>798</b>		<b>1,189</b>	
Occupied Housing Units	635	79.6%	1,088	91.5%
Owner-Occupied	512	80.6%	948	87.1%
Renter-Occupied	123	19.4%	140	12.9%
Vacant Housing	163	20.4%	101	8.5%

In both areas, median monthly rental cost of \$513 was lower than the county-wide median values.

### **3.17.4 Environmental Consequences**

#### **3.17.4.1 Effects Determination Methods**

This analysis used both qualitative and quantitative methods to determine the effects that implementation of the alternatives would have on population and housing. Significance criteria were used to qualitatively assess the impacts of each alternative. Effects considered for this resource area would be related to availability of housing for non-local construction workers and whether the use of housing by construction workers would impact the local housing market. Implementation of the alternatives would not require any land acquisition that would require housing units to be relocated. The project description includes preliminary estimates of the numbers of workers required for construction actions. This analysis compared the housing needs associated with these workers with existing demographics and housing statistics described in the Affected Environment.

#### **3.17.4.2 Significance Criteria**

Significant impacts on population and housing would result if the project resulted in substantial population growth in the area of analysis. For the purposes of this EIS/EIR, population growth in a community is “substantial” if it would result in housing needs exceeding the number of housing units projected to be available and affordable.

#### **3.17.4.3 Effects Determinations**

This section presents the effects of each of the alternatives on population and housing. For all alternatives except for the No Action/No Project Alternative, some level of construction or deconstruction would be involved at all Four Facilities. Construction labor would require up to 250 workers during the peak construction period. As described

in Section 3.15, Socioeconomics, peak construction at J.C. Boyle, Copco 2, and Iron Gate Facilities generally overlap; peak construction at the Copco 1 Facility would occur separately. Peak number of workers required to implement the alternatives range from 175 to 195 workers at one time for Copco 1, Copco 2 and Iron Gate Dams (in California), and from 30 to 55 workers at one time for J.C. Boyle Dam (in Oregon). Potential mitigation measures increase these estimates by as much as 20 workers. Workers that could not be provided by the local communities would need to commute from a near-by community, either a more rural, unincorporated town such as Keno or Hornbrook, or a more urban area such as Yreka, Medford, or Klamath Falls. Table 3.17-6 lists approximate travel distances to the dams from each of these communities for the J.C. Boyle Dam. For the Copco 1, Copco 2, and Iron Gate Dams, Yreka and Medford are communities that might house workers, along with Hornbrook and the rural areas immediately around Copco 1 Reservoir. The capacity of each of these communities to house the workers needed for each of the alternatives is discussed below.

It is likely that some of the workforce required for the deconstruction alternatives could be satisfied with local residents; however, some non-resident workers are likely to be necessary for specialized tasks. Section 3.15, Socioeconomics, assumes that about 90 percent of the unskilled labor and 20 percent of the skilled labor could be supplied locally from Klamath and Siskiyou Counties during peak construction (approximately 98 workers). The remaining approximate 150 workers needed during peak construction would have to be brought into Klamath and Siskiyou Counties. During non-peak construction, all unskilled as well as skilled workers could be provided locally. It is further assumed that one housing unit would be required per non-local worker.

**Table 3.17-6. Approximate Commute Distances<sup>1</sup> (miles)**

	Klamath Falls	Medford	Yreka	Hornbrook	Keno
J.C. Boyle	20	55	70	55	8
Copco 1 & 2	50	50	27	21	40
Iron Gate	60	44	22	8	50

<sup>1</sup> Distances were approximated using Google Maps, and are only accurate to within 5 miles.

There are a limited number of PacifiCorp-owned housing units at the dam sites. Because the noise analysis in this EIS/EIR estimates high noise levels at these housing facilities resulting from the alternatives (see Section 3.23, Noise and Vibration), these facilities are not included as potential housing sources for the population and housing section.

It is assumed that relocation of the City of Yreka’s water supply pipeline and relocation or demolition of recreation facilities would occur during non-peak construction (before and after dam deconstruction activities, respectively). Therefore, the workers required for these construction activities would not add to the peak housing needs in Klamath and Siskiyou Counties. Additionally, the number of workers required to complete these

construction activities would be less than the peak number required for implementation of the action alternatives. Thus, it is assumed that the housing units described in the analysis of the action alternatives would accommodate workers necessary for water supply pipeline relocation and relocation or demolition of recreation facilities.

### **Alternative 1: No Action/No Project Alternative**

*Under the No Action/No Project Alternative, there would be no change in project dam and associated facility operations and no impacts on population and housing.* The No Action/No Project Alternative would not result in construction activities taking place at the sites of the Four Facilities. There would be no influx of temporary workers and no impacts on population and housing. Population and housing would follow current trends. **There would be no change from existing conditions to population and housing under the No Action/No Project Alternative.**

### **Ongoing Resource Management Actions**

Ongoing resource management actions and programs would continue to take place under the No Action/No Project Alternative. Construction, implementation, and monitoring activities associated with these ongoing projects could result in increases in new jobs throughout the Klamath Basin and a demand for more workers.

Ongoing actions considered for impact to population and housing under the No Action/No Project Alternative include:

- Fish Habitat Restoration
- Williamson River Delta project
- Agency Lake and Barnes Ranches project

*Construction, restoration, and monitoring activities associated with ongoing programs could create new jobs and could employ non-local workers, who would need housing for the duration of their employment.* Construction activities necessary for ongoing resource management include floodplain rehabilitation, large woody debris placement, fish passage correction, cattle exclusion, riparian vegetation planting, mechanical thinning to promote conifers, and channel construction. These activities as well as follow-up monitoring are anticipated to result in the creation of additional jobs. **While it is anticipated that the majority of these jobs could be filled with local workers, some amount of workers (both skilled and unskilled) may need to be hired from outside of the local areas. It is anticipated that the effects on population and housing would be less than significant.**

### **Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

*Construction activities involved in dam removal could employ non-local workers, who would need housing for the duration of their employment.* During peak deconstruction periods, implementation of the Full Facilities Removal of Four Dams Alternative would require up to 250 total workers with 195 working at the Copco and Iron Gate Facilities combined, and up to 55 workers at the J.C. Boyle Facility. Both of these numbers include administrative and management staff. At the Copco and Iron Gate Facilities, 78 workers

would be provided from within the region and 117 would be required from outside of the region. At J.C. Boyle, 20 workers would come from within the region and 35 from outside of the region. Therefore, the housing need would be up to 117 housing units for the California facilities and 35 housing units for the Oregon facility. Peak worker needs would occur between November 2019 and September 2020.

For J.C. Boyle Dam, communities that could possibly house workers include Keno and Klamath Falls. In 2000, only 10 housing units were available for rent in Keno. Recent Klamath County plans (Johnson and Gardner 2009) do not include growth projections for Keno, but a sudden increase in 35 workers would roughly present a 3 percent increase in population and could stress the Keno rental housing market. However, an increase of 35 workers in Klamath Falls on a temporary basis could likely be absorbed by that city. With a current population of over 20,000 people and a projected increase in population of more than an additional 10,000 people by 2030 due to in-migration (Johnson Gardner 2009), these 35 workers in Klamath Falls would result in a 0.1 percent population increase. It is likely that, workers required for full removal of the J.C. Boyle Dam could be accommodated between the community of Keno and the City of Klamath Falls.

For the Copco 1, Copco 2, and Iron Gate Dams, large communities that could house workers include Yreka and Medford. In 2000, there were more than 1,500 vacant housing units in Medford. While the corresponding gross vacancy rate in Medford was 5 percent (U.S. Census Bureau 2000), the 2010 estimated vacancy rate was less than 3 percent (City of Medford 2010), with close to 800 vacant housing units. While the more recent vacancy rate is low, the total number of housing units available indicates a strong likelihood that Medford could accommodate most, if not all, housing needs associated with the Proposed Action.

Yreka's housing market has limited available housing. For example, in 2008 only 41 housing units were available for rent. Projecting Yreka's current planned housing expansion to 2019 would result in 202 more housing units in Yreka in 2019 (the beginning of construction) than are present in 2010. Because these new units are planned to accommodate anticipated growth regardless of the project alternative chosen, it is uncertain how many of the planned units would be available to non-local workers for the alternatives.

There are several other potential housing possibilities that could accommodate housing needs both in California and Oregon, including:

- *Hornbrook.* According to the 2000 Census, Hornbrook had 23 vacant housing units not for seasonal use. The County has identified 36 possible new housing units within Hornbrook for future growth.
- *Rentals at Copco 1 Reservoir.* It is also possible that seasonal vacation homes in the vicinity of Copco 1 Reservoir could be available for rent. In 2000, in the unincorporated areas immediately around the Copco 1 and Copco 2 Developments, there were 48 housing units for rent or for sale. Section 3.15, Socioeconomics, describes that dam removal could lead to decreases in the

number of non-local visitors to the region due to losses of reservoir recreation activities and loss of access to recreation sites at the dam. Additionally, Section 3.15, Socioeconomics, assumes that losses in recreation spending would directly affect accommodation services in Klamath County. Recreational use of vacation homes near the reservoirs could decrease, making these seasonal homes available to workers.

- *Campgrounds and Recreational Vehicle (RV) Parks.* It is also likely that the local campgrounds near the dams would be available as temporary housing. In addition to campgrounds at Iron Gate and Copco 1 Reservoirs, the Bureau of Land Management maintains a campground along the Klamath River in Oregon, and another near the state line (Bureau of Land Management (BLM) 2011a and 2011b). RV parks in Hornbrook and Yreka may also be available (Siskiyou County Visitor's Bureau 2011).
- *Hotels.* Among the various hotels in Yreka, there are more than 600 rooms available via a simple internet search.<sup>1</sup> In addition, Klamath Falls contains more than 1,000 hotel rooms. Non-local temporary workers who have short contracts may prefer this housing option to renting a more permanent housing unit.

Peak workforce estimates apply to a several-month period. Because of the short duration of workforce needs, temporary housing may be desirable to non-local workers. Hotels and RV/camping options would very likely compensate for any shortage of more permanent housing in Medford, Yreka and Klamath Falls. For the purposes of this EIS/EIR, population growth in a community is "substantial" if it would result in housing needs exceeding the number of housing units projected to be available and affordable. **Because the housing needs associated with construction activities could be met with resources in the area of analysis, these housing impacts would be less than significant.**

*Dam removal at Iron Gate would require the relocation of the Yreka water supply pipeline.* The construction of the pipeline would take place during the deconstruction period and would not require an increase in construction workers or construction time. The relocation would occur after drawdown of the reservoir was complete and would not interfere with the deconstruction schedule. **There would be a less than significant impact to population and housing as a result of the pipeline relocation.**

*Dewatering of the reservoirs would result in recreational facilities currently located on the banks of the existing reservoirs to be removed following drawdown.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities will be removed. This facility removal will be done following the deconstruction of the dams, but will not require large crews or specialized labor that would need to be brought in from out of the area. **There would be no change from existing conditions for population and housing resulting from the removal of the recreational facilities.**

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<sup>1</sup> Information collected using [www.expedia.com](http://www.expedia.com) on 1/26/2011.

**Keno Facilities Transfer**

*The transfer of the Keno Facility to DOI could result in additional workers.* Keno Dam is an unmanned facility which requires minimal operations and maintenance. Recreation facilities owned by PacifiCorp in the vicinity of Keno Dam will also be transferred to either the state or county as described in the KHSA Section 7.5. Operation of Keno Dam and of the recreation areas are expected to continue in the current fashion. **The transfer of the facility and recreation lands would result in no change from existing conditions for population and housing.**

**Eastside and Westside Facilities Removal**

*The decommissioning of the East and West Side Facilities could result in additional workers.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. The number of workers required for the decommissioning will be fewer than those required for the Proposed Action. **Therefore, there would be no change from existing conditions for population and housing as a result of the decommissioning.**

**KBRA**

Construction activities associated with implementation of several KBRA programs could result in increases in new jobs throughout the Klamath Basin and a demand for more workers. The following programs could cause these impacts:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration
- On- Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction
- Klamath River Tribes Interim Fishing Site

*Construction and monitoring activities associated with the above-listed KBRA programs could employ non-local workers who would need housing for the duration of their employment.* The creation of jobs and potential need to employ non-local workers could strain local housing availability and result in short and long-term increases in population in communities with the potential to house workers migrating into the area. It is anticipated that the majority of workers could be satisfied locally. The timing of and specific locations where these KBRA programs could be undertaken is not certain but it is assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. However, as described in section 3.17.3, it is assumed that there is sufficient housing supply in the current stock to accommodate non-local workers. **Thus, it is expected that population and housing effects from construction and monitoring of KBRA programs would be less than**

**significant. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

**Alternative 3: Partial Facilities Removal of Four Dams**

*Construction activities involved in dam removal could employ non-local workers, who would need housing for the duration of their employment.* Implementation of the Partial Facilities Removal of Four Dams Alternative would result in less facility removal. However, during peak deconstruction periods, implementation of the Partial Facilities Removal of Four Dams Alternative would require the same number of workers at each facility as described for the Proposed Action. These numbers include administrative and management staff. This would require the same number of workers from within and outside of the region as described for the Proposed Action. Peak worker needs would occur between November 2019 and September 2020.

Peak housing requirements for deconstruction at the Iron Gate and Copco Facilities could be met with housing available in Medford, Yreka, Hornbrook, Copco Village, and other options as described above for the Proposed Action. Peak housing requirements for the J.C. Boyle Dam construction could be met by housing available in Klamath Falls and Keno. Because the Partial Facilities Removal of Four Dams Alternative would require fewer workers than the Proposed Action, the detailed discussion of housing availability provided in the Proposed Action section also applies to this alternative.

For the purposes of this EIS/EIR, population growth in a community is “substantial” if it would result in housing needs exceeding the number of housing units projected to be available and affordable. **Because the housing needs associated with construction activities could be met with resources in the area of analysis, these housing impacts would be less than significant.**

**Eastside and Westside Facilities Removal**

Potential impacts from the decommissioning of the East and Westside Facilities would be the same as under the Proposed Action.

**Keno Facilities Transfer**

*The transfer of the Keno Facility to DOI could result in additional workers.* Potential impacts for the Keno Facilities Transfer would be the same as those described under the Proposed Action. **The transfer of the facility and recreation lands will have no change from existing conditions for population and housing.**

**KBRA**

Implementation of the KBRA would have the same effects as the Proposed Action.

**Alternative 4: Fish Passage at Four Dams**

*Construction activities involved in fish passage creation could employ non-local workers, who would need housing for the duration of their employment.* Implementation of the Fish Passage at Four Dams Alternative would result in fish passage installation at the Four Facilities. During peak construction periods, implementation of the Fish Passage at Four Dams Alternative would require up to 75 workers at the Copco and Iron Gate

Facilities combined, and up to 20 workers at the J.C. Boyle Facility. These numbers include administrative and management staff. Because detailed schedules for this alternative are not available, work force estimates assume that an average work force level at each facility would be required throughout construction actions at each facility. Of the workers at Copco and Iron Gate Facilities, it is assumed that 36 would come from within the region and 59 would come from outside of the region. Of the workers at J.C. Boyle, it is assumed that 10 would come from within the region and 20 would come from outside of the region. These housing requirements for construction at the J.C. Boyle Dam could be met by housing available in Klamath Falls and Keno, while the housing requirements for construction at the Iron Gate and Copco Facilities could be met with housing available in Medford, Yreka, Hornbrook, Copco Village, and other options described above for the Proposed Action. Because the Fish Passage at Four Dams Alternative would require fewer workers than Proposed Action, the detailed discussion of housing availability provided in the Proposed Action also applies to this alternative.

For the purposes of this EIS/EIR, population growth in a community is “substantial” if it would result in housing needs exceeding the number of housing units projected to be available and affordable. **Because the housing needs associated with construction activities could be met with resources in the area of analysis, housing impacts from this alternative would be less than significant.**

**Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

*Construction activities involved in dam removal and fish passage creation could employ non-local workers, who would need housing for the duration of their employment.*

Implementation of Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in full removal of the Copco 1 and Iron Gate Dams and fish passage construction at J.C. Boyle and Copco 2 Dams. During peak deconstruction/construction periods, implementation of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would require a total peak construction workforce of up to 205 workers. This includes up to 175 workers at the Copco and Iron Gate Facilities combined, and up to 30 workers at the J.C. Boyle Facility. These numbers include administrative and management staff. At the Copco and Iron Gate Facilities, 69 workers would be provided from within the region and 106 would be required from outside of the region. At J.C. Boyle, 9 workers would come from within the region and 21 from outside of the region. Therefore, the housing need would be up to 106 housing units for the California facilities and 21 housing units for the Oregon facility. Peak worker needs would occur between November 2019 and September 2020.

Peak housing requirements for construction at J.C. Boyle Dam could be met by housing availability in Klamath Falls and Keno. Peak housing requirements for activities at the Copco and Iron Gate Facilities could be met with housing available in Medford, Yreka, Hornbrook, Copco Village, and other options as described above for the Proposed Action. Because the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would require fewer workers than the Proposed Action, the detailed

discussion of housing availability provided in the Proposed Action section also applies to this alternative.

The housing needs associated with construction activities could be met with resources in the area of analysis. **Because this alternative would not result in a substantial increase in population growth or in housing unit needs, the housing impacts from this alternative would be less than significant.**

#### **3.17.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequence Summary**

No mitigation measures are proposed.

#### **3.17.4.5 Mitigation Measures Associated with other Resources**

*Construction of new recreation facilities could require additional workers affecting population and housing.* Mitigation REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. Recreation facilities, such as campgrounds and boat ramps, currently located on the reservoir banks will need to be relocated down slope to be near the new river bed once the reservoir is removed. Impacts specific to the relocation of the recreation facilities are discussed in Section 3.20, Recreation. The planning and construction of these sites would take place after the deconstruction of the dams and would require a much smaller work force than the Proposed Action. Most, if not all of the labor required to replace the recreational facilities could be drawn from the local work force. **Therefore, the implementation of REC-1 would have a less than significant impact on population and housing.**

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## **3.18 Public Health and Safety, Utilities and Public Services, Solid Waste, Power**

This section presents the Public Health and Safety, Utilities and Public Services, Solid Waste, and Power analyses. Public health and safety includes potential impacts associated with construction-related health and safety risks, including fires and emergencies, and disease vectors. Another safety issue, the potential for changes in flooding downstream of the reservoirs, is discussed in Section 3.6, Flood Hydrology. Utilities and public services include potential impacts on electricity, natural gas, water supplies, stormwater management, wastewater, solid waste, telecommunications, public roads, police, and fire services. The power analysis examines the potential impacts on existing power facilities and the resulting loss of power production. The economic impacts from changes in PacifiCorp customer rates as a result of dam removal costs are discussed in Section 3.15, Socioeconomics.

### **3.18.1 Area of Analysis**

The area of analysis differs based upon the specific resource being analyzed. The primary area of analysis includes the Klamath River from Keno Dam through the J.C. Boyle Reservoir to Iron Gate Dam, the Klamath River downstream of Iron Gate Dam, counties and communities in the area, and areas in the Upper Klamath Basin that could be affected by implementation of the Klamath Basin Restoration Agreement (KBRA) (see Figure 3.18-1).

#### **3.18.1.1 Public Health and Safety**

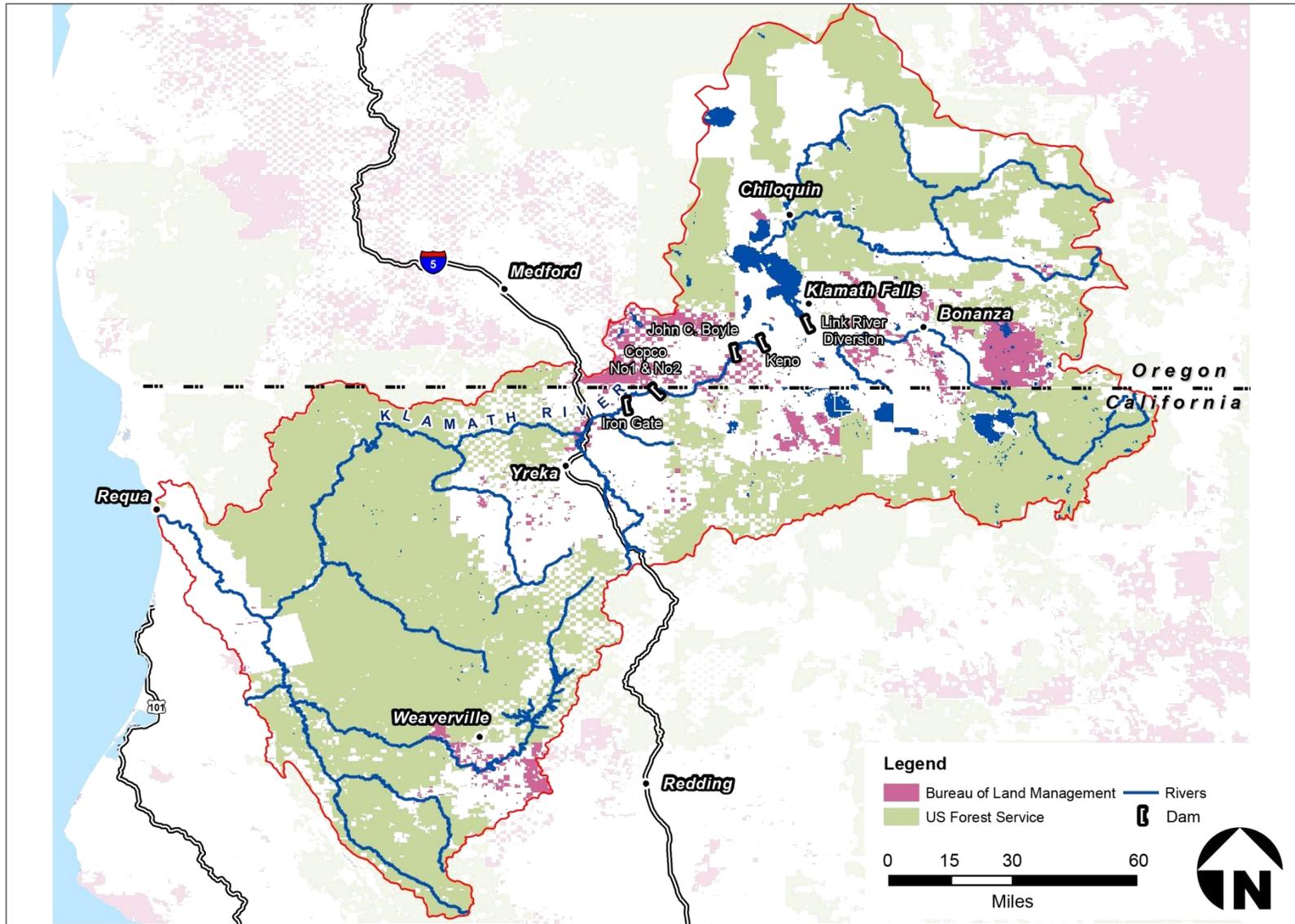
The area of analysis includes the area in the immediate vicinity of the Klamath River, from Keno Dam through J.C. Boyle Dam to Iron Gate Dam, including the Four Facilities as well as areas identified as construction/demolition areas and staging areas for the alternatives. These areas will have construction and physical changes to the environment that may result in public health and safety concerns.

#### **3.18.1.2 Utilities and Public Services**

The area of analysis for utilities and public services includes the counties and communities where temporary workers would live and use community resources and services, and the areas where substantial construction activities would occur, as shown in Table 3.18-1.

#### **3.18.1.3 Solid Waste**

The area of analysis for solid waste includes the landfills and waste management facilities in Siskiyou and Klamath Counties.



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Figure 3.18-1. Area of Analysis

INTERNAL WORKING DOCUMENT - NOT FOR DISTRIBUTION

**Table 3.18-1. Area of Analysis for Utilities and Public Services**

County	Community	State
Siskiyou	Yreka	CA
	Hornbrook	CA
	Copco Village	CA
	Beswick	CA
Klamath	Merill	OR
	Klamath Falls	OR
	Chiloquin	OR
	Keno	OR

**3.18.1.4 Power**

The area of analysis for power includes the Klamath Hydroelectric Project (KHP), which is owned by PacifiCorp and covers 64 river miles from the Link River Dam in Oregon to Iron Gate Dam in California.

**3.18.2 Regulatory Framework**

Public Health and Safety, Utilities and Public Services, Solid Waste, and Power within the area of analysis are regulated by federal, state and local regulations, which are listed below.

**3.18.2.1 Federal Authorities and Regulations**

- Federal Energy Regulatory Commission (FERC) Founding Legislation: Title 42, chapter 84, Subchapter IV, section 7171.
- Federal Powers Act
- United States Department of Energy Organization Act.
- Resource Conservation and Recovery Act; 42 U.S.C section 6901 et seq. (1976)
- 29 CFR Part 1910: Occupational Safety and Health Standards
- 29 CFR Part 1925: Safety and Health Standards for Federal Service Contracts
- 29 CFR Part 1926: Safety and Health Regulations for Construction
- 29 CFR Part 1952: Approved State Plans for Enforcement of State Standards

**3.18.2.2 State Authorities and Regulations**

- California Public Utilities Commission (CPUC)
- Oregon Public Utilities Commission (Oregon PUC)
- Oregon Administrative Rules (OAR) Chapter 860
- California Code of Regulations (Title 14, Chapter 3)
- California Integrated Waste Management Act (AB 239, aka the Recycling Act)
- Oregon Department of Environmental Quality (ODEQ), OAR Chapter 340, Division 94 (OAR-340-94), and by adoption, 40 CFR Part 258 (2009).

- State Occupational Safety and Health Programs, certified under Section 18 of the Occupational Safety and Health Act of 1970 (California, certified 1973; Oregon, certified 2005)
- ODEQ, Water Quality Control. OAR Chapter 340, Division 41 (OAR-340-41) (2010).

### **3.18.2.3 Local Authorities and Regulations**

- Siskiyou County General Plan (Siskiyou County 1993).
- Siskiyou County Source Reduction and Recycling Element (CH2MHill 1997)
- The Yreka General Plan 2002–2022 (City of Yreka 2003).
- The Klamath County Comprehensive Plan (County Solid Waste Management Plan) (Klamath County 2010a).

## **3.18.3 Existing Conditions/Affected Environment**

This section describes the existing conditions/affected environment for public health and safety, utilities and public services, solid waste, and power.

### **3.18.3.1 Public Health and Safety**

An analysis of the potential affects in geologic hazards including seismology, earthquakes, and landslides in the project area is appears in Section 3.11, Geology, Soils, and Geologic Hazards. The potential for changes in flood risk downstream of the Four Facilities is described in Section 3.6, Flood Hydrology.

### **Emergency Centers**

Figure 3.18-2 shows the locations of the hospitals and fire stations within the area of analysis. No hospitals and only one fire station (Copco Lake Fire Department Station 210), at Copco 1 Reservoir, lie directly within the area of analysis. The nearest hospitals are Sky Lakes Medical Center in Klamath Falls, Oregon (roughly 20 miles east northeast of J.C. Boyle Dam), Ashland Community Hospital in Ashland, Oregon (roughly 35 miles north northwest of Iron Gate Dam), and Fairchild Medical Center in Yreka, California (roughly 18 miles southwest of Iron Gate Dam).

### **Fire Risk**

Figure 3.18-3 shows fire hazard in the project area as mapped using MODerate-resolution Imaging Spectroradiometers by the United States Department of Agriculture Forest Service (United States Department of Forest Service (USFS), Remote Sensing Applications Center, 2010). During the dry season, areas surrounding reservoirs are at risk for fires, particularly at the interface between residential development and open space. As shown in the figure, the fire threat is high to very high in the areas surrounding the Four Facilities (CalFire 2007, Oregon Department of Forestry 2006).

The Hilt Fire Company in Northern California and the Colestin Rural Fire Protection District operate as one agency out of geographic necessity. Legally, however, they are two separate entities (Colestin Rural Fire District 2005). The Hilt volunteer fire department jurisdiction includes the California side of the Colestin valley, and also

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covers part of northern Siskiyou County, down to the Hornbrook boundary (Colestin Rural Fire District 2011). The next nearest fire stations are the Keno Rural Fire Protection District Station 1 (east of Keno Dam), Yreka Fire Department (in Yreka, California), and Colestin Rural Fire Protection District (in Oregon northwest of Iron Gate Dam).

CalFire, in conjunction with county and volunteer fire departments, is also responsible for fire protection throughout the unincorporated areas of the state. There are CalFire stations in the project vicinity, including Yreka and Hornbrook. There are also a number of county fire stations throughout the project area, including Happy Camp, Seiad Valley, Etna, Fort Jones, Montague, Butte Valley, McCloud, Dunsmuir, and Mount Shasta (Fire Department Directory 2010).

Siskiyou County began developing a Multi-Jurisdictional Hazard Mitigation Plan in July of 2010. As of the writing of this document, that plan has not been adopted. A Community Wildlife Preparedness Plan was completed in 2008. The document identifies "...most County, State, and Federal roads in the region" as emergency evacuation routes (Firesafe Council of Siskiyou County 2008). The Community Wildfire Protection Plan also identifies a number of locations as evacuation sites, including the Hornbrook School and Grange.

#### **3.18.3.2 Utilities and Public Services**

The existing conditions and affected environment for utilities and public services are presented in Table 3.18-2 by county and community.

#### **3.18.3.3 Solid Waste**

County and local landfill and waste processing facilities are described below.

##### **Siskiyou County**

Solid waste in the Siskiyou County is handled by the General Services Sanitation Department (Siskiyou County 2010a). Siskiyou County has transfer stations in Mount Shasta, Happy Camp, Tulelake, Yreka, and in the Salmon River Area (Siskiyou County 2010a). Yreka Sanitary Landfill is a Class III landfill 2 miles southwest of Yreka, California. It is owned by the City and County of Siskiyou and operated by the City of Yreka. Class III landfills accept construction debris, most household garbage, greenwaste, carpet, and other types of non-hazardous waste. Hazardous wastes, such as batteries, paints, and hazardous materials must be disposed of in Class I facilities which are lined to prevent the contamination of underlying soils and groundwater.

##### **Klamath County**

The Klamath Falls Landfill is a demolition only, unlined landfill 2 miles northeast of Klamath Falls, Oregon. It is owned by the County of Klamath and operated by the Klamath County Community Development-Solid Waste Division.

#### **Summary of Local Landfills and Transfer Facilities**

Several landfills in the project area could receive solid waste from deconstruction activities. Table 3.18-3 summarizes regional landfills and recycling centers closest to the Iron Gate Dam.

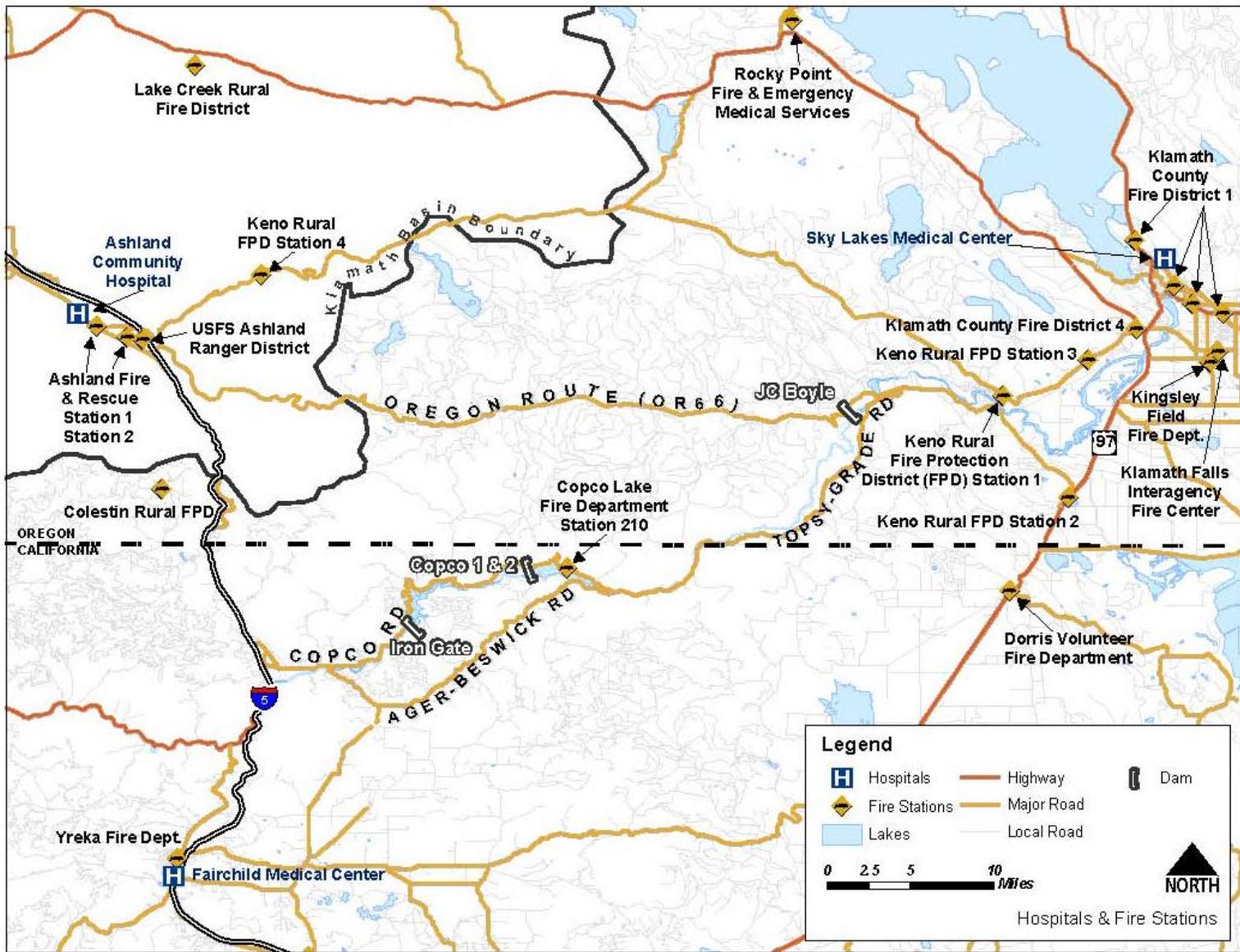


Figure 3.18-2. Hospitals and Fire Stations near the Project Area

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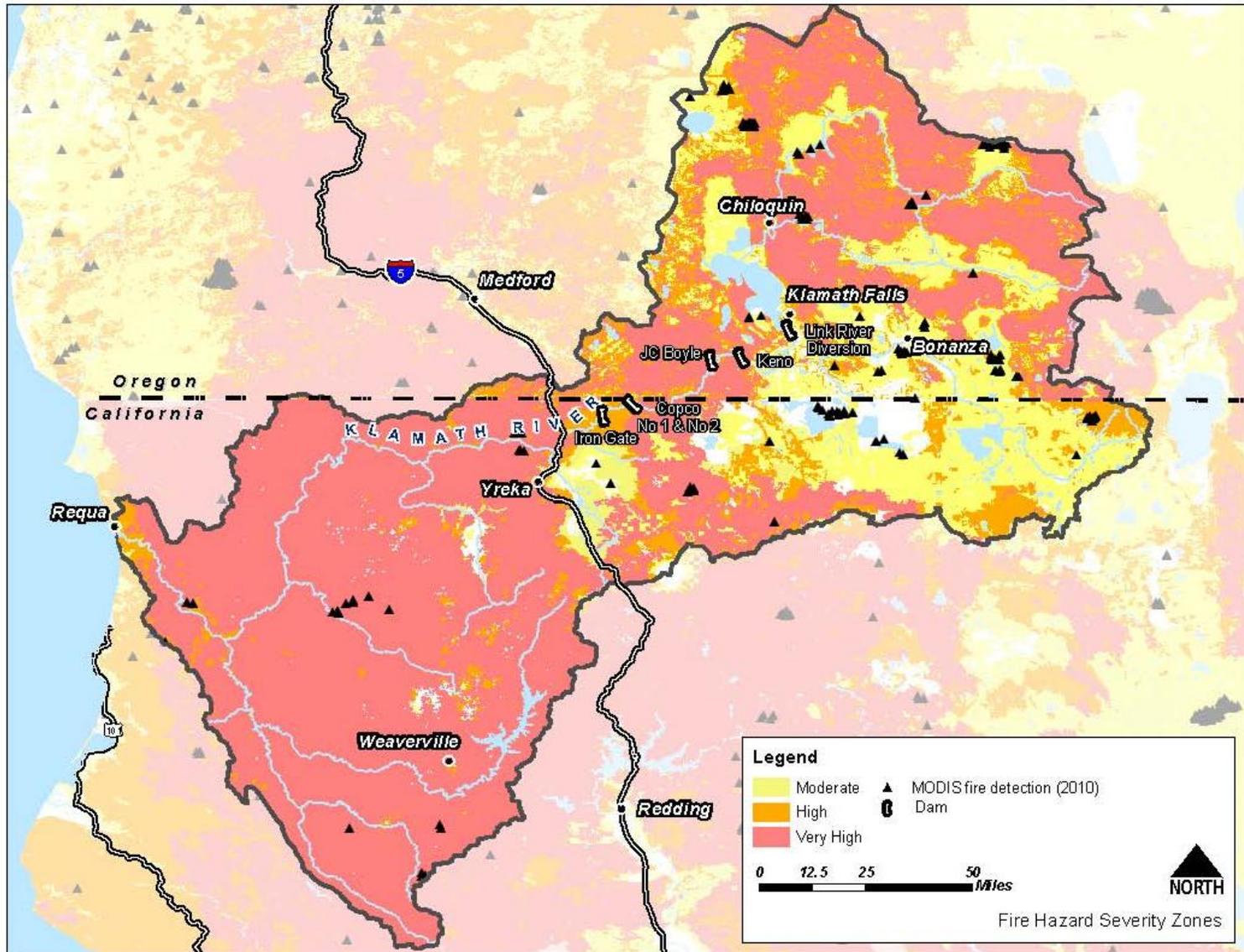


Figure 3.18-3. Fire Hazard in the Area of Analysis

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**Table 3.18-2. Utilities and Public Services in the Study Area**

County	Electricity	Natural Gas	Water Service	Wastewater	Stormwater	Telecommunications	Police and Fire	Schools
<b>Siskiyou County</b>	Siskiyou County is served primarily by PacifiCorp. <sup>1</sup> Electricity supplies are mainly hydro-generated, with the closest PacifiCorp hydroelectric facilities in Siskiyou and Klamath Counties on the Klamath River.	Natural gas is supplied by PG&E (California Energy Commission (CEC) 2010b).	Municipal and Industrial water supply is not provided by the county; it is provided by cities and towns in the county (Siskiyou County DPW 2010).	The county does not provide wastewater treatment. Residences in the unincorporated county are served by on-site septic systems (Dean 2010). Cities, as described below, are responsible for wastewater treatment.	Stormwater management is done by the individual municipalities within the county.	Telephone services are provided by AT&T and Pac-West (Wise 2010).	Police services are provided by the Siskiyou County Sheriff's Department (Siskiyou County 2010b). Fire protection is provided by 12 fire protection districts: Happy Camp District, Copco Lake District, Hornbrook District, South Yreka District, Scott Valley District, Callahan District, Montague District, Gazelle District, Butte Valley District, Tulelake District, Mount Shasta District, and the Dunsmuir District (Siskiyou County 1975).	The Siskiyou County Office of Education oversees the school districts and educational programs (Siskiyou County Office of Education, 2010). The county has charter schools, elementary schools, high schools, and a unified school district (Siskiyou County Office of Education 2010).
<b>City of Yreka</b>	PacifiCorp provides electrical power (CEC 2010a). <sup>1</sup>	Natural gas is provided by PG&E (CEC 2010b).	Yreka currently receives its municipal water supply from Fall Creek (City of Yreka 2010a). Yreka's main transmission line runs under Iron Gate Reservoir upon the lakebed (City of Yreka 2010b). Yreka's water supply is piped from the Fall Creek Pumping Station near Copco 1 Reservoir through a 24-inch pipe for 23 miles to Yreka (City of Yreka 2003). Current water use in the winter is approximately 1 mgd; however, in the summer this use increases up to approximately 6 mgd (City of Yreka 2003). Yreka obtains its water based on a state water right allowing withdrawal of up to 15 cfs (9.7 mgd) (City of Yreka 2010a).	The city has one wastewater treatment plant that treats and disposes of both domestic and industrial sewage generated within the city's boundaries (City of Yreka 2010c). The facility is designed to accommodate up to 1.3 mgd of average dry weather flow. Yreka's general plan reported that average dry weather flow in 2003 was between 0.7 and 0.9 mgd (City of Yreka 2003).	Stormwater management is the responsibility of Yreka's Public Works Department.	Telephone service is provided by AT&T and Pac-West.	Police services are provided by the City of Yreka Police Department and Fire services are provided by the Yreka Fire Volunteer Department (City of Yreka 2010d; City of Yreka 2010e).	Yreka is served by the Yreka Union Elementary School District and the Yreka Union High School District (Siskiyou County Office of Education, 2010).
<b>Hornbrook</b>	Electricity is provided by PacifiCorp (Wise 2010).	Natural gas in the county is supplied by PG&E (CEC 2010b).	Water supply in Hornbrook comes from private groundwater wells (Wise 2010).	Residents use on-site septic systems for wastewater treatment (Dean 2010).	Stormwater runoff is conveyed through natural drainages (Dean 2010).	Telephone services are provided by AT&T (Dean 2010).	The Siskiyou County Sheriff provides police protection services to the community of Hornbrook (Wise 2010).	Yreka Union School District serves the community of Hornbrook (Wise 2010).
<b>Copco Village</b>	Electricity is provided by PacifiCorp (Wise 2010).	Natural gas in the county is supplied by PG&E (CEC 2010b).	Water supply in Copco Village comes from private groundwater wells (Wise 2010).	Wastewater service is provided by on-site septic systems (Dean 2010).	Stormwater runoff is conveyed through natural drainages (Dean 2010).	Telephone services are provided by AT&T (Dean 2010).	The Siskiyou County Sheriff provides police protection services to the community of Copco Village (Wise 2010).	Yreka Union School District serves the community of Copco Village (Wise 2010).
<b>Beswick</b>	Electricity is provided by PacifiCorp (Wise 2010).	Natural gas in the county is supplied by PG&E (CEC 2010b).	Water supply in Beswick comes from private groundwater wells (Wise 2010).	Wastewater is treated in on-site septic systems (Dean 2010).	Stormwater runoff is conveyed in natural drainages (Dean 2010).	Telephone services are provided by AT&T and Pac-West (Wise 2010).	The Siskiyou County Sheriff provides police protection services to the community of Beswick (Wise 2010).	Yreka Union School District serves the community of Beswick (Wise 2010).
<b>Klamath County</b>	PacifiCorp provides electric power to the county (Dobry 2010).	Avista Utilities provides natural gas services to the county (Dobry 2010).	Water supplies in the unincorporated county come from private groundwater wells as well as numerous private water companies that serve some community subdivisions (Dobry 2010). Additionally, some water is provided by the City of Klamath Falls (Dobry 2010).	Wastewater in the county is provided by the Klamath County Community Development On-Site Sanitation Division (Klamath County 2010b).	Stormwater flows through roadside ditches and natural drainages (Gallagher 2010).	Telephone service is provided by USWest (Gallagher 2010).	The Klamath County Sheriff Department provides police protection in the county (Klamath County 2010c). Klamath County is served by 17 fire districts: Bly Fire District, Bonanza Fire District, Chemult Fire District, Chiloquin Fire District, Crescent Fire District, Central Cascades Fire District, Harriman Fire District, Keno Fire District, Klamath County Fire Districts numbers 1 through 5, La Pine Fire District, Malin Fire District, Merrill Fire District, and North Klamath Fire District (Klamath County 2010c).	The Klamath County School District includes 20 schools, including elementary, junior high, and senior high schools (Klamath County School District 2010). Schools serving the project area include Chiloquin Elementary and Junior and Senior High Schools, Keno Elementary, and Merrill Elementary.

**Table 3.18-2. Utilities and Public Services in the Study Area**

County	Electricity	Natural Gas	Water Service	Wastewater	Stormwater	Telecommunications	Police and Fire	Schools
<b>Merrill</b>	PacifiCorp provides electric power to Merrill.	There is no natural gas supplied to Merrill (Fuller 2010).	Water supply comes from city groundwater wells on Front Street (Fuller 2010).	Wastewater is treated in Merrill's wastewater treatment plant (Fuller 2010).	Stormwater flows through natural drainages; Merrill does not maintain any constructed stormwater infrastructure (Fuller 2010).	Telephone service is provided by Century Link (Fuller 2010).	The Merrill City Police Department provides police protection services in the city (Fuller 2010). Fire protection services are provided by the Merrill Rural Fire Protection District, a primarily volunteer fire company serving the town and surrounding area.	Merrill Elementary School and Lost River High School serve the City of Merrill. Both schools are within the Klamath County School District (Fuller 2010).
<b>Klamath Falls</b>	PacifiCorp provides electricity to Klamath Falls.	Amerigas and Klamath Natural Gas Services provide natural gas in Klamath Falls	Klamath Falls' Water Division is responsible for providing water to more than 40,000 residents in the urban area. The division operates and maintains 13 groundwater wells, 21 pumping stations, and 22 water reservoirs with a total storage capacity of 16 million gallons (City of Klamath Falls 2010a). Klamath Falls' water supply comes from groundwater wells.	Wastewater collection and treatment service is provided by the City of Klamath Falls Wastewater Division. The division services nearly 20,000 city residents and Klamath Basin area customers (City of Klamath Falls 2010b). In addition to sewage collection and treatment, the division provides stormwater collection services, and sewage treatment for a major residential development and a major resort/residential development outside of the city limits (City of Klamath Falls 2010b). Equipment and facilities include two wastewater treatment plants, 11 wastewater pumping stations, four stormwater pumping stations, and stormwater collection lines. Wastewater treatment facilities process an average combined 4.2 mgd of wastewater from over 7,100 service connections (City of Klamath Falls 2010b). Within the Klamath Falls Urban Growth Boundary, wastewater treatment is provided by the South Suburban Sanitary District.	The City of Klamath Falls Wastewater Division manages the stormwater infrastructure in the city (City of Klamath Falls 2010b).	Phone service in the city is provided by Qwest.	The Klamath Falls Police Department is responsible for police services in the city (City of Klamath Falls 2010b). Fire protection is provided by the Klamath County Fire District No. 1. The existing fire district serves an area of 201 square miles containing approximately 52,000 residents (Klamath County Fire District 2010).	Klamath Falls City Schools oversees a mix of elementary, junior high and high school, and alternative education schools in the city (Klamath Falls City Schools 2010). There are 11 schools in the district.
<b>Chiloquin</b>	PacifiCorp provides electricity in Chiloquin.	Chiloquin does not use natural gas resources (Foreman 2010).	The City of Chiloquin supplies water to all city residents as well as some residents that are outside of the city but within the urban service area. Municipal water supplies come from one groundwater well (Foreman 2010).	Chiloquin has a city wastewater treatment plant (Foreman 2010).	Chiloquin maintains roadside drainages for stormwater runoff (Foreman 2010).	Telephone service is provided by Century Link (Foreman 2010).	Police and public safety in Chiloquin is provided by the Klamath County Sheriff and the Oregon State Police (City of Chiloquin 2010a). Fire service is provided by the Chiloquin-Agency Lake Rural Fire Protection District, a volunteer fire department that serves a 105-square-mile area that encompasses the city and the areas to the north and east (Klamath Fire 2005).	Three county schools in the city serve children living in Chiloquin: Chiloquin Elementary and Chiloquin Junior and Senior High Schools (City of Chiloquin 2010b; Foreman 2010).

Key:  
CEC: California Energy Commission  
DPW: Department of Public Works  
PG&E: Pacific Gas and Electric

**Table 3.18-3. Regional Landfills and Recycling Centers and Type of Waste Accepted**

Facility Name	Address	City, State/ County	Remaining Capacity (yd <sup>3</sup> )	Wastes Accepted	Distance from Iron Gate (mi)
Yreka Solid Waste Landfill	Off Oberlin Rd; 2 mi SE of Yreka	Yreka, CA/ Siskiyou	3,924,000	Construction/demolition, mixed municipal	26.7
Dry Creek Landfill	6260 Dry Creek Road	Eagle Point, OR/ Jackson	165,000,000	Construction/demolition, mixed municipal, contaminated soils	54.0
Klamath Falls Landfill	801 Old Fort Road	Klamath Falls, OR/ Klamath	435,000	Construction/demolition, contaminated soils	89.0
Yreka Med. Vol. Transfer Station	Off Oberlin Rd; 2 mi SE of Yreka	Yreka, CA/ Siskiyou	Recycling facility	Inert, metals, mixed municipal	26.7
Ecosort Material Recovery Facility	3425 E 17th Avenue	Eugene, OR/ Lane	Recycling facility	Wood, concrete, asphalt, metal, aluminum	209
Delta Sand & Gravel Demolition Landfill	999 Division Street	Eugene, OR/ Lane	1,000,000 of general excavation and 200,000 of concrete	Dirt, rock, concrete, building demolition, clearing debris and brush removal.	215
Anderson Landfill, Inc	18703 Cambridge Road	Anderson, CA/ Shasta	11,914,025	Construction/Demolition, green waste, mixed municipal, tires	134

Source: CalRecycle 2010, Loeschen 2010, Oregon Department of Environmental Quality 2007, Sorensen 2010, United States Environmental Protection Agency 2006

Key:

yd<sup>3</sup> = cubic yards

mi = miles

SE = southeast

### 3.18.3.4 Power

The KHP, operated by PacifiCorp, provides power to residential, industrial, and agricultural customers across the PacifiCorp service area (Figure 3.18-4). The KHP consists of seven hydroelectric facilities and one reregulating facility with an installed capacity of approximately 169 megawatts (MW) and a total average annual electric output of 716,800 megawatts hours (MWh), as shown in Table 3.18-4 (FERC 2007). Six of the generating facilities are on the Klamath River, with the seventh on Fall Creek, a tributary to the Klamath River that enters at River Mile 196.3, between Iron Gate and Copco 2 Reservoirs. Keno Dam is a reregulating facility with no generating capacity. The KHP covers 64 river miles, from the Link River Dam in Oregon to Iron Gate Dam in California (California Energy Commission [CEC] 2003).

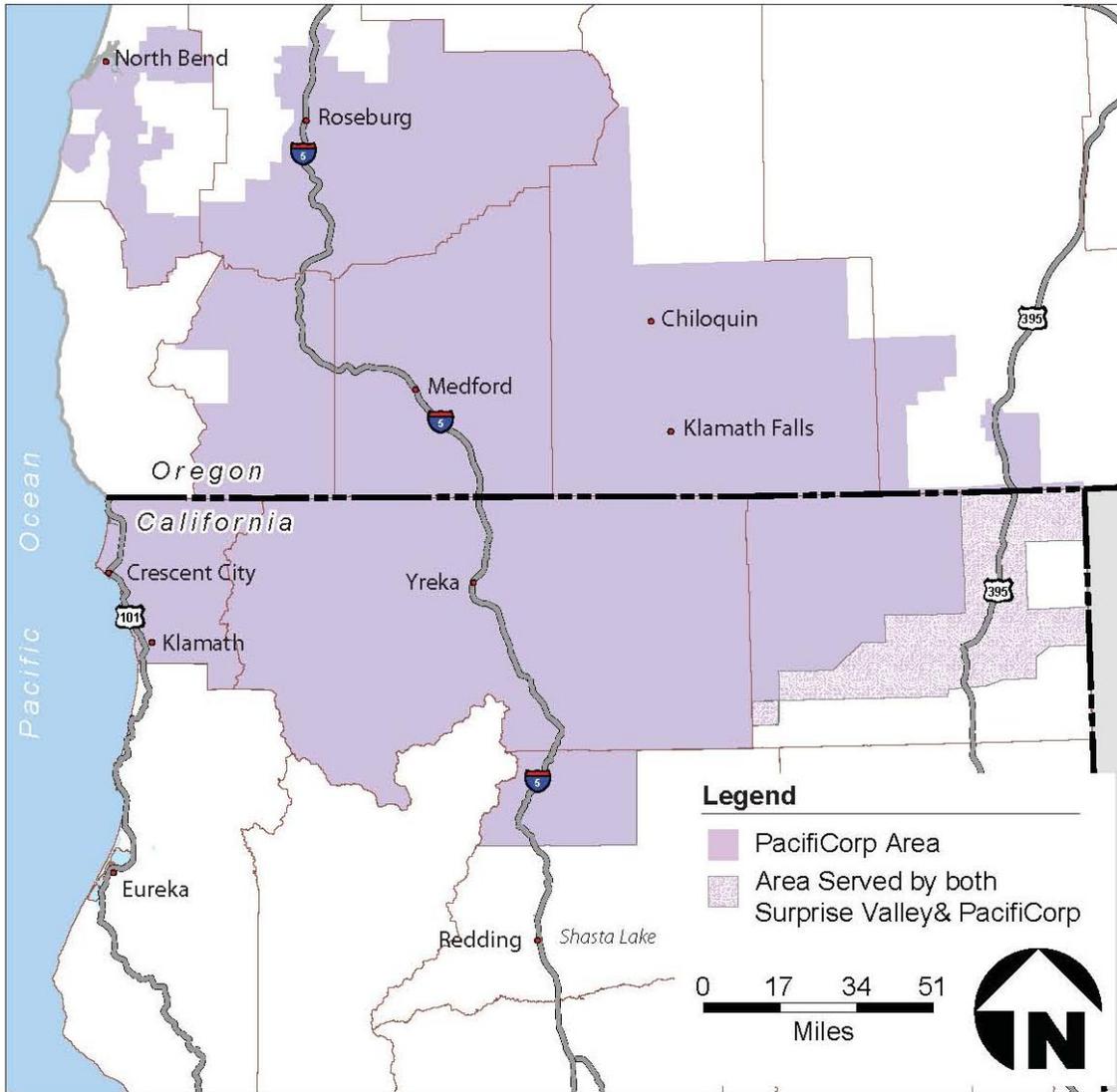


Figure 3.18-4. PacifiCorp Service Area

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**Table 3.18-4. Klamath Hydroelectric Project Facilities**

Facility Name	Generating Facility	Total Authorized Generating Capacity (MW)	Average Annual Generation (MWh)	Location	River Mile (RM)
Link River Dam	East Side Powerhouse	3.19 MW	15,400	Klamath Falls, OR	RM 254
	West Side Powerhouse	0.6 MW	3,400	Klamath Falls, OR	RM 254
Keno Dam and Impoundment	None (Re-regulating facility with no power generation capabilities)	None	None	20 miles downstream of East Side and West Side Powerhouses	RM 233
J.C. Boyle Dam and Reservoir	J.C. Boyle Powerhouse	97.98 MW	329,000	OR	RM 224.7 (Dam) RM 220.4 (Powerhouse)
Copco 1 Reservoir	Copco 1 Powerhouse	20.0 MW	106,000	CA	RM 198.6
Copco 2 Reservoir	Copco 2 Powerhouse	27.0 MW	135,000	CA	RM 196.8
Iron Gate Dam and Reservoir	Iron Gate Dam Powerhouse	18.0 MW	116,000	CA	RM 190
Fall Creek (On Klamath River tributary that flows into upper Iron Gate Dam Reservoir)	Fall Creek Powerhouse	2.2 MW	12,000	CA	196.3
<b>Total:</b>		<b>168.97</b>	<b>716,800</b>		

Key:  
 MW = megawatts  
 Source: FERC 2007

PacifiCorp has, in its 2004 relicensing submission to FERC, described plans to decommission the East Side and West Side Powerhouses. These two facilities are located at the Link River Dam, and as shown in Table 3.18-4, have a combined nameplate capacity of less than 4 MW. The cost to install screening on these facilities to protect the federally listed suckers in Upper Klamath Lake would be prohibitive given the small amount of power they produce (FERC 2007). The Proposed Action would remove four of the eight facilities (J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams). These Four Facilities under consideration for removal have a nameplate generation capacity of approximately 163 MW of electricity, and produce an average of 686,000 MWh annually (see Table 3.18-4). J.C. Boyle is able to produce peaking power during periods of high demand (FERC 2007); but, due to a number of factors, such as limited storage capacity in the reservoirs and flow restrictions imposed by the Biological Opinions for coho salmon and the sucker species, the rest of the project is operated more as a “run of the river” facility (CEC 2006).

While an excess of generation capacity exists in the Northwest sub region, transmission constraints prevent much of the power generated in the Northwest Power Pool from being used south of the project area in areas that are constrained by electrical supply (North American Electric Reliability Corporation 2010). PacifiCorp’s 2008 Integrated Resource

Plan provides an overview of the company's available generation and transmission capacity. According to the Integrated Resource Plan, which assumes relicensing of all of the company's hydroelectric facilities, PacifiCorp will be "summer peak resource deficit" in 2011 (PacifiCorp 2008). This deficit was to be met in the short term with additional renewable, demand-side programs, market purchases from other generating companies, and improvements to the efficiency of coal fired plants (PacifiCorp 2008). PacifiCorp outlined a series of actions in the plan to meet this deficit, including the addition of 144 MW of wind resources in 2009 through company owned resources and purchases, and the addition of 269 MW of wind resources in 2010 with company owned resources and 119 MW of power purchases (PacifiCorp 2008). These improvements and purchases will allow PacifiCorp to meet the expected load across their service area.

### **3.18.4 Environmental Consequences**

#### ***3.18.4.1 Environmental Effects Determination Methods***

##### **Public Health and Safety**

The impact analysis for public health and safety focuses on proposed deconstruction activities surrounding the Four Facilities and associated reservoirs and how these would affect the health and safety of the general public and construction workers. Other sections in the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) describe several public health and safety impacts. Section 3.11, Geology, Soils, and Geologic Hazards discusses Geologic stability of nearby soils (i.e., slumping and landslides) and geologic hazards such as seismology and volcanology. Section 3.3, Aquatic Resources, and Section 3.2, Water Quality, discuss water quality impacts. Changes in hydrology and flooding are discussed in Section 3.6, Flood Hydrology, and Section 3.8, Water Supply/Water Rights. Section 3.22, Traffic and Transportation, discusses the impact to area roads and bridges, and safety issues associated with the Proposed Action and vehicular traffic. Impacts on the recreational areas, with the exception of potential impacts to visitors using the areas, are discussed in Section 3.20, Recreation. Impacts to visitors as a result of the proposed deconstruction are discussed in this section.

##### **Utilities and Public Services**

The Lead Agencies determined the impacts on utilities by examining utilities and services in the project area and how they would be affected by demolition activities. The discussion of utilities also covers the demands for electricity and natural gas that would result from deconstruction and construction activities. Removal of hydropower facilities and resulting changes in hydropower production are addressed below in the hydropower section. The Proposed Action and alternatives do not have the potential to affect schools in terms of additional students or longer bus routes. However, if the Proposed Action is carried out, there could be reduced tax revenue available to fund local schools. Section 3.15, Socioeconomics, discusses impacts to local tax revenues. The Proposed Action would not require new or expanded stormwater or wastewater facilities; therefore, these services and utilities are not discussed further. Geothermal resources have been identified in the area, but no plans exist to develop these resources as part of the Proposed Action.

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Any future development of geothermal resources would require focused environmental compliance and review, and development of these resources is not discussed further.

### **Solid Waste**

The Lead Agencies determined the solid waste impacts by assessing the ability of local facilities to accept non-hazardous materials that could not be disposed of at the dam sites. Deconstruction of the dams is anticipated to generate solid waste comprising earth, concrete, metal, wood planks, and asphalt. It is assumed that most of this material that cannot be safely disposed of on-site would be considered inert material and could be disposed of in Class III landfills (See Table 3.18-3, Regional Landfills and Recycling Centers and Type of Waste Accepted). In addition, a large portion of deconstruction and construction debris, such as the asphalt, concrete, rebar, metal from the powerhouses and transmission infrastructure, and reclaimed lumber, would be diverted from landfills through reuse and recycling. No solid waste would be generated after deconstruction is complete.

### **Power**

The analysis for power focuses on changes to existing hydropower facilities and the potential need for replacement power production after the Proposed Action and alternatives have been implemented.

#### ***3.18.4.2 Significance Criteria***

##### **Public Health and Safety**

For the purposes of this EIS/EIR, impacts on public health and safety would be significant if an alternative would do the following:

- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.
- Expose people or structures to a significant risk of loss, injury or death involving construction safety hazards, emergency routes, or wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

##### **Utilities and Public Services**

For the purposes of this EIS/EIR, impacts on utilities and public services would be significant if the alternative would do the following:

- Result in substantial adverse physical impacts that create the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: fire protection; police protection; schools; parks; other public facilities.
- Result in increased demand for utilities that could exceed the capacity and outputs of existing facilities/infrastructure, and require new or expanded facilities/infrastructure that could result in significant environmental impacts.

- Be served by a landfill with insufficient permitted capacity to accommodate solid waste disposal needs.
- Not comply with federal, state, and/or local statutes and regulations related to solid waste.

### **Power**

For the purposes of this EIS/EIR, impacts on power would be significant if an alternative would do the following:

- Require or result in the construction of new facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.
- Result in insufficient power supplies available to serve existing customers.

### **3.18.4.3 Effects Determinations**

#### **Alternative 1: No Action/No Project**

Under the No Action/No Project Alternative, no deconstruction or construction would occur at the Four Facilities. Thus, no change to risk of public safety as a result of construction related safety risks, emergency routes, or wildland fires would occur under the No Action/No Project Alternative. Because no deconstruction or construction activities would occur under the No Action/No Project Alternative, no changes in the provision of public services and utilities would result from the No Action/No Project Alternative.

*Under the No Action/No Project Alternative, hydropower generation would continue subject to the conditions of the United States Bureau of Reclamation (Reclamation) Biological Opinions, which could have the potential to decrease hydropower production.* Hydropower generation is controlled by the allowed ramping rates in the J.C. Boyle Bypass Reach and the minimum flow requirements downstream of Iron Gate Dam allowed by the annual license (see Chapter 2 for a description of these requirements). Until a new license is issued, operations would continue under the annual license terms and the terms of the Biological Opinions issued by Reclamation with consultation from National Oceanic and Atmospheric Administration Fisheries and the U.S. Fish and Wildlife Service (Reclamation 2010). The flows downstream of Iron Gate Dam are governed by the 2010 Biological Opinion, which supersede the terms of the annual license. However, the flows and ramp rates downstream of J.C. Boyle Dam are still governed by the 2007 environmental measures. Peaking generation would continue, but the flow limitations would not allow “no load to full two-unit peaking events” which is able to increase flows by up to 3,000 cfs (PacifiCorp 2006). Two- unit operations would only be done when inflows to J.C. Boyle are high enough to run both units, or run one unit in continuous operation and use the second unit for peaking generation. PacifiCorp estimates that power generation would be reduced by 40 percent over the long term at J.C. Boyle, and by up to 100% during summer time peak demand periods due to the daily flow change limits discussed above. However, PacifiCorp maintains adequate power supplies to provide service to its customers in the Project Area. **There would be no**

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**change from existing conditions for the provision of hydropower from the No Action/ No Project Alternative.**

**Ongoing Management Activities**

*Construction activities related to the ongoing restoration and management activities could impact public health and safety.* Under the No Action/No Project Alternative, there would be some limited construction activities associated with ongoing habitat restoration projects. Construction associated with these projects would be short-term and an applicable public health and safety plan would be developed for each project to ensure construction workers and the public were not adversely affected during construction and operation. **There would be no impact to public health and safety from these ongoing management activities.**

**Alternative 2: Full Facilities Removal of Four Dams (the Proposed Action)**

The Proposed Action involves removal of all features, with the exception of buried features, at the Four Facilities.

*Construction activities could result in public health and safety risks.* Earthwork and blasting have the potential to cause injuries from flying rock and other debris. Large construction vehicles and other equipment used for deconstruction and activities (referred to in this document as construction equipment) operating in and around the project area would pose a safety hazard to the general public. Work within waterways would pose hazards to boaters, if boating were allowed in the construction zone. **Construction impacts on public health and safety would be significant, but Mitigation Measure PHS-1 would reduce this impact to a less-than-significant level.**

*Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities.* The dam demolition and construction areas (referred to in this sub-section as construction areas) would be closed off to the public while they are under construction to reduce hazards; however, the use of the roadways for truck hauling of materials could interfere with existing emergency evacuation plans and increase response times for emergency vehicles. Due to the rural nature and the low concentration of roads in the area, most roads are used as evacuation routes in the event of fire or other emergencies. Figure 3.18-2 shows the locations of the hospitals and fire stations within the area of analysis. Figure 3.23-1 in Section 3.23, Noise and Vibration shows potential haul routes that would be used for transporting materials as part of the Proposed Action. Although the dams are not directly on major roadways (Route 66, Copco Road, and Interstate 5), these roads would likely need to be accessed to transport materials and equipment to and from the dam sites and to landfills or nearby borrow areas for disposal. **The placement of construction equipment in areas potentially accessible by residents and recreational visitors would be a significant impact. The use of the roadways for truck hauling of materials could also be a significant impact on public safety. Implementation of Mitigation Measures PHS-1 and PHS-2 would reduce these impacts to a less-than-significant level.**

*Construction and demolition activities could increase the risk of wildfires.* As shown in Figure 3.18-3, the fire threat in the areas surrounding the Four Facilities is categorized as high to very high (CalFire 2007). During the dry season, the areas surrounding J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs are at risk for wildfires, particularly at the interface between residential development and open space. Deconstruction activities, particularly those that may result in accidental spills of flammable liquids or use of equipment that generates heat, such as welding, grinding, torch-cutting, gas and diesel generators, and other construction activities could result in open sparks or flame in vegetated open space could further aggravate the risk of fire. **The risk of fire would be a significant impact to public health and safety, but implementation of Mitigation Measure PHS-2 would reduce this impact to a less-than-significant level.**

*Removal of the dams could eliminate a water source for wildfire services and could increase response times.* Currently, helicopter fire crews use water from the reservoirs and the Klamath River to fight wildfires in the project vicinity (Dodds 2010). Under the Proposed Action, removal of the J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs would remove a potential water source for fire fighting. The Klamath River would remain after dam removal, and surface water modeling (described in Section 3.6, Flood Hydrology and Section 3.8, Water Supply/Water Rights) indicates that flows in the Klamath River downstream of the removed dams would remain unchanged. As such, helicopter fire crews could still obtain water from the Klamath River, Ewauna Lake, or Upper Klamath Lake.

The loss of the reservoirs could increase turnaround times for helicopters fighting wildfires in the project area. While it is possible for some specialized equipment to fill the water tanks from water bodies with depths as little as 18 inches, others require depths in excess of 36 inches, depending on the equipment used and the discretion of the pilot (personal communication, Henderson Aviation, January 19, 2011). Therefore, use of the Klamath River as an alternate source of water might be possible after removal of the reservoirs. However even in remote areas wildfires originate in the wildland urban interface. As discussed, the loss of the reservoirs could increase turn-around time for helicopters refilling buckets but the presence of the Klamath River and nearby reservoirs would still provide a water source for fighting fire in the wildlands surrounding the Copco area. Initial response times would not be changed by the loss of the reservoirs, and existing fire fighting assets, such as the air tankers in Klamath Falls, and the water source of Lake Ewauna, would still be in place and available. **The loss of the reservoirs would have a less than significant impact on fire suppression in the area.**

*Removal of the reservoirs could eliminate a water source for residential firefighting in and around Copco Village, potentially increasing the risk to homes from fire.* Comments received during the scoping period expressed concern that the loss of the reservoirs, particularly Copco 1 Reservoir, could endanger the existing residential areas by removing an easily accessible water source for both engines and helicopters. As discussed, the loss of the reservoirs would increase turn-around time for helicopters refilling buckets, and could eliminate easily accessible water sources for trucks, and increase turn-around times

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for trucks operating in the Copco Village. The presence of the Klamath River, existing water systems, and existing fire fighting resources ensures that assets for firefighting are present in the area. **The loss of Copco 1 Reservoir would have a less than significant impact on the water supply for residential firefighting in and around Copco Village.**

*Implementation of the Proposed Action could affect police services.* Construction activities would involve staging and stockpiling areas and equipment that would be kept on-site for the duration of construction. Security services would be provided by the construction contractor and would not increase the need for police services or the number of police personnel. **There would be no change from existing conditions in police services.**

*Implementation of the Proposed Action could require the use of electricity and natural gas supplies in the study area.* Implementation of the Proposed Action would require the use of heavy equipment to draw down and deconstruct the dams. The Dam Removal Entity (DRE) would supply power for these activities using gasoline and diesel-powered generators; power for these activities would not originate from the grid. No natural gas would be used for implementation of the Proposed Action. Thus, there would be no demand for municipal electricity or natural gas supplies during deconstruction as part of the Proposed Action, and would be no resulting increase in demand on these utilities. **There would be no change from existing conditions for electricity or natural gas supplies in the study area due to construction activities.**

*The Proposed Action deconstruction could affect the City of Yreka's municipal water supply.* As described in the environmental setting, the City of Yreka's municipal water supply pipeline passes under Iron Gate Reservoir and could be affected during construction activities. To avoid potential disruption to the city's water supply, the DRE would construct a pipe bridge to suspend the pipeline above the river during and following construction. The work on the pipeline would be planned and implanted in such a way that the pipe would be disconnected for only a short period of time, as dictated by the existing storage capacity, to avoid disrupting water service to the City. Thus, there would be no disruption in municipal water supply under the Proposed Action. **The deconstruction of Iron Gate Dam would have a less than significant impact on the City's water supply.**

*Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs would be removed following drawdown and could affect public health and safety.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities will be removed. The deconstruction could have health and safety impacts as a result of the construction equipments and work site safety issues. **The removal of the recreational facilities could impact public health and safety. The implementation of Mitigation Measures PHS-1 and PHS-2 would reduce these impacts to less-than-significant**

*Implementation of the Proposed Action could affect public services and utilities in the counties and cities in the study area.* Construction of the Proposed Action would result in short-term population increases in the area from construction workers. There could be a maximum of 100–220 workers during overlap in construction schedules for removal of all four dams. Construction workers could remain in the area for the duration of deconstruction, a period of approximately 1 year. While many of these workers might already live in the surrounding communities described under the affected environment, the need for construction workers could result in an influx of people in the area as out of area workers and their families move in for the duration of the project. Because deconstruction activities would occur temporarily, no permanent population increases would be expected. Therefore, no permanent increase in demand of public services or utilities would occur. There would not be a need for the construction of new government facilities such as water supply, wastewater treatment, or stormwater drainage.

Construction workers working at the deconstruction sites would require restroom facilities which would be provided by portable units. No other utilities would be required at the construction site. Construction workers would not deteriorate service ratios and would not require any new utilities. **Public service and utility impacts would be temporary and less than significant.**

*Implementation of the Proposed Action could result in the need for new roads.* Transportation of dam waste materials would require the development of haul roads. All new roads would be temporary and would be developed and maintained by the DRE. The DRE would remove temporary roads and return the road areas to their previous conditions after deconstruction is complete. No new public roads would be required for the Proposed Action; therefore, there would be no impact on local government services responsible for road maintenance. **The construction of new haul roads would result in less than significant impacts on local roads and government services.**

*Implementation of the Proposed Action could affect road conditions.* Construction equipment could stress road beds, causing cracking and settling, and increase the amount of maintenance and repairs that would be required to keep the roads in serviceable condition (see Section 3.22, Traffic and Transportation for more details). Indicators of road impacts, such as rutting and unevenness in the road surface, surface cracking, and road bed slumping could occur. Roadway effects would vary based on climate, the weight of the trucks and their loads, the composition of traffic, and other variables. However, the DRE would be responsible for repairing any road damage under the terms of the construction contract. **Impacts on road conditions would be less than significant given the terms of the construction contract.**

*Activities associated with the Proposed Action could generate a substantial amount of solid waste that would exceed capacity of facilities to receive the waste.* The Proposed Action would involve removal of all appurtenant features, with the exception of buried features, at the Four Facilities. Although activities associated with deconstruction would generate a substantial amount of solid waste, material recycling would reduce the amount of waste disposed in landfills in the surrounding counties. At J.C. Boyle Dam, waste

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concrete and earth materials would be used to refill the original borrow pits on the right abutment of the dam and also would be placed into the eroded scour hole through the hillside below the forebay spillway structure. For Copco 1 and Copco 2 Dams, concrete rubble would be buried on the right abutment within an on-site disposal area at Copco 1 Dam. At Iron Gate Dam, excavated embankment materials would be disposed of 1 mile upstream from the dam on the left abutment at the original borrow site. Approximately 300,000 cubic yards (yd<sup>3</sup>) of excavated embankment material would be used to fill the concrete-lined side channel spillway, chute, and flip-bucket terminal structure<sup>1</sup>. Concrete rubble from Iron Gate Dam would be buried within an on-site disposal area.

All mechanical and electrical equipment from the J.C. Boyle Dam would be hauled to the Klamath Falls Landfill, while mechanical and electrical equipment waste from Iron Gate, Copco 1, and Copco 2 Dams would be hauled to the Yreka Transfer Station. At both the Klamath Falls Landfill and the Yreka Transfer Station, mechanical and electrical equipment and scrap metal would be salvaged and recycled.

As shown in Table 3.18-5, the total amounts of inert solid waste generated under the Proposed Action would be 1,241,500 yd<sup>3</sup> of earth, 126,000 yd<sup>3</sup> of concrete, 4,500 tons of rebar, and 7,200 tons of metals. As described above, all of the waste concrete and earth are expected to be disposed of in on-site disposal areas or in the original borrow pits. A portion of the metals would be recycled, in accordance with relevant construction debris recycling regulations, at the Yreka Transfer Station, the Yreka Sanitation Landfill, and the Klamath Falls Landfill. Given that the combined remaining permitted Class III landfill capacity available at the Klamath Falls Landfill and the Yreka Solid Waste Landfill is 4.3 million yd<sup>3</sup>, the regional landfills in the surrounding counties would be capable of handling the additional waste generated by the Proposed Action. In addition, Dry Creek Landfill, also in the vicinity of the project area, has 165 million yd<sup>3</sup> of disposal capacity, and could be utilized for disposal. The disposal capacities of the existing surrounding landfills are anticipated to be sufficient for the waste generated by the Proposed Action, and the waste generated would not conflict with the solid waste policies and objectives of AB939. **The solid waste impacts associated with the Proposed Action would be less than significant.**

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<sup>1</sup> A Flip-Bucket is a type of energy dissipater that takes excess water from the reservoir and directs it downstream at a sufficient distance to prevent the spillover from creating a plunge pool or otherwise eroding the footing of the dam ( Bureau of Reclamation, Development of Hydraulic Structures, Thomas J. Rhone, 1988. [http://www.usbr.gov/pmts/hydraulics\\_lab/history/Rhone/index.html](http://www.usbr.gov/pmts/hydraulics_lab/history/Rhone/index.html))

**Table 3.18-5. Summary of Solid Waste Generation for Each Action Alternative**

Dam Location	Earth <sup>2</sup> (yd <sup>3</sup> )	Concrete <sup>2</sup> (yd <sup>3</sup> )	Metal (tons)	Wood – Hazmat <sup>1</sup> (tons)	Rebar (tons)
<b>Proposed Action - Full Facilities Removal</b>					
J.C. Boyle	140,000	40,000	3,000	-	2,400
Copco No. 1	-	62,000	1,200	-	900
Copco No. 2	1,500	12,000	2,000	550	600
Iron Gate	1,100,000	12,000	1,000	-	600
<b>Total</b>	<b>1,241,500</b>	<b>126,000</b>	<b>7,200</b>	<b>550</b>	<b>4,500</b>
<b>Partial Facilities Removal of Four Dams</b>					
J.C. Boyle	140,000	20,000	2,000	-	1,200
Copco No. 1	-	57,500	200	-	600
Copco No. 2	0	4,500	500	550	200
Iron Gate	1,100,000	8,000	500	-	400
<b>Total</b>	<b>1,240,000</b>	<b>90,000</b>	<b>3,200</b>	<b>550</b>	<b>2,400</b>
<b>Fish Passage at Four Dams</b>					
J.C. Boyle	-	2,800	-	-	90
Copco No. 1	-	5,800	-	-	190
Copco No. 2	-	1,000	-	-	30
Iron Gate	-	7,000	-	-	230
<b>Total</b>	<b>-</b>	<b>16,600</b>	<b>-</b>	<b>-</b>	<b>540</b>
<b>Fish Passage at Two Dams</b>					
J.C. Boyle	-	2,800	-	-	90
Copco No. 1 (removed)	-	62,000	1,200	-	900
Copco No. 2	-	1,000	-	-	30
Iron Gate (removed)	1,100,000	12,000	1,000	-	600
<b>Total</b>	<b>1,100,000</b>	<b>77,800</b>	<b>2,200</b>	<b>-</b>	<b>1,620</b>

Source: Reclamation 2011

Notes:

<sup>1</sup> Wood power poles not included. See Section 3.21, Toxic/Hazardous Materials for further information regarding wood waste.

<sup>2</sup> In-place volumes shown. Increase volumes by 20 percent for earth and 30 percent for concrete for transportation purposes.

Key:

yd<sup>3</sup>: cubic yards

*The Proposed Action would remove existing hydropower facilities, resulting in a loss of hydropower. Under the Proposed Action, four of the seven power generating facilities of the KHP would be removed. PacifiCorp would continue to own its Fall Creek Facility, and its continued operation is not part of the Secretarial Determination. Also, as noted above, PacifiCorp proposed to decommission its East Side and West Side facilities as part of relicensing (FERC 2007). The installed capacity of the*

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Four Facilities that would be removed is approximately 169 MW and FERC rates the project's dependable capacity as 42.7 MW<sup>2</sup> (CEC 2006). The Four Facilities have a total average annual electric output of 716,800 MWh (FERC 2007).

Dam decommissioning would require replacement power to serve the customers in the project area. According to the Western Electricity Coordinating Council's (WECC) 2009 Power Supply Assessment, the Northwest region has a large surplus power supply resulting from increased generating resources and a demand reduced due to the economic downturn; however, this surplus may be overstated based on the way the power supply model solves supply deficits (WECC 2009).

In addition to the surplus, the power is generated in the Northwest with hydroelectric facilities, which are able to provide peaking power, but not sustained heavy load production (WECC 2009). Nevertheless, all energy forecasts show the Northwest region having an energy surplus at the beginning of the 2010 forecast period that, while in decline over the study period (2010 – 2018), are sufficient to meet the needs of the sub region through 2018 (WECC 2009). The surplus capacity may not be able to be sustained over a prolonged cold spell or heat wave, due to the nature of hydro generation.

Removal of the Four Facilities would result in the loss of 169 MW, or 658,000 MWh from the Northwest Power Pool. This accounts for approximately 1.8 percent of PacifiCorp's power portfolio. While the loss of the power generated may have some impact to the local area, the effects of the loss to the Northwest Power Pool, in light of the scale of the additional generation needed to meet demand over the next 10 years, is minimal.

With the generation capacity of most of the KHP gone, PacifiCorp would be required to buy replacement power on the open power market (PacifiCorp 2004). Given the loss of the KHP, PacifiCorp would need to purchase at least 42.7 MW from other sources to meet their obligations (PacifiCorp 2004).

PacifiCorp's Integrated Resource Plan for 2008 discusses a number of different technologies for meeting the power needs in the Northwest Region forecast for 2018: geothermal, wind, natural gas, coal, and cogeneration (PacifiCorp 2010). Each of the replacement power options would involve some uncertainty specific to the power source. Natural gas plants would require a large amount of fuel, and the future costs and availability of gas supplies are uncertain (PacifiCorp 2004). Cogeneration facilities use excess steam from industrial plants, and the technology is a common form of power generation; however, cogeneration would require an industrial partner and the siting of a potential cogeneration plant (PacifiCorp 2004). Coal plants would require longer

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<sup>2</sup> Dependable capacity is the MW output of a generator or group of generators during a period of low water or other operational constraints that coincide with a peak electrical system load -- essentially a worst case generation capacity, where low water coincides with peak demand. The dependable capacity is the number of megawatts that can be produced for at least four to six hours under these conditions. This is generation based on real world operations at a hydropower generating facility, whereas nameplate capacity is the amount of power that the turbines are capable of generating with all other conditions being perfect (CEC 2003).

construction times and cost more than natural gas plants, but would have much lower operational costs (PacifiCorp 2004). The major issue associated with coal fired plants would be the uncertainty of future carbon tax prices, which could increase the overall cost of the power. The climate change and green house gas emission consequences of these replacement power alternatives are addressed in Section 3.10, Greenhouse Gases/Global Climate Change.

In addition to replacement power, the electrical transmission system that delivers power from existing generation plants in the northwest to the Klamath area is in need of investment. PacifiCorp is planning a series of transmission system upgrades and additions (PacifiCorp 2011a). This project, called the Energy Gateway Transmission Expansion, is intended to upgrade the western electrical transmission system, which has not received a major upgrade in nearly 20 years (PacifiCorp 2011a). Transmission constraints remain an impediment to delivering replacement power to the KHP area. PacifiCorp is currently planning a new transmission line that will connect eastern Idaho to Southern Oregon at the Captain Jack substation outside of Klamath Falls, Oregon (PacifiCorp 2011b). The line would help to balance and transfer the power generated in PacifiCorp's East Side region with the demand in the West (PacifiCorp 2011b).

In addition to the replacement power options and the planned transmission upgrades, PacifiCorp acquired the 520 MW Chehalis gas plant (PacifiCorp 2010).

Under the Klamath Hydroelectric Settlement Agreement, the United States Department of Interior would acquire power from the Bonneville Power Administration (Klamath Basin Signatories 2010). The power would be delivered to the Captain Jack or Malin substations, and transferred by PacifiCorp to customers throughout the company's service area (Figure 3.18- 4, PacifiCorp Service Area). In summary, even without implementation of the Proposed Action, there would be a need to build more generating capacity generally across the Northwest over the next 10 years; PacifiCorp's plans to upgrade transmission capacity; and the KHP's capacity is relatively small in relation to the overall demand and generation capacity in the Northwest region. **The loss of electrical generating capacity/ hydropower from the Proposed Action would be a less than significant impact<sup>3</sup>.**

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<sup>3</sup> This lost hydropower analysis significance determination relies on facility production rates provided in the 2007 FERC FEIS. As noted these production rates currently account for approximately 2% of PacifiCorp's total production portfolio (CEC 2006). Potential upgrades that would improve the efficiency and maximum capacity of the hydroelectric project have been estimated to provide 22% improvements in power production efficiency (Auslam et al 2011). While a number factors influence power production, if this 22% increase in power production efficiency were directly applied to the project's annual average electric output of 716,800 megawatts hours, the Klamath Hydroelectric Project output would increase to approximately 860,160 megawatts hours which would account for approximately 2.5% of PacifiCorp's total production portfolio, assuming no other changes in the portfolio. As noted in this section PacifiCorp has system wide efficiency and power production upgrades planned to meet forecasted power shortages in 2018. These upgrades are assumed to replace the power production lost from dam removal even with the potential efficiency upgrades and the determination that this impact would be less than significant would not change.

*The loss of the reservoirs could increase available mosquito habitat and increase the risk of disease transmission.* During scoping, members of the public raised a concern that the loss of the lakes would result in an increase in swampy lands and standing water in the footprint of the current reservoirs. The additional standing water could provide mosquito breeding habitat, increasing mosquito population numbers and the chances of disease transmission through insect bites. However, the removal of the reservoirs will reduce the amount of standing water in the vicinity of the existing lakes by returning the river to its free flowing condition. The removal of the reservoirs, the increase in flow to the Klamath River, and the restoration of the river channel will result in less standing water than currently exists in the long term. **The removal of the reservoirs would increase the amount of mosquito breeding areas in the short-term, and would have a less than significant impact on disease transmission.**

#### **Keno Transfer**

*Under the Proposed Action, the Keno Facility will be transferred to the DOI, which could cause adverse effects to Public Health and Safety.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on Public Health and Safety, Utilities and Public Services, Solid Waste, or Hydropower compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, the Keno Transfer would result in no change from existing conditions and would have no adverse effects on public health and safety and public utilities.**

#### **East and West Side Facilities**

*Under the Proposed Action, the East and West Side Facilities will be decommissioned, resulting in the loss of generated power.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. As shown in Table 3.18-4, the total combined power generating capacity of the facilities is approximately 3.8 MW. The loss of these facilities would not impact PacifiCorp's ability to provide power to the region. The complete decommissioning of the facilities, according the terms of the appropriate public health and safety plan would have no impact to Public Health and Safety. **The impact to public health and safety and public utilities from the decommissioning of the East and West Side Facilities would be less than significant.**

#### **KBRA**

The KBRA includes several programs that could affect utilities and public services, solid waste, and power, including:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan

- Wood River Wetland Restoration
- On-Project Plan
- Water Use Retirement Program
- Power for Water Management Program
- Emergency Response Plan
- Fish Entrainment Reduction

*Prescribed burning and mechanical thinning under the Phases I and II Fisheries Restoration Plans could affect public services and utilities.* Prescribed burning and mechanical thinning in forests are KBRA actions associated with the Fisheries Restoration intended to mimic natural fire regimes. The efforts reduce the potential for catastrophic fires and subsequent erosion by reducing the available fuel sources for wild fire.

Prescribed burning can affect public services by using public resources to monitor and manage burning which can leave other areas more vulnerable during the prescribed burn. Mechanical thinning has limited effects on utilities and public services. There is some potential for damage to utility lines from falling trees and branches, but these are minimal and addressed through project level plans and environmental analysis. Adverse effects are short term and less than significant and addressed through proper project planning.

Burning and thinning also have long term beneficial effect to public services. These fuel reduction treatments help to slow wildfires, provide defensible areas, and increase the natural resistance to wildfire by removing excess fuels that can help increase the chance that a wildfire will have catastrophic impacts. The long term benefits of fuel reduction in terms of fire prevention outweigh the adverse effects of the actions. The timing of and specific locations where these burning and thinning actions could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. The short term effect burning and thinning actions could contribute to the significant impact to public services and utilities of construction activities associated with hydroelectric facility removal. As described above the affect of facility removal on fire risk could be reduced to a less than significant level with mitigation reducing the severity of any interaction with burning and thinning actions. **The effects of prescribed burning and mechanical thinning could be potentially significant in the short term, but implementation of Mitigation Measure PHS-2 would reduce this impact to a less than significant level. The long term effects of fuel reduction are beneficial. Implementation of Prescribed Burning and Mechanical Thinning under the Phases I and II Fisheries Restoration Plans will require future environmental compliance as appropriate.**

*Construction activities associated with the KBRA programs could result in public health and safety impacts.* Potential construction activities could include a variety of restoration actions and habitat improvements. The Fisheries Reintroduction and Management Plan, the Wood River Wetland Restoration, and elements of the On-Project Plan contain construction components that could have distinct health and safety issues related to the

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construction activities. Prior to implementing construction, an applicable public health and safety plan would be developed to ensure construction workers and the public would not be adversely affected during construction and operation. **Impacts from the restoration and habitat improvement action in the KBRA on public health and safety and public utilities are expected to be long term and beneficial. Some short term impacts related to construction activities could occur during the implementation of the restoration and habitat improvement projects. Implementation of these restoration and habitat improvement actions will require future environmental compliance as appropriate.**

*Implementation of the Power for Water Management Program could create new renewable energy sources.* Implementation of the Power for Water Management Program (KBRA Section 17) would provide affordable electricity to eligible users to allow efficient use, distribution, and management of water. This could also involve the development of renewable energy sources, which would provide green energy. This would be a beneficial effect on public utilities. Implementation of the Power for Water Management Program will require future environmental compliance as appropriate. **The Power for Water Management Program would have long term, beneficial effects to public utilities.**

*Completing the Emergency Response Plan could have beneficial effects on Public Services and Public Safety.* The Emergency Response Plan is intended to prepare water managers and emergency responders for potential failure of Reclamation's Klamath Project dikes or other facilities that affect the storage and delivery of water to Reclamation's Klamath Project irrigators. The plan will include a process to prepare for potential emergencies, identify available funding sources for responding to emergencies, a prioritization method for funding emergency responses, and a process to implement emergency responses. The response plan will create new protocols for emergency responders in the area, but new funding sources would offset the costs of training and planning required to prepare effectively for the emergencies covered in the plan.

The Emergency Response Plan could rely on alternative sources of water to meet the irrigation requirements of Reclamation's Klamath Project irrigators. This could reduce local water supplies and effect public utilities in the event of an emergency. These effects would be short term, until the emergency was addressed and supplies rebounded after the use of emergency supplies was finished. **The effects of the Emergency Response Plan on public health and safety would be beneficial as the Plan is intended to address impacts from a failure of the levies and other infrastructure that could adversely affect health and safety. Any impacts to utilities and public services from creating the plan would be beneficial by improving the capacity of local agencies to respond to emergencies.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

Under the Partial Facilities Removal of Four Dams Alternative, certain project features would be retained, while meeting the requirements for a free-flowing river and for volitional fish passage through all four dam sites. There would be no appreciable

difference between the impacts of the Partial Facilities Removal of Four Dams and the Proposed Action Alternatives, except as noted below. As it would be for the Proposed Action, implementation of Mitigation Measures PHS-1 and PHS-2 would mitigate the impacts of the Partial Facilities Removal of Four Dams Alternative to a less-than-significant level.

*Retained structures could have the potential to result in public health and safety risks.* The presence of powerhouses, tunnels, penstocks and other equipment would have the potential to cause injuries resulting from entrapment and falls. Implementation of this alternative would include installing appropriate fencing and blocking access to retained facilities. **These safety hazards would be a less than significant impact given that fencing and access restrictions are part of the construction activities associated with the project.**

*Construction activities could generate a substantial amount of solid waste that would exceed the capacity of facilities to receive the waste.* Under the Partial Facilities Removal of Four Dams Alternative, certain project features would be retained, while meeting the requirements for a free-flowing river and for volitional fish passage through all four dam sites. As with the Proposed Action, construction and demolition activities would produce solid waste. As shown in Table 3.18-5, the total amount of inert solid waste that would be generated under the Partial Facilities Removal of Four Dams would be 1,240,000 yd<sup>3</sup> of earth, 90,000 yd<sup>3</sup> of concrete, 2,400 tons of rebar, and 3,200 tons of metals. As with the Proposed Action, all the waste concrete and earth would be disposed in on-site disposal areas or in the original borrow pits, and a portion of the metals would be recycled, in accordance to relevant construction debris recycling regulations, at the Yreka Transfer Station, the Yreka Sanitation Landfill, and the Klamath Falls Landfill. In addition, Dry Creek Landfill, also in the vicinity of the project area, has 165 million yd<sup>3</sup> of disposal capacity, and could be utilized for disposal. The disposal capacities of the existing surrounding landfills are anticipated to be sufficient for the waste generated by activities associated with the Partial Facilities Removal of Four Dams Alternative, and the waste generated would not conflict with the solid waste policies and objectives of AB939. **The solid waste impacts associated with the Partial Facilities Removal of Four Dams Alternative would be less than significant.**

#### **KBRA**

The KBRA would be fully implemented under this alternative. The public health and safety, public services, and hydropower impacts of the KBRA under the Partial Facilities Removal of Four Dams Alternative would be the same as for the Proposed Action.

#### **Alternative 4: Fish Passage at Four Dams**

Under the Fish Passage at Four Dams Alternative, no facilities removal would be conducted at the Four Facilities. Fish passageways will be built at each of the Four Facilities in the form of pool & weir, vertical slot, ice harbor, or hybrid fish ladder with auxiliary water systems. The impacts associated with the Fish Passage at Four Dams

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Alternative would be similar to those of the Proposed Action, except as noted below. As it would be for the Proposed Action, implementation of Mitigation Measures PHS-1 and PHS-2 would mitigate the impacts of the Partial Facilities Removal of Four Dams Alternative to a less-than-significant level.

*Construction activities could generate solid waste that would exceed the capacity of facilities to receive the waste.* Under this alternative, construction of fish passageways would generate solid waste. As shown in Table 3.18-5, the total amount of inert construction solid waste generated under the Fish Passage at Four Dams Alternative would be 16,600 yd<sup>3</sup> of concrete and 540 tons of rebar from demolition and replacement of the existing fish ladder at J.C. Boyle Dam. As with the Proposed Action, all of the waste concrete is expected to be disposed of in on-site disposal areas or in the original borrow pits and a portion of the metals would be recycled, in accordance to relevant construction debris recycling regulations, at the Yreka Transfer Station, the Yreka Sanitation Landfill, and the Klamath Falls Landfill. In addition, Dry Creek Landfill, also in the vicinity of the project area, has 165 million yd<sup>3</sup> of disposal capacity, and could be utilized for disposal. The disposal capacities of the existing surrounding landfills are anticipated to be sufficient for the waste generated by activities associated with the Fish Passage at Four Dams Alternative, and the waste generated would not conflict with the solid waste policies and objectives of AB939. **The solid waste impacts associated with the Fish Passage at Four Dams Alternative would be less than significant.**

*Impacts on Hydropower resulting from the Fish Passage at Four Dams Alternative would reduce power generation compared to the No Action/No Project Alternative.* Providing fish passage at the Four Facilities would allow the hydroelectric facilities to remain in place, but hydropower generation would be subject to significant reduction from additional bypass flows, changes to flows in the peaking reaches, and flows required for fish passage structures as compared with the No Action/No Project Alternative. These additional flow releases would be needed to support fish migration in the J.C. Boyle and Copco 2 bypass reaches and peaking reaches. All dams would require flows to support fish bypass structures.

Although the hydropower loss would vary from 100 percent to 73 percent in the peak demand summer months with additional bypass and fish flows (PacifiCorp 2006), the loss of this power would not require the construction of additional electrical generating facilities or infrastructure, as described under the discussion of Proposed Action effects. **The loss of power would be less than significant.**

#### **Alternative 5: Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate**

Under the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, facilities would be removed at Copco 1 and Iron Gate Dams, and fish passage facilities would be constructed at J.C. Boyle and Copco 2 Dams. Because only Copco 1 and Iron Gate Dams (and not J.C. Boyle or Copco 2 Dams) would be removed under this alternative, there would be less demolition than under the Proposed Action. As it would be for the Proposed Action, implementation of Mitigation Measures PHS-1 and

PHS-2 would mitigate the impacts of the Partial Facilities Removal of Four Dams Alternative to a less-than-significant level. The impacts of the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to those of the Proposed Action, except as noted below.

*Construction activities could generate solid waste that would exceed capacity of facilities that receive the waste.* Under the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, facilities would be removed at Copco 1 and Iron Gate Dams. Fish passage facilities would be constructed at J.C. Boyle and Copco 2 Dams. As with the other action alternatives, construction and demolition activities would produce solid waste.

As shown in Table 3.18-5, the total amount of inert construction and demolition solid waste generated under the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be 1,100,000 yd<sup>3</sup> of earth, 77,800 yd<sup>3</sup> of concrete, 2,200 tons of metals, and 1,620 tons of rebar. As with the Proposed Action, all of the waste concrete and earth would be disposed of in on-site disposal areas or in the original borrow pits and a portion of the metals would be recycled, in accordance to relevant construction debris recycling regulations, at the Yreka Transfer Station, the Yreka Sanitation Landfill, and the Klamath Falls Landfill. Given that the combined remaining permitted Class III landfill capacity available at the Klamath Falls Landfill and the Yreka Solid Waste Landfill is 4.3 yd<sup>3</sup>, the regional landfills in the surrounding counties should be capable of handling the additional waste generated by the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. In addition, Dry Creek Landfill, also in the vicinity of the project area, has 165 million yd<sup>3</sup> of disposal capacity, and could be utilized for disposal. The disposal capacities of the existing surrounding landfills are anticipated to be sufficient for the waste generated by activities associated with the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, and the waste generated would not conflict with the solid waste policies and objectives of AB939. **The solid waste impacts associated with the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be less than significant.**

*Impacts on Hydropower resulting from the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would reduce power generation compared to the No Action/No Project alternative.* Under this alternative, Iron Gate and Copco 1 Dams would be removed, leaving Copco 2 and J.C. Boyle Dams. The total authorized power production that would be lost under this alternative would be 38 MW, or 0.4 percent of PacifiCorp's total generating capacity. Additionally, operations of the remaining dams would require bypass flows and fish passage structure flows further decreasing hydropower production, as noted for the Fish Passage at J.C Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. This alternative would result in a small amount of power lost compared with PacifiCorp current generating capacity and planned generating and transmission capacity upgrades. As discussed for the Proposed Action, PacifiCorp will acquire surplus power from other existing facilities to serve the project

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area and no additional facilities or infrastructure would be necessary. **The reduced power impacts would be less than significant.**

#### **3.18.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequences Summary**

*Mitigation Measure PHS-1:* A public safety management plan will be prepared and implemented to maintain public safety during all phases of construction and demolition. Components of the plan will include the following:

- Public notification of the location and duration of construction and demolition activities, pedestrian/bicycle path/trail closures, and restrictions on reservoir use (i.e., boating, water skiing, fishing, swimming).
- Verification with local jurisdictions that construction blockage of existing roadways will not interfere with existing emergency evacuation plans.
- Verification with local jurisdictions that construction use of existing roadways for truck hauling of materials will not substantially interfere with response times of emergency vehicles.
- Adequate signage will be installed regarding the location of construction and demolition sites and warning of the presence of construction equipment.
- Fencing of construction staging areas and of construction and demolition areas if dangerous conditions exist when construction and demolition are not occurring.
- Temporary walkways (with appropriate markings, barriers, and signs to safely separate pedestrians from vehicular traffic) and detour signage where an existing sidewalk or pedestrian/bicycle path/trail will be closed during construction and demolition.

*Mitigation Measure PHS-2:* Prior to initiating construction and demolition activities, the Dam Removal Entity, in consultation with the appropriate city, county, and state fire suppression agencies will prepare and implement a Fire Management Plan. The plan will include fire prevention and response methods including fire precaution, pre-suppression, and suppression measures consistent with the policies and standards in the affected jurisdictions. Additionally, fire suppression equipment will be required on-site at all times and emergency contact numbers will be posted in case of a fire. This plan will include provisions that areas of construction and deconstruction work involving welding, grinding, torch-cutting, gas and diesel generators and other construction activities that could result in open sparks or flame be cleared of dried vegetation or wetted-down to prevent wildfires.

##### **Effectiveness of Mitigation in Reducing Consequence**

Implementation of PHS-1 and PHS-2 would reduce potential public health and safety risks to a less than significant level.

##### **Agency Responsible for Mitigation Implementation**

The DRE would be responsible for implementing mitigation measures PHS-1 and PHS-2.

##### **Remaining Significant Impacts**

Following implementation of Mitigation Measures PHS-1 and PHS-2, no significant adverse impacts associated with public health and safety, utilities and public services, solid waste, and power are anticipated.

### **Mitigation Measures Associated with Other Resource Areas**

Several other mitigation measures require construction, including mitigation measures H-2 (flood-proof structures), GW-1 (deepen or replace affected wells), WRWS-1 (modify or screen affected water intakes), REC-1 (develop new recreational facilities and access to river), TR-6 (assess and improve roads to carry construction loads), and TR-7 (assess and improve bridges to carry construction loads). Construction required for the mitigation measures would not require substantial equipment or materials and would not pose risks to public health or safety. **Construction associated with these mitigation measures would have temporary and less-than-significant effects on public health and safety, solid waste, and public utilities and services. There would be no change from existing conditions for power.**

*Mitigation REC-1 would develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam.*

Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoir is removed. Impacts specific to the relocation of the Recreation Facilities are discussed in Section 3.20, Recreation. The facilities would be built to current standards, and maintained by the final title holder of the exposed land. **The replacement of recreational facilities would have a less than significant impact on public health, safety, solid waste, and public utilities and services. There would be no change from existing conditions for power.**

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## 3.19 Scenic Quality

This section analyzes the effects on scenic quality from implementation of the Proposed Action or alternatives to the Proposed Action. The analysis primarily entails the identification and description of changes to scenic resources in the landscape. Scenic quality is the essential resource that supports the recreational activity of “sightseeing” discussed in Section 3.20, Recreation. Other potential aesthetic impacts associated with odor, noise and physical contact are described in Sections 3.2, Water Quality, 3.4, Algae, 3.9, Air Quality, 3.20, Recreation, and 3.23, Noise and Vibration.

### 3.19.1 Area of Analysis

The area of analysis for the evaluation of scenic quality includes the vicinities and the areas within sight lines of the Four Facilities, as well as areas identified as construction/demolition areas and staging areas for the Proposed Action and alternatives. The area of analysis also includes the Upper Klamath Basin where activities associated with the implementation of the Klamath Basin Restoration Agreement (KBRA) could occur. Because retention or removal of these dams could affect scenic quality aspects such as water clarity, fish viewing opportunities, and riparian and channel characteristics of the river below the dams, the area of analysis also includes the Klamath River from Iron Gate Dam to the Pacific Ocean.

### 3.19.2 Regulatory Framework

Scenic resources within the area of analysis are regulated by several federal, state, and local laws and policies, which are listed below.

#### 3.19.2.1 Federal Authorities and Regulations

- Federal Land Policy and Management Act (43 U.S.C. 1701 et seq.)
- Clean Water Act (33 USC § 1251 et seq.)
- Bureau of Land Management Draft Upper Klamath River Management Plan Environmental Impact Statement/Environmental Impact Report (EIS/EIR) and Resource Management Plan Amendments
- Bureau of Land Management Visual Resource Management Methodology
- U.S. Forest Service, Klamath National Forest Land and Resource Management Plan
- Wild and Scenic Rivers Act (WSRA) (16 U.S.C. 1271 et seq.)
- Redding Resource Area Resource Management Plan (RMP) and Record of Decision (ROD)
- Klamath Falls Resource Area RMP, ROD, and Rangeland Program Summary
- U.S. Forest Service, Six Rivers National Forest Land and Resource Management Plan
- U.S. Forest Service Scenery Management System

### **3.19.2.2 State Authorities and Regulations**

- Oregon Parks and Recreation Department, Klamath River Scenic Waterway Rules (Oregon Revised Statute [ORS] 390 et seq.)
- California Wild and Scenic Rivers Act

### **3.19.2.3 Local Authorities and Regulations**

- Siskiyou County General Plan
- Siskiyou County Zoning Ordinance
- Klamath County Comprehensive Plan
- City of Klamath Falls Comprehensive Plan
- City of Klamath Falls Community Development Ordinance
- City of Klamath Falls Parks Recreation and Open Space Master Plan

### **3.19.3 Existing Conditions/Affected Environment**

This section provides an overview of the basin's scenery resources and how these resources are identified and analyzed through the Visual Resource Management (VRM) process. A description of scenic resources, as defined by the Bureau of Land Management (BLM), will be used as the No Action basis for comparison. Per the BLM VRM system, impacts to the affected environment will be evaluated by measuring potential impacts to the current Visual Resource Inventory (VRI) (namely scenic quality condition) as well as perceivable contrast with the characteristic landscape when viewed from Key Observation Points (KOPs).

In response to the Federal Land Policy and Management Act and subsequent agency-specific regulations, federal land management agencies such as the BLM and U.S. Forest Service (USFS) developed systems specifically designed to inventory, evaluate and manage for scenic (visual) resources on public lands. To evaluate scenic resources under BLM jurisdiction and to develop management objectives for those resources, the BLM developed the VRM system. BLM's VRM policy consists of three primary components; 1) Maintaining an up-to-date VRI, 2) Establishing VRM Classes as part of RMPs, and 3) Evaluating Project Planning for physical impacts and plan conformance (BLM 2007).

VRI consists of three data components; scenic quality, visual sensitivity, and distance zones (BLM 2007). Together, these three elements comprise a final VRI class that reflects the current physical condition of the visual resource within a geographic area. Thus, this information should serve as one part of an effects analysis within project planning as part of the existing condition/affected environment section. Current state of BLM VRI will be described under the Affected Environment section.

VRI information is considered along with other resource conditions and goals during RMP analysis in order to delineate final VRM Classes for every acre of BLM land. These management classes are **not** equivalent to the physical condition of the visual resource, but instead, equate to the management goal for a particular area. All BLM lands are assigned one of four VRM Classes, ranging from Class I, which reflects the highest value and protection for scenery, to Class IV, which reflects the least value and

protection for scenery. The VRM Classes represent the baseline for determining plan conformance during project planning. The nature of VRM Class designations applicable to the planning area are described later in this section.

During project planning, the contrast-rating system process (BLM 2007) is used to help assess the degree of visible contrast within primary landscape features, with respect to landscape character elements of form, color, line, and texture. The contrast-rating system is utilized to not only assess the potential physical impacts from ground disturbing activities (and thus impacts to the visual resource inventory, or existing conditions), but also can be used to help determine project conformance. Degrees of contrast in a range of none/weak/moderate/strong roughly coincide with VRM Class I, II, III, and IV, accordingly.

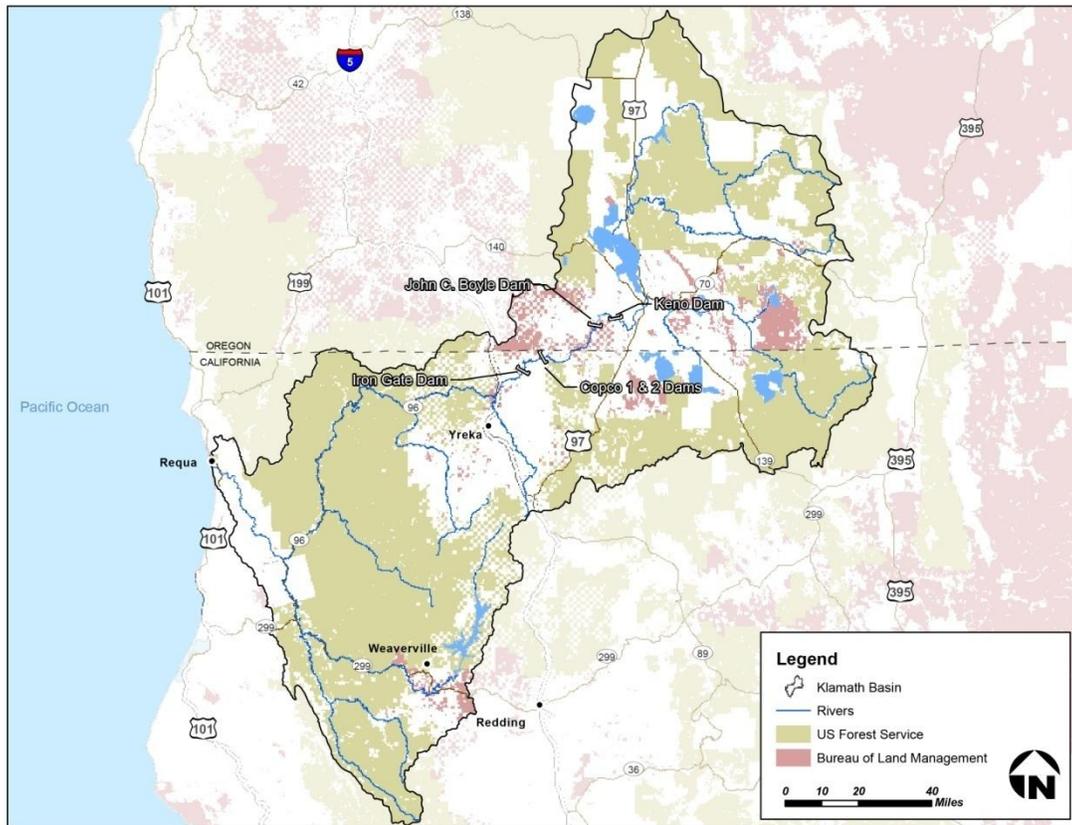
The USFS has a parallel system, known as the Scenery Management System (SMS). The primary components of the SMS are similar to BLM's VRM system (e.g., BLM's scenic quality versus SMS' inherent scenic attractiveness; visual sensitivity/ public concern levels, and distance zones/seen areas and distance zones).

Ownership of lands varies geographically across this Project (see Figure 3.19-1). While the description of the scenic resources within a particular land management agency's jurisdiction will be referenced in respect to agency system terminology, to obtain consistency, the BLM's VRM methodology will be used for the entire Project area in terms of describing the potential physical effects to scenic quality, even though only a portion of the project area is actually subject to BLM VRM management objectives.

#### **Applicable Visual Resource Management Class Designations within the Planning Area**

The area of the dam sites contains no Class I visual resources. The lands in the area of analysis primarily fall under two classes:

- **Class II** The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- **Class III** The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape (BLM 2007).



**Figure 3.19-1. Project Area Land Ownership for BLM and USFS**

Currently, there is no up-to-date VRI record on file for the project area, only final VRM Classes for the area. Project level inventory information should be gathered for activity level planning in order to help determine impacts to the physical condition of the visual environment, where VRI information does not exist. For the purposes of this document, the site-specific, project level inventory would be limited to the area of analysis as defined in Section 3.19.1 and based upon a combination of original data from the 2004 PacifiCorp Technical Report with additional analysis from several KOPs.

The following represent the conclusions for the baseline VRI within the project area, according to the three components (scenic quality, visual sensitivity, distance zones).

In terms of scenic quality, BLM policy requires all public land to be classified as either Class A, B, or C scenic quality, with A being the most distinctive and Class C being the most common, in terms of variety of key factors such as; color, water, vegetation, landform, influence of adjacent scenery, scarcity, and cultural modifications (BLM 2007). Analysis by the Lead Agencies concluded that all of the project area would be contained within Class A landscapes because of the following key factors:

- **Color** - Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element
- **Water** – Water flowing or still, dominant in the landscape when viewed from most KOPs, but not always clear and clean appearing
- **Vegetation** - A variety of vegetative types as expressed in interesting forms, textures, and patterns
- **Landform** - Steep canyons, some interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional
- **Influence of adjacent scenery** - Adjacent scenery moderately enhances overall visual quality
- **Scarcity** - Distinctive, though somewhat similar to others within the region
- **Cultural modifications** – Some modifications add favorably to visual variety while other add little or no visual variety or may be discordant

Based on the point system assigned to each of these key factors, the scenery in the project area scores within the range of Class A scenic quality.

In terms of visual sensitivity, BLM policy requires all landscapes be rated as either High, Moderate, or Low to document the public's relative level of concern for visual quality. The Lead Agencies concluded that all of the project area would be considered High visual sensitivity because recreational sightseers are highly sensitive to changes in visual quality, public interest and controversy created in response to proposed activities, portions of the area of analysis are within the viewshed of residential areas, and most of the Klamath River has been designated under the WSRA.

In terms of distance zone analysis, BLM policy requires all public lands be classified within either a Foreground-Middleground, Background, or Seldom Seen classification. The Lead Agencies concluded that all of the project area would be located with the foreground-middleground distance zone because of the proximity of views from recreational access sites along the river, campgrounds, KOPs along scenic highways, riverside and/or reservoir communities and residences, rivers, or other viewing locations are less than 3 to 5 miles away.

Thus, in combining these three layers according to BLM's VRI Matrix (Table 3.19-1), the project area would be classified as a VRM II (Class A scenic quality of high visual sensitivity as viewed from a foreground/ middleground distance zone – see highlighted cells in VRI Matrix shown in Table 3.19-1), from an inventory context.

Several river segments within the Klamath Basin have been designated under the WSRA. Four of these Wild Scenic Rivers (WSR) segments could potentially be affected by dam removal: the Klamath River (Oregon and California segments), the Sprague River and the Sycan River. The Sprague River and Sycan River are in the Fremont-Winema National Forest. Potential scenic impacts to these rivers could result from KBRA project implementation.

**Table 3.19-1. Visual Resource Inventory Matrix**

		Visual Sensitivity						
		High			Medium			Low
<b>Special Areas</b>		I	I	I	I	I	I	I
<b>Scenic Quality</b>	<b>A</b>	II	II	II	II	II	II	II
	<b>B</b>	II	III	III*	III	IV	IV	IV
	<b>C</b>	III	IV	IV	IV	IV	IV	IV
		f/m	b	s/s	f/m	B	s/s	s/s
<b>DISTANCE ZONES</b>								

Source: BLM 2007

Notes:

Highlighted cells indicate visual resource inventory determinations for the affected environment

\*If adjacent area is Class III or lower assign Class III, if higher assign Class IV

Key:

b: background

f/m: foreground/midground

s/s: seldom seen

When the California portion of the Klamath River was designated under the WSRA in 1981, “outstandingly remarkable” recreational or scenic values were not identified, only “outstandingly remarkable” fisheries values. Scenic values along Wild and Scenic Rivers are protected by the WSRA to various degrees but all segments have requirements to maintain at least a generally natural appearance along their waterways. The natural appearing scenic quality within the more immediate and prominent portions of these rivers is protected along these segments by both the WSRA and Forest Land and Resource Plans.

In 1990, BLM found the 5.3-mile section of the Klamath River from the Oregon-California state line to the slack water of Copco 1 Reservoir to be eligible and suitable for WSR designation. The river segment is free-flowing and possesses outstandingly remarkable scenic, recreational, fish, and wildlife values. This river segment is not a designated WSR and is not protected under the WSRA and its Section 7(a) requirements. BLM is required within its authorities, to protect this suitable river segment’s free-flowing character, water quality, and outstandingly remarkable river values. This segment of the Klamath River is also listed on the Nationwide Rivers Inventory (National Parks Service [NPS] 2009).

For the Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement (FEIS) (2007), PacifiCorp conducted a detailed visual evaluation of the project vicinity as summarized in the FEIS (2007) and documented it in the *Land Use, Visual, and Aesthetic Resources Final Technical Report* (PacifiCorp 2004). This evaluation involved identifying and photographing KOPs during different seasons and the reservoirs

at different water levels in 2002 and 2003. Figure 3.19-2 shows the locations of the KOPs in the PacifiCorp (2004) report. The results of this study are used in the Klamath Facilities Removal EIS/EIR to establish the existing environmental setting of the area of analysis, and are described below. To verify that current conditions are similar to 2003 conditions, photographs taken from selected locations in October 2010 were compared to the 2003 photographs. Appendix Q presents this comparison. In addition, photographs from the FERC FEIS (2007) are included in Appendix Q to identify typical scenic/landscape character along the Klamath River, including its elements of canyon-walled enframement, channel configuration, water clarity, bank and riparian appearance.

### **3.19.3.1 Klamath Basin**

The Klamath Basin contains widely varied scenic resources, including wetlands, upland, rangeland, National Wildlife Refuges (NWRs), farmland, timberlands, and urbanized areas in Klamath Falls. Section 3.5, Terrestrial Resources, provides detailed descriptions of the landscape along the Klamath River throughout the area of analysis. Sightseeing opportunities to enjoy the scenic resources are widely available in the Klamath Basin generally, and more specifically within its three segments (above, between and below the reservoirs). The Upper Klamath Basin includes the headwaters of the Klamath River in south-central Oregon and north-central California, and contains Reclamation's Klamath Project. Scenery in the area served by Reclamation's Klamath Project includes agricultural areas and the Upper Klamath Basin NWR Complex, which comprises six refuges. Regionally, a variety of public lands contain notable scenic resources. Table 3.20-1 in Section 3.20, Recreation, lists locations in the area of analysis and surrounding region that offer wildlife viewing, and opportunities for sightseeing, leisure driving, photography, and other forms of recreation that benefit from scenic quality within the area of analysis. Section 3.20, Recreation, discusses recreation resources and includes the activity of sightseeing as a key element of the recreation experience.

The Upper Klamath Basin is the area of analysis for scenic resource effects that would be associated with implementation of the KBRA. However, specific locations for actions associated with implementation of the KBRA have yet to be identified, so no specific analysis is possible regarding the effects that would be associated with KBRA implementation in the Upper Klamath Basin. Instead, general effects of the multiple components of the KBRA on scenic resources in the Klamath Basin will be discussed.

The area of analysis for the Klamath Hydroelectric Settlement Agreement (KHSA) Four Facilities removal actions includes the Klamath River from J.C. Boyle Dam to the Pacific Ocean and the structures of the J. C. Boyle, Copco 1, Copco 2, and Iron Gate Facilities. The following sub-sections describe scenic resources in the area of analysis.

Klamath Facilities Removal EIS/EIR  
Public Draft

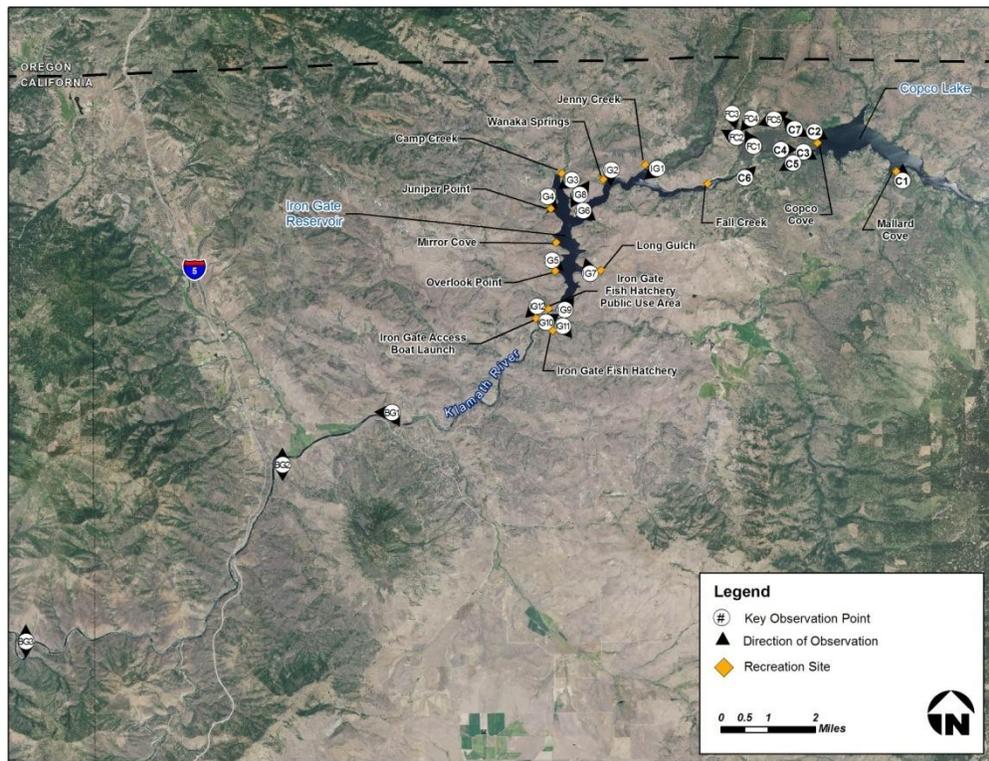
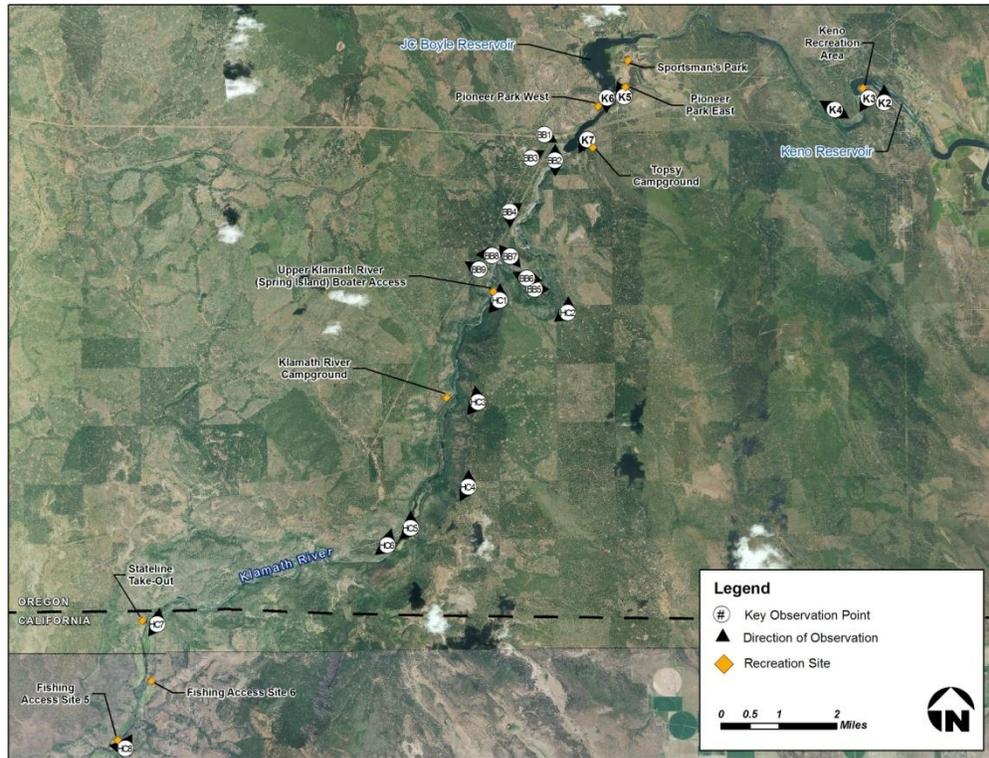


Figure 3.19-2. Key Observation Points from PacifiCorp (2004) Report

### **3.19.3.2 Klamath River**

PacifiCorp (2004) viewed 7 KOPs from Keno Impoundment to the J.C. Boyle Reservoir, 9 KOPs in the J.C. Boyle bypass reach, 8 KOPs in the Hell’s Corner Reach (the river between J.C. Boyle Powerhouse and Copco 1 Reservoir), 7 in the Copco 1 Reservoir area, 12 in the area of Iron Gate Reservoir, and 3 downstream of Iron Gate Dam. Many of the reaches have similar general characteristics with the aesthetic differences between high flows and low flows varying depending on the individual physical features (e.g., rocks, vegetation, bends, width of channel, depth of water) of each reach. During low flows, more rocks and vegetation were visible at the river edges than at high flows.

These KOPs are not intended to be comprehensive, but were selected to represent typical views (including scenic overlooks) for members of the public from riverside and/or reservoir communities and residences, recreational access sites, campgrounds, Scenic Byways (Highway 96/State of Jefferson Scenic Byway and Highway 96/Bigfoot Scenic Byway), State Highways 96, 169, and 101. Other “sightseeing areas” below Iron Gate Dam could have potential scenery effects to sensitive public viewpoints.

Klamath River components are part of the National Wild and Scenic Rivers System (NWSRS) because of their free-flowing condition and “outstandingly remarkable” values. Scenery associated with WSRs is protected by the WSRA. Scenery within two WSR segments of the Klamath River could be affected by the project alternatives:

- Oregon Klamath River Component. The segment of the Klamath River beginning immediately downstream of the J.C. Boyle Powerhouse and flowing 11 miles to its terminus at the Oregon-California State Border is classified as scenic and possesses outstandingly remarkable scenic use values. The Upper Klamath River (upstream of Iron Gate Dam) was evaluated by BLM in 1977 and 1981, and received a Class A scenic quality rating, the highest scenic quality classification. The 2006 Preliminary Determination Report (completed for the Section 7 WSR requirement during FERC relicensing of the PacifiCorp facilities) stated that the Upper Klamath WSR increased the visual variety in the canyon flowing through diverse topography and dropping to form a series of pools and rapids. The unique landforms, water, and vegetation create an ever-changing landscape from desert to more mountainous terrain, and steep canyons and vertical cliffs with diverse vegetation (Bonacker et al. 2007).
- California Klamath River Component: The mainstem segment of the Klamath River beginning 3,600 feet downstream of Iron Gate Dam and flowing 189 miles to the Pacific Ocean mainstem is classified as recreational with portions of the tributaries classified as scenic and wild. Scenery within the California Klamath WSR is dominated by natural settings. Its characteristic river flows, water appearance, anadromous fish and riparian vegetation within a forested river canyon are the primary scenic aspects. Since 1981, flow regimes have varied moderately in response to water resource competition within the Klamath Basin. During summer months, these have typically been caused by water diversions (Van de Water et al. 2006). As described in Sections 3.2, Water Quality, and 3.20,

Recreation, reduced water clarity and discoloration resulting from algae blooms has impaired the scenic character of reaches downstream of Iron Gate Dam (River Mile [RM] 190.1) to the mouth of the Klamath River (RM 0.0).

### **3.19.3.3 Dam Settings**

#### **Reservoirs**

PacifiCorp (2004) described the area landscape from 11 KOPs in the vicinity of the reservoirs, including 3 in the J.C. Boyle Reservoir area, 2 in the Copco 1 Reservoir area, and 6 in the Iron Gate Reservoir area. All reservoirs were viewed under high pool and low pool conditions, and at J.C. Boyle Reservoir and Copco 1 Reservoir the maintenance condition was also observed. In general, the reported visual observations of the reservoirs indicated that under normal operating conditions, the four reservoirs share the visual characteristics of open expanses of relatively flat water. Also, as described in Sections 3.2, Water Quality, and 3.20, Recreation, reduced water clarity and discoloration from algae blooms occur seasonally, typically peaking in late summer to early fall (Karuk Tribe of California 2009).

#### **Project Facilities**

PacifiCorp viewed project area scenic characteristics at the following 10 KOPs of the project facilities (alphanumeric designations refer to KOP designations and accompanying photographs in the PacifiCorp (2004) report):

- BB1: J.C. Boyle Dam
- BB8: J.C. Boyle Powerhouse and Penstocks
- BB9: J.C. Boyle Transmission Line
- C3 Copco 1 Dam and Powerhouse
- C4: Copco 2 Dam
- C6: Copco 2 Powerhouse
- C7: Copco Transmission Line
- IG8 Iron Gate Transmission Line
- IG9 Iron Gate Dam and Powerhouse from Iron Gate Fish Hatchery
- IG10 Iron Gate Fish Hatchery and Fish Ladder

In the PacifiCorp (2004) report, the views of the project facilities from these KOPs were characterized using the BLM VRM system. The report describes each of the facilities in the context of the BLM VRM classification for the surrounding area. These observations may be summarized by facility as follows:

- **J.C. Boyle Facilities** - The PacifiCorp report concluded that the J.C. Boyle Dam, Powerhouse, penstocks, and transmission line were not consistent with VRM Class II and III of the surrounding area. Although the line of the dam follows the site's topography, its large size makes it very noticeable against the natural setting. The powerhouse and penstocks have prominent colors and strong lines, which make them also apparent in the landscape. Although the transmission line

is distant from the viewer, it rises above other features in the distance and is visible for its length and height.

- **Copco 1 Facilities** - Copco 1 Dam and Powerhouse were not considered to be consistent the VRM Class III of the surrounding area. The size and prominence of these facilities were considered to dominate the view from the KOP. However, the Copco transmission line was typically at a distance from the viewing points and would blend into the sky and not obstruct views of other parts of the landscape. Thus, the transmission line was considered to be consistent with VRM Class III objectives.
- **Copco 2 Facilities** - Copco 2 Powerhouse was not considered to be consistent with of the VRM Class III of the surrounding area because its size and prominence dominates the view from the KOP. On the other hand, although the Copco 2 Dam is large, it has been designed with colors and lines that blend with the landscape, and when viewed in isolation, could hence be considered to be consistent with VRM Class III objectives.
- **Iron Gate Facilities** - The Iron Gate Dam, Powerhouse, and transmission lines were considered to be consistent with the VRM Class III objectives of the surrounding area in detailed visual evaluation of the project vicinity as summarized in the FEIS (2007) and documented it in the *Land Use, Visual, and Aesthetic Resources Final Technical Report* (PacifiCorp 2004). Although the dam and powerhouse are large, their colors and lines blend with the landscape. Similarly, the transmission line was typically at a distance from the viewing points and would blend into the sky and not obstruct views of other parts of the landscape. In instances where the support poles of the transmission lines were prominent, it was only for a short time while a viewer walks or drives by.

### 3.19.4 Environmental Consequences

#### 3.19.4.1 Effects Determination Methods

To determine the significance of effects on scenic resources, the Lead Agencies inventoried the scenery that would be affected by the Proposed Action and alternatives; identified the changes that would occur to those scenic resources in terms of degree of contrast, relative size or scale, distance, and visibility; and the magnitude of the potential changes. The effects method involves two stages: inventory and analysis.

#### Inventory

In the inventory stage, the Lead Agencies identified sensitive sightseeing areas within the watershed using maps of the Klamath Basin that identify land ownership, zoning, existing land use, roads, floodplains, notable scenic features and KOPs. Areas considered for sightseeing included riverside and/or reservoir communities and residences, recreational access sites, campgrounds, Scenic Byways (Highway 96/State of Jefferson Scenic Byway and Hwy 96/Bigfoot Scenic Byway), State Hwys 96, 169, and 101. The Lead Agencies determined the relative visibility from travel routes or observation points, or specific points with views of the Klamath River and the Four Facilities to show the characteristic landscape types found at significant viewpoints. A detailed discussion of the VRI process is provided in Section 3.19.3 Affected Environment.

The area of analysis experiences four distinct seasons. Flows in the Klamath River, water levels in the reservoirs, and the appearance of vegetation vary seasonally. The Lead Agencies used the detailed visual evaluation of the project vicinity as summarized in the Final FERC EIS (FERC 2007) and documented in the *Land Use, Visual, and Aesthetic Resources Final Technical Report* (PacifiCorp 2004) to characterize the area of analysis because this report included viewing the KOPs during different seasons and at different water levels over an extended time period. This PacifiCorp report provided an assessment of a baseline measure of the scenic appeal of the Project area through a Scenic Quality Evaluation consistent with the BLM inventory process. Scenic quality and sensitivity information were delineated and/or inventoried and documented spatially, in a manner that follows physical features in the landscape in the PacifiCorp (2004) report.

### **Analysis**

For this EIS/EIR, the contrast rating worksheets provided in the BLM VRM process were not completed for the KOPs. However, these forms should be completed during project level planning and provided in the Project Specific Plan. Although the contrast rating forms were not filled out for this EIS/EIR, the scenic quality impact analysis is built on the premise that many of the scenery conservation design principles identified in the forms would be applied by the Project Specific Plan.

In the analysis stage, the Lead Agencies identified changes in scenic quality by establishing a level of contrast [i.e., no effect (visual contrast is imperceptible), weak, moderate, and strong (contrast caused by the action would be substantial)] considering effects on form, line, color, texture, and comparing to approved VRM objectives for the area (Class). The Lead Agencies also determined whether the techniques that would be used in the Proposed Action and alternatives would ensure that surface-disturbing activities would harmonize with the surrounding natural environment. The Lead Agencies also considered light pollution effects that could be generated during construction.

It should be noted that a significance in visual contrast as defined under the BLM VRM system is not necessarily the same as a significance determination for the purposes of this document. The BLM VRM process is used as guidance for assessing the impacts of the proposed action and alternatives. The significance criteria used for significance determination for the purposes impact analyses are defined in the following section.

#### **3.19.4.2 Significance Criteria**

For the purposes of this document, an alternative would result in significant impacts if it would do any of the following:

- Cause a landscape to be inconsistent with the VRM classification of the surrounding area as defined for the purposes of this analysis.
- Result in a substantial adverse change to scenic resources, including, but not limited to landforms, trees, and rock outcroppings viewed from a river segment,

community, recreation site area, trail, scenic highway, or designated wild and scenic river reach, by altering the characteristic (i.e., natural, pre-development) state.

- Remove historic properties.
- Create a new source of light or glare that would adversely affect day or nighttime views in the area.

#### **3.19.4.3 Effect Determinations**

This section describes the potential effects of the No Action/No Project Alternative, the Proposed Action, and alternatives on scenic resources. Although the Proposed Action and alternatives would result in short-term and long-term changes in scenic resources, the scenic quality of the landscape would still remain the same as the inventoried scenic quality Class A because the changes would not significantly alter the key factors to change the determination. In fact, some of the project features may result in improvements of the key factors (e.g., water quality). The following discussion provides specific details on the impacts. The analysis considers the existing scenic character/landscape character, degree of existing disturbance and resulting scenic disturbance resulting from the proposed activity.

#### **Alternative 1: No Action/No Project**

Under the No Action/No Project Alternative, no construction or physical changes would occur; thus, there would be no changes in the short-term to the existing scenic quality of the dams, reservoirs, surrounding areas and adjacent river reaches.

*Continued impoundment of water at the Four Facilities could result in water quality impacts that could have long-term impacts on scenic quality.* As described in Section 3.2, Water Quality, degradation of water quality could continue in the long-term, if the dams are not removed. **The No Action/No Project Alternative would not change this existing condition.**

*Not removing the facilities could have the impact that they would remain inconsistent with the VRM classification of the surrounding area (where such inconsistency is defined as a criteria of significance).* PacifiCorp's analysis (2004) identified the following project features as being currently inconsistent with their VRM classification. Under the No Action/No Project Alternative, these features would remain inconsistent with their VRM classification:

- Class II VRM classification—the J.C. Boyle powerhouse and penstocks, J.C. Boyle Dam, bypass canal, and transmission line.
- Class III VRM classification—Copco No. 1 Dam and powerhouse, Copco No. 2 powerhouse and substation, and Iron Gate Hatchery and fish ladder.
- While not identified as being inconsistent with the surrounding area by PacifiCorp's 2004 analysis, Iron Gate Dam, bypass spillway, powerhouse, penstock, and associated landform and vegetation disturbances are also inconsistent with their Class III VRM classification and would remain so under

the No Action/No Project Alternative (personal communication with J. Mosier, Klamath National Forest, April 26, 2011). **The No Action/No Project Alternative would not change this existing condition.**

### **Ongoing Restoration Actions**

Under the No Action/No Project Alternative a number of Ongoing Restoration Actions are currently underway and would be implemented regardless of the Secretarial Determination on the removal of the Four Facilities.

#### **Fish Habitat Restoration Actions**

*These actions could result in short-term impacts on scenic resources during construction.*

Ongoing restoration activities for fish habitat would occur throughout the entire basin with the exception of the Trinity River basin. These activities may include floodplain rehabilitation, large woody debris replacement, fish passage correction, cattle exclusion fencing, riparian vegetation planting, mechanical thinning of upland areas to mimic natural forest conditions, fire treatment to mimic natural forest conditions, purchase of conservation easements/land, road decommissioning, gravel augmentation, and treatment of fine sediment sources. **During construction, impacts on scenic resources would be potentially significant, albeit temporary. No mitigation measures could be implemented to lessen the impact on scenic resources; therefore it would be significant and unavoidable in the short term.**

*These actions could result in long-term impacts on scenic resources.* Restoration activities would be anticipated to result in scenery more consistent with the naturally established, characteristic landscape. **Therefore, they have the potential to be beneficial to scenic resources in the long term.**

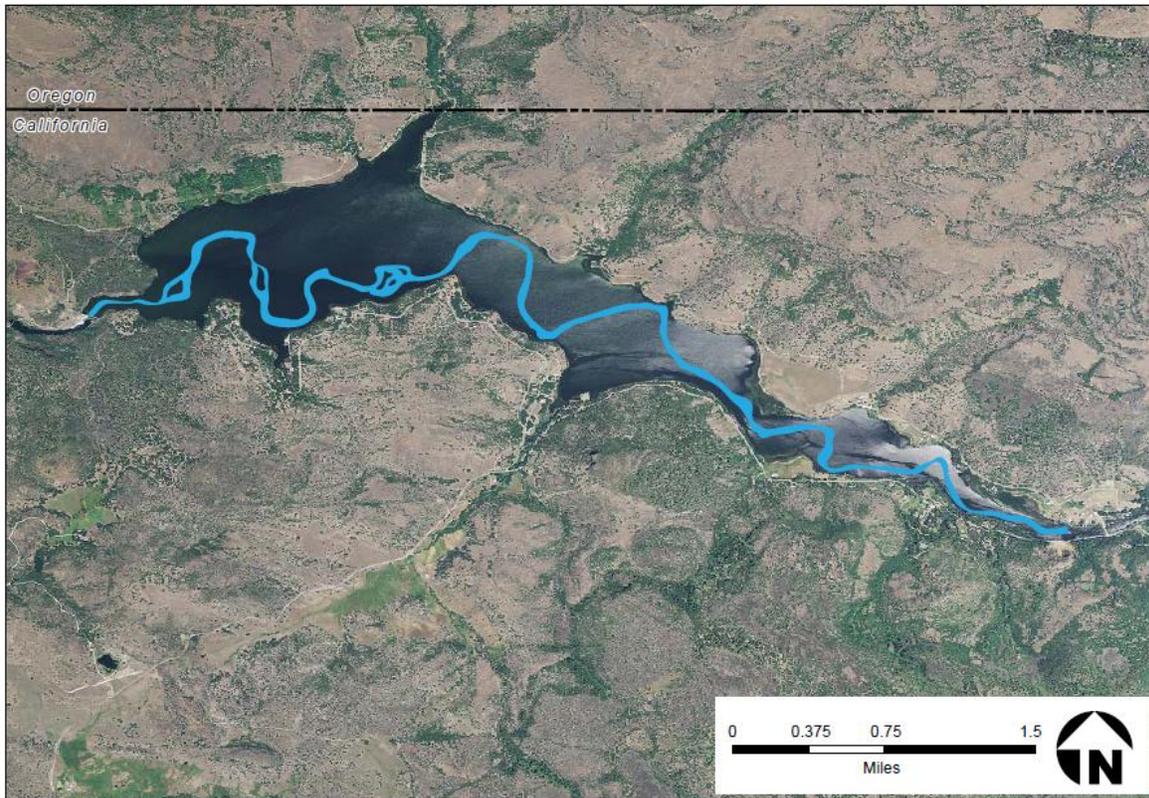
#### **Agency Lake and Barnes Ranches**

*This action could result in long-term impacts on scenic resources.* Effects could include changes in land uses, including changes from rangeland to water storage areas. These changes are intended to result in scenery more consistent with the naturally established, characteristic landscape. **Therefore, they have the potential to be beneficial to scenic resources.**

### **Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

The Proposed Action involves removal of dams and all appurtenant features, with the exception of buried features, at the Four Facilities. The Proposed Action would include reservoir drawdown and removal of four dams. This would expose the former inundated areas to view. After drawdown, the Dam Removal Entity (DRE) would perform restoration activities of the exposed areas. Restoration plans would include stabilizing and revegetating the newly exposed reservoir areas with various herbaceous species through hydroseeding, aerial hydromulching, and planting. Various woody species would also be planted. Invasive species would be weeded out. The hard lines of the dam and large expanses of water in the reservoirs would be changed to views of large natural expanses with vegetation and a continuous river. This scenic change would be visible for a very long distance around the reservoir sites and most reservoir KOPs, and would be

permanent. Figures 3.19-3, 3.19-4, and 3.19-5 show aerial photos of the existing reservoirs with an overlay of historic river channels. The historic channel represents what the extent of the Klamath River is expected to be in the long-term following dam removals. However, until the restoration was complete, the area would appear barren and/or sparsely vegetated.



**Figure 3.19-3 Historic River Channel for J.C. Boyle Reservoir**

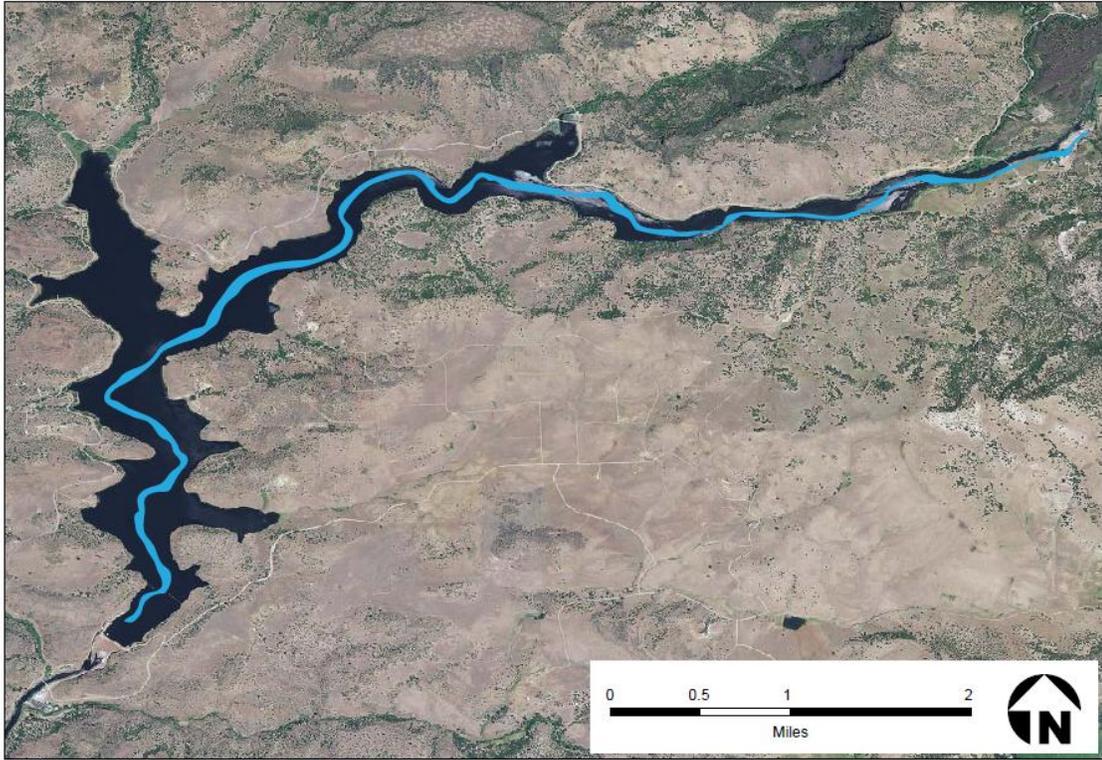


Figure 3.19-4 Historic River Channel at Copco Reservoir

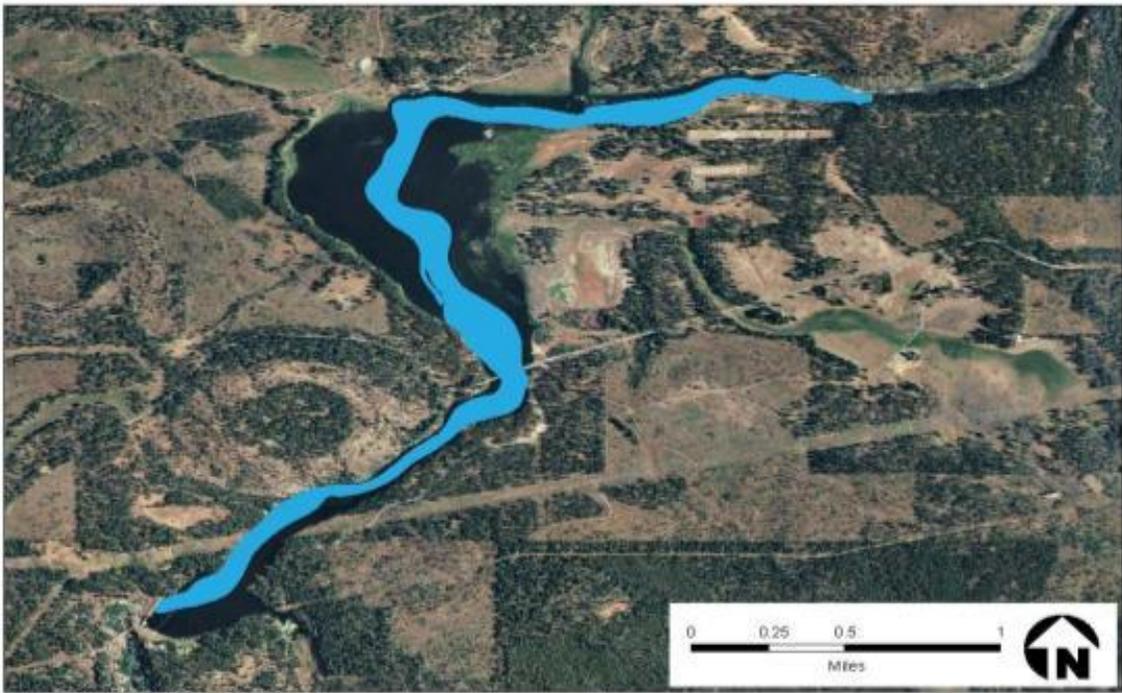


Figure 3.19-5. Historic River Channel at Iron Gate Reservoir

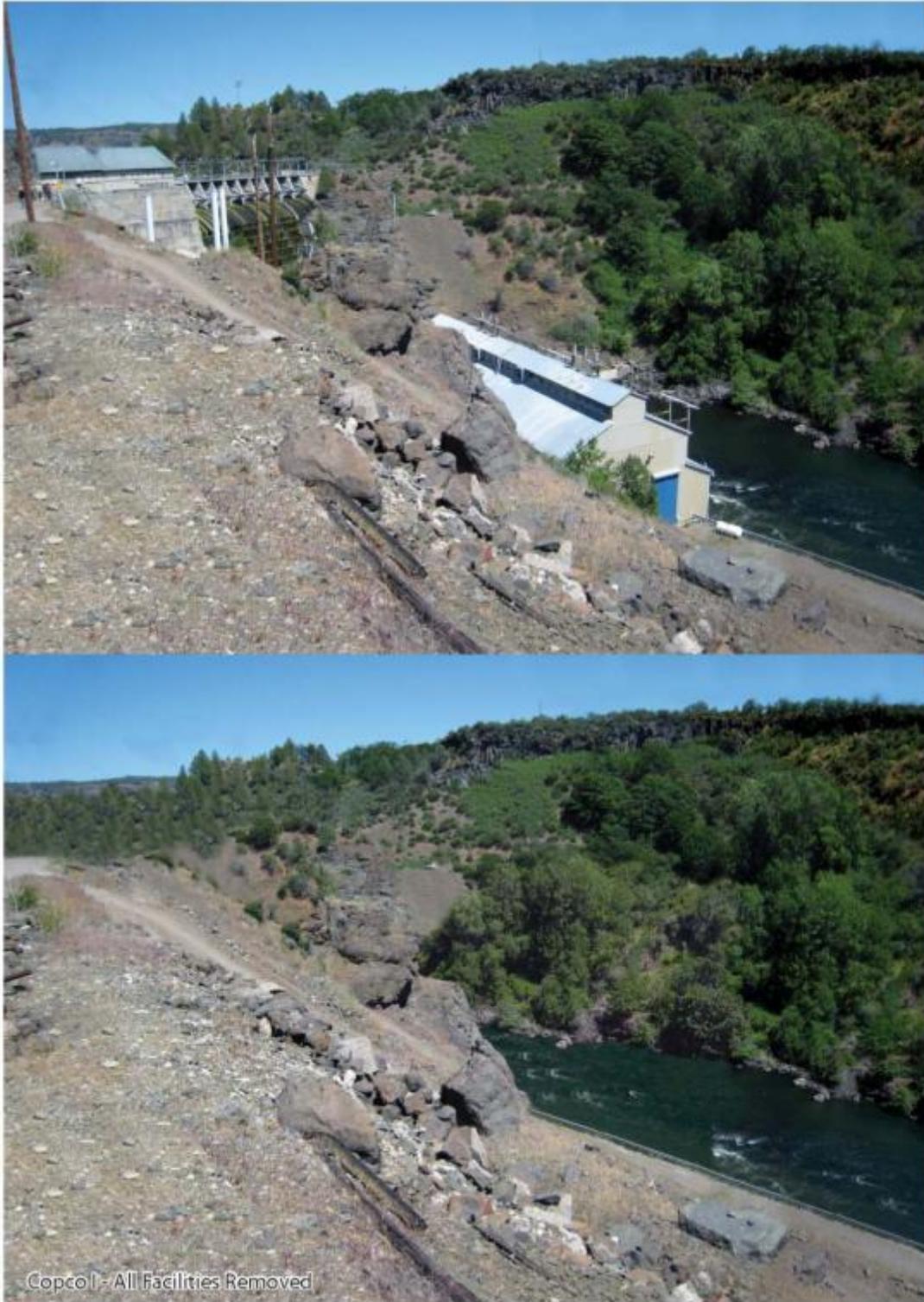
In addition, the existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and would have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline would be suspended from a pipe bridge across the river near its current location. Surveys are still required to determine if the bridge is adequate to support the construction traffic from the decommissioning activities. If the existing wooden bridge is not adequate to support the construction traffic, it will be replaced in the same location with a concrete bridge. In addition, the Proposed Action includes relocation of recreation facilities, such as campgrounds and boat ramps, currently located on the reservoir banks down slope to be near the new river bed once the reservoir is removed. Activities described in the KBRA are included in the Proposed Action as connected actions.

*The Proposed Action would result in impacts on scenic resources from removal of the dams and facilities.* Under existing conditions, some of these facilities do not blend with the natural landscape and can dominate views due to their form, line, color, size or locations, particularly those that appear taller than other natural features from a distance. Since the facilities are inconsistent with the VRM classification for the surrounding area, their removal would result in a landscape that would appear more similar to the surrounding characteristic natural landscape. Figures 3.19-6 and 3.19-7 show photo-simulations of the removal of Iron Gate Dam and Copco 1 Dam, respectively. **Removal of the facilities as part of the Proposed Action would be a beneficial effect.**

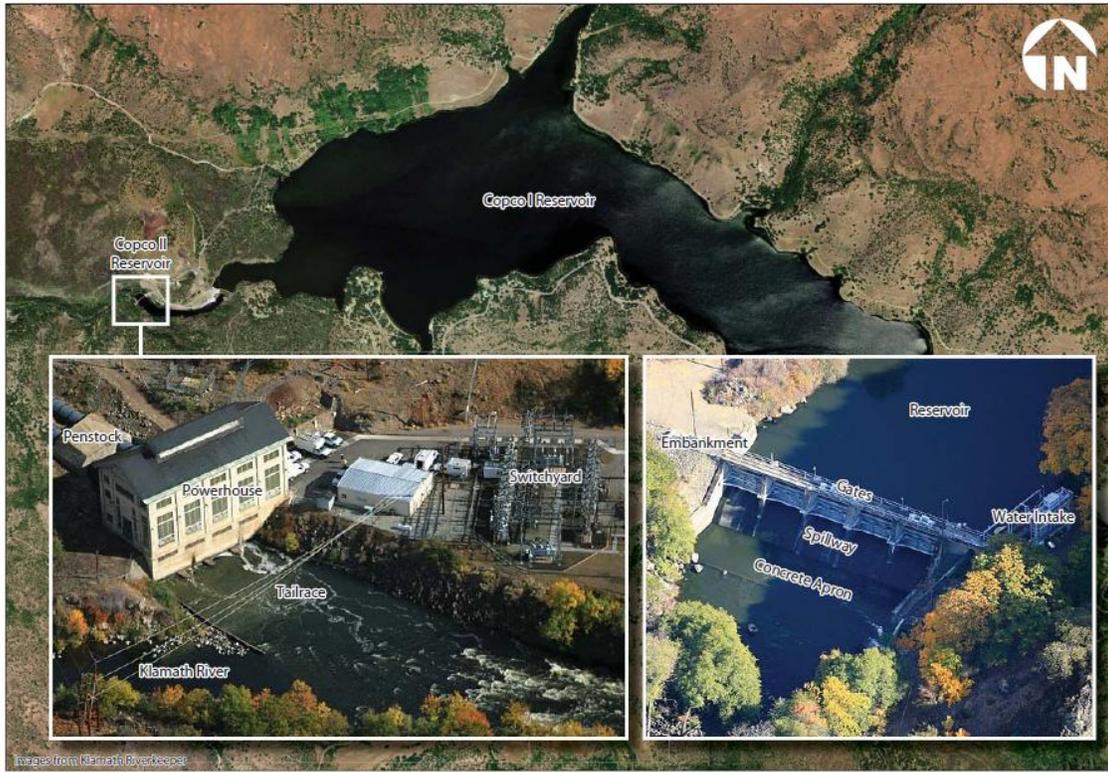
*The Proposed Action would result in impacts on scenic resources from the removal of some historic properties.* Some of the facilities (the Copco 2 facilities shown in Figure 3.19-8, for example) are considered historic properties (FERC 2007), and their removal would require consultation with the California State Historic Preservation Office (see Section 3.13, Cultural and Historic Resources). In general, the BLM VRM process is based upon the premise that natural appearing landscapes are more highly valued by the public than modified landscapes. Therefore, the removal of buildings to be replaced by natural landscape would be preferred. However, some historic scenery elements may be considered socially valued and their elimination from the scenic character would be considered a significant scenery impact of the project. **The impact on historic properties would be a permanent significant impact. No mitigation measures could be implemented to lessen the visual impact of the loss of historic properties; therefore it would be significant and unavoidable.**



**Figure 3.19-6. Iron Gate Dam before removal (top) and a simulation of what the facility could look like after full removal (bottom)**



**Figure 3.19-7 Copco 1 Dam before removal (top) and a simulation of what the facility could look like after full removal (bottom)**



**Figure 3.19-8. View of Copco 2 Powerhouse and Historic Structure**

*Removal of the Four Facilities could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.* The Proposed Action would include removal of the dams' associated reservoirs, and substantial changes would occur in the former reservoir area during drawdown and until restoration is complete. The Klamath River in the vicinity of the reservoirs would be reduced to its historic channel width and depth (see Section 3.6, Flood Hydrology), exposing all previously inundated areas except the historic river channel. The receding water would expose reservoir sediments at the bottom of the reservoir. Since sediment in the reservoirs is less than five feet deep in general, the river channel would not appear to be entrenched or flowing through mud, but rather, would appear very similar to conditions before the river was impounded (with exception of vegetation not yet becoming established). Depending on the sediment, odors may be evident while the reservoir bottoms dry out and new vegetation is established (riverside revegetation planned as part of the project is described below). Erosion of the reservoir sediment and slumping of the sediment is anticipated, followed by drying, cracking, and hardening of the sediment prior to the establishment of vegetation. Existing wetland vegetation on the reservoir shorelines may also die off temporarily, though it may repopulate the newly formed exposed banks (United States DOI 2011).

The Proposed Action would involve stabilizing and revegetating the newly exposed reservoir areas with herbaceous and woody vegetation. Until the restoration was complete, however, the area would appear barren and/or sparsely vegetated. The facilities removal schedule estimates that removal of the facilities and appurtenant structures would be completed in stages and would take approximately a year and a half with the objective of revegetation of 75 percent of the reservoir area by desirable vegetation that would provide minor and temporary scenery improvements within three years following dam removal. As discussed, establishment of woody vegetation with cover and density similar to adjacent natural woodlands would take many years to attain. This schedule translates to approximately four and a half years during which the area of analysis would be in a highly visible state of transition, and several more years where contrast from adjacent natural woodlands would be evident. The exposure of previously inundated areas would be considered a moderate contrast from the existing condition because it would dominate the landscape and would encompass a large area surrounding the river. It would likely be visible from various KOPs around each of the reservoirs.

Although revegetation of herbaceous species in barren and/or sparsely vegetated areas may be achieved in the short-term (one to three years), it should be noted that this is not necessarily consistent with restoration of natural appearing vegetation patterns below and above the reservoir line. Natural appearing vegetation patterns with woody riparian vegetation may take long-term (10 to 50+ years) to develop. Although the condition is considered temporary because the characteristic landscape is expected to be rehabilitated, some adverse scenery impacts would be extensive and long-term. In a report prepared for the California State Coastal Conservancy, Philip Williams and Associates, LTD estimated that it will take 30 years for the river corridor habitats to fully recover from the dam removals (Phillip Williams and Associates [PWA] 2009). **The impact on scenic resources would be a significant impact that would occur in both the short and long term, until vegetation has become established. No mitigation measures could be implemented to lessen the impact on scenic resources; therefore it would be significant and unavoidable.**

*Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.* Removal of the dam facilities and associated structures would be completed in stages over one year, with primary deconstruction activities occurring over a three-month period. During the deconstruction, the area of analysis would have large construction vehicles and equipment, temporary structures (e.g., trailers, portable toilets, security fencing, temporary power supply, fueling stations), temporary access roads, equipment storage areas, material stockpiles, piles of demolition materials (rock, concrete, steel), and other common construction items that would detract from the natural surroundings. The construction activities would be considered weak to strong contrasts, depending on the amount of vehicles, equipment, and materials in any given area. Some stockpiling areas may be visible but may not stand out in some areas because the color and form of the materials may blend in to the surrounding landscape. However, typically temporary stockpiling of dam fill materials, larger vehicles, and equipment would be a moderate to strong contrast as the color and form would stand out substantially from the existing landscape. Some scenic resources,

such as trees, rocks, and vegetation, particularly in the immediate vicinity of the dams, would need to be removed. Dust emissions from project activities may also temporarily impact views and enjoyment of the river. However, as part of the decommissioning plan, prior to initiation of deconstruction or construction activities, the contractor will be required to prepare and implement a worker Health and Safety Plan prior to the start of construction activities. The Health and Safety Plan will include proper housekeeping and best management practices (BMPs) to keep the construction areas orderly and suppress dust emissions, as required.

During deconstruction, the area would be inconsistent with the VRM classification for the surrounding area. After construction, all vehicles, equipment, and stockpiles would be removed and the area would be restored. **The impact on scenic resources would be significant; this impact would occur temporarily, until deconstruction was complete. No mitigation measures could be implemented to lessen the impact on scenic resources; therefore it would be significant and unavoidable in the short term. As described above, removal of the facilities would benefit scenic resources in the long term through the restoration of the characteristic natural landscape.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources.* The new prefabricated steel pipe bridge would likely be three spans with a center span of 200 feet and two end spans of 100 feet. The spans would be supported on concrete piers. The new pipeline would be connected to the existing buried pipeline at each end of the bridge. New structures would be painted (or manufactured) to blend with the natural color of the landscape. **The impact on scenic quality would be a significant impact that would occur in both the short and long term. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore it would be significant and unavoidable.**

*Replacement of the existing wooden Lakeview Bridge just downstream of Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.* If it is determined that the Lakeview Bridge is not adequate to support the construction traffic from the decommissioning activities, it would be replaced with a concrete bridge in the same location. There would be short-term significant impacts on scenic quality during construction from the presence of construction equipment. Long-term impacts on scenic quality from the change from a wooden to concrete bridge would be less than significant. **The impact on landscape would be a temporary significant and unavoidable impact; however, in the long-term impacts on scenic quality would be less than significant.**

*Relocation of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.* There would be short-term significant impacts on scenic quality during construction of the new recreation facilities from the presence of construction equipment and temporary loss of vegetation. In the long-term, impacts on scenic quality from the change of location of the recreation facilities from the reservoir

shoreline to the river shoreline would be less than significant. **The impact on landscape would be a temporary significant and unavoidable impact; however, in the long-term impacts on scenic quality would be less than significant.**

*Deconstruction could create a new source of light or glare that could adversely affect nighttime views in the area.* Temporary lighting would be erected for nighttime activities, and security lighting might be required during deconstruction. This light could cause glare that would adversely affect day or nighttime views in the area, particularly for visitors and residents whose homes are near the dam sites, such as the residences near the Copco Development. **The impact on nighttime views would be a significant impact that would occur temporarily, until deconstruction was complete. Mitigation Measure SQ-1 would reduce this impact to less than significant.**

*Drawdown and removal of the four reservoirs could cause temporary changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.* As part of the Proposed Action, the reservoirs would be drawn down, allowing the Klamath River to return to a natural channel depth and width. Hydrologic modeling (see Section 3.6, Flood Hydrology) indicates that the flows in the Klamath River would not be expected to be substantially different from historic conditions after the effects of the initial drawdown passed. Water flow levels are expected to remain very similar to current flow levels and the existing river channel configuration patterns would likely be continued. In the short-term, water aesthetics (clarity, turbidity (depth of view), and color) in the receding reservoir and downstream river reaches would likely be affected as the sediment behind the dams erodes and washes downstream (see Section 3.2, Water Quality). In addition to reducing water clarity for a few weeks, the temporary pulse of sediment could also cause possible short term deposition in eddies and slack water pools until subsequent annual flood events move the sediment to the ocean. Depending on the severity of the color change, this would represent a weak to moderate contrast from the existing condition and could be visible from quite a distance, especially from higher elevation viewpoints along the river canyon. **The impact on the appearance of the Klamath River would be a temporary significant impact. No mitigation measures could be implemented to lessen the impact on scenic resources; therefore it would be significant and unavoidable. The impact on scenic resources would be temporary but remain significant and unavoidable.**

*Removal of the dams and facilities could result in long-term impacts on scenic resources from changes to water quality.* As described in Section 3.2, Water Quality, removal of the dams at the Four Facilities is expected to improve water quality in the long-term. The changes are expected to reduce the river's summer algae concentrations, resulting in changes in both water clarity and coloration. An improvement in water quality could result in some improvement in scenic resources, such as water clarity or fish viewing opportunities. These improvements would be most noticeable from on-river and riverside viewpoints, and much less noticeable from river canyon roadway and community viewpoints. **Improvements to water quality would have a beneficial effect on scenic resources.**

### **Keno Transfer**

*The Keno Transfer could have adverse effects to scenic quality.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on scenic quality compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSA Section 7.5.4). **Therefore, the transfer of Keno to the DOI would result in no change from existing conditions.**

### **East and West Side Facilities**

*The decommissioning of the East and West Side Facilities could have adverse effects on scenic quality.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. There will be temporary visual resource effects during facility deconstruction activities. Long-term effects would be dependent on future land use, which is not identified at this time. **Therefore, the decommissioning of the East and West Side Facilities would have a less than significant effect on scenic quality.**

### **KBRA**

The KBRA, which is a component of the Proposed Action, includes several programs that could result in impacts on scenic resources, including:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management
- Fish Entrainment Reduction
- Wood River Wetland Restoration
- Water Diversion Limitations
- On-Project Plan
- Water Use Retirement Program (WURP)
- Interim Flow and Lake Level Programs
- Klamath Tribes Interim Fishing Site

### **Phases I and II Fisheries Restoration Plans**

*Construction activities associated with the Fisheries Restoration Plan - Phase I and Phase II could result in impacts on scenic resources.* The Fisheries Restoration Plan would include measures to restore riparian and floodplain vegetation throughout the Klamath Basin. Actions that could have impacts on scenic resources within the project area include those where construction or restoration activities would occur, due to the presence of construction equipment and temporary loss of vegetation. These actions include the following:

- Floodplain rehabilitation
- Wetland and aquatic habitat restoration
- Woody debris placement

- Fish passage correction
- Cattle exclusion fencing
- Mechanical thinning and prescribed burning
- Road decommissioning
- Gravel augmentation

These actions would result in temporary impacts on scenic resources within localized construction areas. The restoration actions would not occur in the same location or at the same time as the hydroelectric facility removal actions to contribute to or change potential effects of dam removal on scenic resources. **Therefore, impacts on scenic resources would be less than significant during construction.**

*The Fisheries Restoration Plan- Phase I and Phase II could result in long-term impacts on scenic resources.* These programs are intended to benefit fish populations and therefore increase fish viewing opportunities, which would result in beneficial effects to scenic resources. In addition, actions are anticipated to result in scenery more consistent with the naturally established, characteristic landscape. These actions would not occur in the same location as hydroelectric facility removal actions and would not affect any scenic improvements as a result of dam removal. **However, they are anticipated to result in beneficial effects to scenic resources.**

#### **Fisheries Reintroduction and Management Plan**

*Construction activities associated with fish collection facilities would introduce new features into the landscape.* Trap and haul operations within the Fisheries Reintroduction and Management Plan would require construction of fish collection and handling facilities at Keno and Link River Dams to seasonally move fish around Keno Impoundment and Link River during times of poor water quality. Constructing these facilities would result in temporary impacts on scenic resources at Keno and Link River Dams, and the fish handling facilities would remain in the long term to change the visual landscape. The handling facilities at Keno and Link River Dams would not be in the same visual area as the Four Facilities; therefore, construction of fish handling facilities would not compound the effects of facility removal actions. **The impacts on scenic resources would be less than significant during construction. However, the impact to scenic resources from the addition of the fish management structures could be a significant, permanent impact. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore, it would be significant and unavoidable.**

#### **Wood River Wetland Restoration**

*The Wood River Wetland Restoration Project could result in long-term impacts on scenic resources.* This project would be a new project designed to provide additional water storage for a total of 16,000 AF of storage in or adjacent to Agency Lake (see Section 2.4.3.8). Depending upon the final outcome of the project design it could provide additional wetland habitat with naturally established, characteristic landscapes beneficial to scenic resources. However, if changes result in more open water storage only (no

wetlands), this is not consistent with the naturally established, characteristic landscape. **Open water storage views would be a less than significant impact to scenic resources. This wetland restoration action would not occur in the same visual setting as the hydroelectric facility removal actions and would not affect scenic quality effects of dam removal.**

### **Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Program**

*Construction activities associated with the WURP could result in impacts on scenic resources.* Construction actions would include removal of juniper trees. This could result in temporary impacts on scenic resources within localized areas. Juniper removal actions would be in a different location from the removed hydroelectric facilities analyzed above, which would reduce the potential for any scenic quality impacts generated by juniper removal actions from contributing to the effects of facility removal. **Therefore, impacts on scenic resources would be less than significant during construction.**

*The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in long-term impacts on scenic resources.* Changes in land uses, including changes from rangeland to water storage areas, could occur under these programs. These actions would not occur at the same location or time as hydroelectric facility removal, which would reduce the potential for any scenic quality impacts generated by these programs from contributing to the effects of facility removal. **These changes have the potential to be beneficial if they result in landscapes (wetlands) that are consistent with the naturally established, characteristic landscape. However, if changes result in more open water storage only (no wetlands), this is not consistent with the naturally established, characteristic landscape and would be a less than significant impact to scenic resources.**

### **Fish Entrainment Reduction**

*Construction activities associated with Fish Entrainment Reduction could result in impacts on scenic resources.* Construction actions would result in temporary impacts on scenic resources within localized construction areas. Fish entrainment reduction construction actions would not occur at the same location or time as the hydroelectric facility removal actions. As a result, scenic quality impacts generated by these construction actions would not contribute to or change the scenic quality effects of facility removal actions. **Therefore, impacts on scenic resources would be less than significant during construction.**

*Fish Entrainment Reduction could result in long-term impacts on scenic resources.* This action is anticipated to benefit fish populations and therefore increase fish viewing opportunities, which would result in beneficial effects to scenic resources. However, the entrainment reduction facilities would likely be inconsistent with the naturally established, characteristic landscape, which would be an adverse effect. The installation of fish screens would occur at various existing water diversion structures for the Klamath Reclamation Project and would not result in a substantial change from existing

inconsistencies with natural landscapes. Entrainment reduction facilities would not be near the hydroelectric facilities and would not contribute to or change any scenic quality impacts of facility removal. **Impacts on scenic resources would be less than significant.**

#### **Klamath Tribes Interim Fishing Site**

*Construction activities associated with the Klamath Tribes Interim Fishing Site could result in impacts on scenic resources.* Construction actions would result in temporary impacts on scenic resources within localized construction areas. This construction action would not occur in the same location or at the same time as the hydroelectric facility removal actions. As a result, it would not contribute to or change any scenic quality impacts of facility removal. **Impacts on scenic resources would be less than significant during construction. In the long-term changes generated by the presence of the interim fishing site would be anticipated to retain consistency with the naturally established, characteristic landscape and would be a less than significant.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

Under the Partial Facilities Removal of Four Dams Alternative, certain project features would be retained, while providing the requirements for a free-flowing river and for volitional fish passage through all four dam sites. Table 3.19-2 summarizes which facilities would be retained under the Partial Facilities Removal of Four Dams Alternative.

Figure 3.19-6 and 3.19-7 show photo-simulations of the partial removal of Iron Gate Dam and Copco 1 Dam, respectively.

*The Partial Dam Removal Alternative could result in impacts on scenic resources from the removal of the four dams and some facilities.* Impacts on scenic resources would be similar to the Proposed Action. The facilities which remain could continue to be inconsistent with the VRM classification for the surrounding area. Removal of some facilities would result in a landscape that would appear more similar to the surrounding characteristic natural landscape. **Therefore, there would be a beneficial effect on scenic resources.**

**Table 3.19-2. Summary of Features that Would Be Removed under the Proposed Action Alternative and that would be Retained under the Partial Facilities Removal Alternative**

Feature	Proposed Action - Full Facilities Removal	Partial Facilities Removal
<b>J.C. Boyle</b>		
- Steel Pipeline and Supports	Remove	Retain
- Powerhouse	Remove	Retain
- Tailrace Channel Area	Remove	Retain
- Power Conveyance Intake	Remove	Retain
- Canal Intake (Screen) Structure	Remove	Retain
- Canal Spillway Channel Area	Remove	Retain
- Tailrace Flume Walls	Remove	Retain
<b>Copco 1</b>		
- Powerhouse	Remove	Retain
- Powerhouse intake structure	Remove	Retain
- Penstocks	Remove	Retain
- Diversion Intake and Gate Structure	Remove	Retain
<b>Copco 2</b>		
- Steel Penstock, Supports and Anchors	Remove	Retain
- Powerhouse	Remove	Retain
- Embankment Section	Remove	Retain
- Switchyard	Remove	Retain
- Tunnel Intake Structure	Remove	Retain
<b>Iron Gate</b>		
- Powerhouse	Remove	Retain
- Fish Hatchery	Retain	Retain

Source: River Design Group. 2010a.

*Under the Partial Dam Removal Alternative the DRE would remove some of the historic properties. (see Section 3.13, Cultural and Historic Resources) In general, buildings are considered visually dominant modifications to the naturally established “characteristic landscape”, however, some facilities could be identified as positive scenery attributes. Therefore, the effects related to the removal of historic properties could be positive, negative, or neutral to scenic resources depending on the historic building. For example, the Copco 2 powerhouse is often perceived as a positive scenery attribute while the J.C Boyle powerhouse is not (compare Figures 3.19-8 with 3.19-9). Under the Partial Facilities Removal Alternative, the J.C. Boyle powerhouse, Copco No. 1 powerhouse, and Copco No. 2 powerhouse would remain as visually dominant modifications to the naturally established “characteristic landscape”. The facilities which remain could continue to be inconsistent with the VRM classification for the surrounding area. The condition of the remaining structures could degrade over time, particularly the facilities*

that would no longer be in use (J.C. Boyle powerhouse and Copco No. 2 powerhouse), and would likely not receive as much maintenance as the facilities still in use. **The impact on historic properties would be a permanent significant impact. No mitigation measures could be implemented to lessen the visual impact of the loss of historic properties; therefore, it would be significant and unavoidable.**



**Figure 3.19-9. View of J.C. Boyle Powerhouse**

*Removal of the Four Facilities could result in short and long term impacts on scenic resources in formerly inundated reservoir areas.* The effects would be similar to the Proposed Action. **The impact on scenic quality would be a significant impact that would occur in both the short and long term, until vegetation has become established. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore it would be significant and unavoidable.**

*Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.* Deconstruction activities would not meet the VRM classification for the surrounding area. **This impact would occur temporarily, until deconstruction was complete. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore it would be significant and unavoidable in the short term.**

*Construction of a new, elevated of a City of Yreka water supply pipeline and steel pipeline bridge could result in impacts on scenic quality.* The impact on the scenic quality would be the same as the Proposed Action. **It would be a significant impact that would occur in both the short and long term. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore it would be significant and unavoidable.**

*Replacement of the existing wooden Lakeview Bridge could result in impacts on scenic quality.* The impact on the scenic resources would be the same as the Proposed Action. **The impact on the landscape would be a temporary significant impact; however, the long term impact on scenic quality would be less than significant.**

*Relocation of existing recreation facilities could result in impacts on scenic quality.* The effects on scenic resources would be the same as for the Proposed Action. **The impact on the landscape would be a temporary significant impact; however, the long term impact on scenic quality would be less than significant.**

*Deconstruction could create a new source of light or glare that would adversely affect nighttime views in the area.* The effects would be the same as the Proposed Action. **This would be a significant impact that would occur temporarily, until deconstruction was complete. Mitigation Measure SQ-1 would reduce this impact to less than significant.**

*Drawdown and removal of the four reservoirs could cause temporary changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.* The effects would be the same as those described for the Proposed Action. **The impact on the Klamath River would be a temporary significant impact. No mitigation measures could be implemented to lessen the impact on scenic resources; therefore, the impact on scenic quality would be temporary but significant and unavoidable.**

*Partial Removal of the Four Dams Alternative could result in water quality impacts that could have long-term impacts on scenic resources.* The effects would be the same as those described for the Proposed Action. **Restoring the river's water quality would have a beneficial effect on scenic quality.**

#### **Keno Transfer**

The effects of the Keno Transfer to visual resources would be the same as under the Proposed Action

#### **East and West Side Facilities**

The effects of East and West Side Facilities decommissioning would be the same as for the Proposed Action.

**KBRA**

Under the Partial Facilities Removal of Four Dams Alternative, the KBRA would be fully implemented and the effects would be similar to those described for the Proposed Action.

**Alternative 4: Fish Passage at Four Dams**

Under the Fish Passage at Four Dams Alternative, no facilities removal (except for demolition of existing fish ladders) would be conducted at the Four Facilities. Fishways would be built at each of the four dams in the form of pool and weir, vertical slot, ice harbor, or hybrid fish ladder with auxiliary water systems.

*Continued impoundment at the reservoirs would result in water quality impacts that could have long-term impacts on scenic quality.* As described in Section 3.2, Water Quality, water quality conditions would remain the same as the under the No Action Alternative. **There would be no change from the existing condition.**

*Continued existence of the buildings and other man-made structures could have the impact that some areas would remain inconsistent with the VRM classification of the surrounding area.* In general, retained structures and facilities would not benefit scenic quality since they are visually dominant modifications to the naturally established “characteristic landscape”. In addition, under the Fish Passage at Four Dams Alternative, PacifiCorp’s analysis (2004) identified some project features as being currently not consistent with the VRM classification of the surrounding area. Therefore, the areas with these structures would not be able to achieve consistency with the VRM classification of the surrounding area. **There would be no change from the existing condition.**

*Demolition, construction, and restoration activities for the fishways could cause short-term adverse effects on the scenic vistas in the immediate vicinity of the Four Facilities.* Under the Fish Passage at Four Dams Alternative, selective demolition would be required to accommodate modifications for the fishways and appurtenances. Demolition and construction would be completed within one year. During construction, the area of analysis could have large construction vehicles and equipment, temporary structures (e.g., trailers, portable toilets, security fencing, temporary power supply, and fueling stations), temporary access roads, equipment storage areas, material stockpiles, and other items that would detract from the natural surroundings in terms of visuals, noise, and smells. Bare soil expanses would be visible where temporary roads were constructed, and where excavated soil was moved. Some scenic resources, such as trees, rocks, and vegetation in the work area could be removed. The construction activities would be considered moderate contrasts as the color and form of vehicles and equipment would stand out from the existing landscape but would be unlikely to be visible from great distances. **The impact on scenic resources would be significant; this impact would occur temporarily, until construction was complete. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore it would be significant and unavoidable.**

*Construction could create a new source of light or glare that could adversely affect nighttime views in the area.* Temporary lighting would be erected for nighttime

activities, and security lighting might be required during deconstruction. This light could cause glare that would adversely affect day or nighttime views in the area. This effect could affect visitors and residents whose homes are near the dam sites, such as the residences near the Copco Development. **The impact on nighttime views would be a significant impact that would occur temporarily, until deconstruction was complete, but Mitigation Measure SQ-1 would reduce this impact to less than significant.**

*Construction of fishways could cause changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.* No long-term changes to the water levels in the reservoirs and downstream river reaches would be expected with the construction of the fish fishways. In the short-term water aesthetics (clarity, turbidity (depth of view), and color) in the reservoir and downstream river reaches could be affected by construction in the waterways. It is anticipated that gravity diversions, coffer dams, physical barriers (e.g., sand/gravel bag berms, sheetpiling, concrete blocks), and pumps would be required to isolate and/or dewater work areas for the water intakes and construction of the V-screens within the reservoirs. In addition, nets or screens would be required to prevent aquatic organisms from entering the work area. All of this equipment could cause short-term scenic and water quality impacts while employed. Any change in color from increased sediment would represent a weak contrast from the existing condition because it would likely not be visible for long distances and would occur on a small scale. Additionally, implementation of a Stormwater Pollution Prevention Plan and other measures described in Water Quality would reduce the impacts associated with clarity and color changes. **The impact on the appearance of the Klamath River would be a less than significant, temporary impact.**

*Fishways could cause substantial long-term impacts on scenic resources.* The addition of the fishways would change the scenic character in the vicinity of the dams by adding hardscape elements that would blend with the facility features but would not blend with the natural landscape and could dominate views due to their size. At Copco 1 and Iron Gate Dams, the fishway structures would be particularly large (see Table 3.19-3) in order to accommodate the vertical drops, which would be 124 feet and 157 feet, respectively. Figures 2-21 (J.C. Boyle), 2-22 (Copco 1), 2-24 (Copco 2), and 2-26 (Iron Gate) from Chapter 2, Proposed Action and Description of the Alternatives, show conceptual layouts for the fishways.

**Table 3.19-3. Minimum Structure Footprint for Fish Ladders under the Fishway Alternatives**

Dam	Minimum Structure Footprint (sq. ft.)
<b>Fishway at Four Dams</b>	
J.C. Boyle	8,712
Copco 1	17,928
Copco 2	3,168
Iron Gate	22,608
<b>Total</b>	<b>52,416</b>
<b>Fishway at Two Dams</b>	
J.C. Boyle	8,712
Copco 2	3,168
<b>Total</b>	<b>11,880</b>

Source: River Design Group 2010b.

Although the fishways have not yet been designed, they likely could display angular geometry, continuous straight lines, and flat surfaces that may moderately contrast with the colors, forms, and textures of the surrounding characteristic landscape, or may be insignificant compared to scenery impacts of the existing dam facilities. Installation of V-screens at J.C. Boyle, Copco 2 and Iron Gate and a floating surface bypass collector at Copco 1 would introduce new permanent facilities near the existing intakes visible from the surface of each reservoir but would not be anticipated to dominate the landscape given their relative scale when compared to the dam facilities. Example cast in place pool and weir fish ladders that are proposed for use at the four dams are shown in Figures 3.19-10 and 3.19-11. **The impact to scenic resources from the addition of the fishways could be a significant, permanent impact. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore it would be significant and unavoidable.**

**Trap and Haul – Programmatic Measure**

*Construction activities associated with fish collection facilities would introduce new features into the landscape.* Trap and haul operations would require construction of fish collection and handling facilities at Keno and Link River Dams to seasonally move fish around Keno Impoundment and Link River during times of poor water quality. Constructing these facilities would result in temporary impacts on scenic resources at Keno and Link River Dams, and the fish handling facilities would remain in the long term to change the visual landscape. **The impacts on scenic resources would be less than significant during construction. However, the impact to scenic resources from the addition of the fish management structures could be a significant, permanent impact. No mitigation measures could be implemented to lessen the impact on scenic quality; therefore, it would be significant and unavoidable.**



**Figure 3.19-10. Example of cast in place pool and weir fish ladder used for fish passage, similar to that proposed for upstream fish passage for all four dams under this alternative**



**Figure 3.19-11. Example of fish ladder built into steep bedrock similar to Copco 1 option (photo courtesy of GEI Consultants)**

**Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, all facilities would be removed at Copco 1 Dam and Iron Gate Dam, and fish passage facilities would be constructed at J.C. Boyle and Copco 2 Dams.

The effects of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be similar to those of the Proposed Action and the Fish Passage at Four Dams Alternative.

*As with the Proposed Action, demolition of Copco 1 and Iron Gate Dams could have long-term scenic effects, including the removal of two dams and reservoirs, and changes from reservoir to river views in the areas near Copco 1 and Iron Gate Dams. **Restoring natural riverine scenery would be a beneficial effect.***

*As with the Fish Passage at Four Dams Alternative, the addition of fishways at the J.C. Boyle and Copco 2 Developments could have long-term impacts on scenic resources. **Mitigation measures may be implemented to lessen the impact on scenic resources; however, the adverse impact on scenic quality could be significant, depending upon size, location and design of fishway facilities. Therefore, the impact on scenic resources could be significant and unavoidable.***

*Temporary deconstruction and construction scenic impacts would be similar to those under the Proposed Action for Copco 1 and Iron Gate Dams sites and could be significant. **No mitigation measures could be implemented to lessen these temporary impacts on scenic quality; therefore they would be significant and unavoidable.***

*Some areas would remain inconsistent with the VRM classification of the surrounding area. The project features that are currently inconsistent with their VRM classification and would remain as visually dominant modifications to the naturally established “characteristic landscape” are: the J.C. Boyle powerhouse and penstocks, J.C. Boyle Dam, bypass canal, and transmission line and Copco No. 2 powerhouse and substation, and the Iron Gate Dam, bypass spillway, powerhouse, penstock, and associated landform and vegetation disturbances. **There would be no change from the existing condition.***

*Lighting impacts would be the same as those under the Proposed Action at the J.C. Boyle and Copco 2 sites and could be significant. **Mitigation measure SQ-1 would reduce this impact to less than significant.***

**Trap and Haul – Programmatic Measure**

*Construction activities associated with fish collection facilities would introduce new features into the landscape. The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. **The impacts on scenic resources would be less than significant during construction. However, the impact to scenic resources from the addition of the fish management structures could be a significant, permanent impact. No mitigation***

**measures could be implemented to lessen the impact on scenic quality; therefore, it would be significant and unavoidable.**

#### **3.19.4.4 Mitigation Measures**

The following mitigation measure would reduce the significant impact associated with light and glare to less than significant.

##### **Mitigation Measure by Consequences Summary**

*Mitigation Measure SQ-1* - To reduce nighttime light and glare on surrounding residences during construction, the DRE will require the use of reflectors, shields, directional lighting, or other appropriate methods to reduce glare. All lighting will be turned off when not in use and/or motion-controlled lighting will be used, where feasible. Permanent lighting needed for security will be selected to be “dark sky friendly<sup>1</sup>” to reduce glare to the surrounding area. “Dark sky friendly” lighting accessories or alternatives to typical lighting systems will be used, where feasible.

##### **Effectiveness of Mitigation in Reducing Consequences**

Implementation of mitigation measure SQ-1 would reduce nighttime light and glare on surrounding residences to less than significant.

##### **Agency Responsible for Mitigation Implementation**

The DRE will be responsible for implementing mitigation measure SQ-1.

##### **Remaining Significant Impacts**

The temporary, short-term impacts from deconstruction, construction, and restoration remain significant and unavoidable as no feasible mitigation can reduce the impacts to less than significant without changes to the construction schedules. The long-term changes in scenic resources, including removal of facilities and changes from reservoir to river views under some alternatives would be significant and unavoidable.

##### **Mitigation Measures Associated with Other Resource Areas**

Several other mitigation measures involve construction work, including mitigation measures H-2 (flood-proof structures), GW-1 (deepen or replace affected wells), WRWS-1 (modify or screen affected water intakes), PHS-4 (repair damaged roads), PHS-5 (construct water storage tanks for firefighting), REC-1 (develop new recreational facilities and access to river), TR-6 (assess and improve roads to carry construction loads), and TR-7 (assess and improve bridges to carry construction loads). Construction equipment associated with the mitigation measures would detract from the natural surroundings. The construction activities would be considered weak to moderate contrasts, depending on the amount of vehicles, equipment, and materials in any given area. Effects would be temporary and would not disrupt large expanses of the natural setting. The impact on scenic quality from implementation of mitigation measures listed above would be less than significant.

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<sup>1</sup> <http://www.darksky.org/mc/page.do?sitePageId=118983&orgId=idsa>

### 3.19.5 References

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## 3.20 Recreation

### 3.20.1 Area of Analysis

The recreational setting within the Klamath Basin is characterized by an expansive rural landscape that offers a myriad of outdoor recreational opportunities. Within the basin, there are five national forests (Klamath, Fremont, Winema, Six Rivers, and Modoc), one joint national and state park (Redwood), one national park (Crater Lake), two national monuments (Lava Beds and Cascade - Siskiyou), five National Wildlife Refuges (NWRs) (Klamath Marsh, Tule Lake, Clear Lake, Upper Klamath, and Lower Klamath) that make up the Klamath Basin NWR System, 297 miles of Klamath River Wild and Scenic Rivers (WSR) (segments of the Klamath, Scott and Salmon Rivers and Wooley Creek analyzed as those WSR segments most likely to be affected by the proposed alternatives), and extensive public and private recreational opportunities along the Klamath River and its reservoirs. Federal and state agencies, including the United States Forest Service (USFS), Bureau of Land Management (BLM) (including the Northern California District, and Lakeview and Medford Districts in Oregon), United States Fish and Wildlife Service (USFWS), and California Department of Fish and Game (CDFG), are responsible for managing these lands which are located in Klamath and Jackson Counties, Oregon, and Siskiyou County, California. Figure 3.14-1 in Section 3.14, Land Use, Agriculture and Forest Resources, shows the management of lands in the Klamath Basin. The analysis of potential effects on WSR components are discussed in the following subsections and pages of this section:

- Scenic Quality - Section 3.20.4.3, pages 3.20-48 and 60
- Recreation – Section 3.20.4.3, pages 3.20-51 and 60
- Fisheries - Section 3.20.4.3, pages 3.20-53 and 60
- Wildlife - Section 3.20.4.3, pages 3.20-56 and 60

The area of analysis includes recreation areas and access along the Klamath River from its headwaters in Oregon to the mouth of the river at the Pacific Ocean. Recreational areas within and directly adjacent to the Klamath Basin are described to provide an overview of regional opportunities. Impacts on recreation opportunities as a result of the alternatives would be limited to those within the Klamath River corridor; therefore, the analysis focuses on those recreational facilities and opportunities adjacent to the Klamath River. Descriptions of recreational opportunities, activities, and settings are presented here by geographic location, including within the Klamath Basin, upstream of J.C. Boyle Reservoir, between J.C. Boyle Reservoir and Iron Gate Dam, and downstream of Iron Gate Dam. Section 3.20.4.3 presents an assessment of potential impacts of the alternatives, including the Proposed Action to remove J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams (the Four Facilities), on recreational resources.

### **3.20.2 Regulatory Framework**

Recreation within the area of analysis are regulated by several federal, state, and local policies, which are listed below.

#### **3.20.2.1 Federal Authorities and Regulations**

- Wild and Scenic Rivers Act (WSRA) (16 U.S.C. 1271 et seq.)
- Federal Land Policy and Management Act (43 U.S.C. 1701 et seq.)
- U.S. Forest Service Six Rivers National Forest Land and Resource Management Plan
- U.S. Forest Service Fremont National Forest Land and Resource Management Plan
- U.S. Forest Service Klamath National Forest Land and Resource Management Plan
- National Park Service (NPS) General Management and Strategic Plan, Redwood National Park
- Federal Endangered Species Act (ESA)

#### **3.20.2.2 State Authorities and Regulations**

- California Wild and Scenic Rivers Act
- Oregon Parks and Recreation Department, Klamath River Scenic Waterway Rules

#### **3.20.2.3 Local Authorities and Regulations**

- City of Klamath Falls Parks Recreation and Open Space Master Plan

### **3.20.3 Existing Conditions/Affected Environment**

#### **3.20.3.1 Regional Opportunities**

Rivers, streams, and lakes are common throughout the mountainous landscape, and grasslands exist in the high plateau areas of the region. A large number of public lands are in the region, including five national forests, five NWRs, one national park, one joint national and state park, and two national monuments. These areas provide sightseeing, camping, hiking, fishing, wildlife viewing, and other recreational opportunities (Figure 3.20-1). In addition, a number of the lands have rivers or river segments designated as WSRs. Table 3.20-1 provides a summary of the opportunities offered on public lands within and adjacent to the Klamath Basin.

#### **River-Based Recreation**

A number of rivers cross the region, including four rivers with segments in the Klamath Basin designated as Wild and Scenic under Section 7 of the WSRA (Sprague River, Sycan River, Smith River, and Trinity River), as well as portions of the Klamath River (described above), designated as Wild and Scenic under Section 2(a)ii of the WSRA. Other rivers in the Klamath Basin, as shown on Figure 3.20-1 include the Salmon River, Scott River, and Clear Creek. These rivers provide a variety of recreational opportunities, including sightseeing, fishing, and whitewater boating. Figure 3.20-1 shows the location of these rivers relative to the Klamath River. Table 3.20-2 provides a summary of the rivers, the fish species caught, and the typical types of fishing methods (e.g., boat, bank, fly). Table 3.20-3 summarizes the whitewater boating opportunities in the region. The Oregon WSRs, in particular, have outstanding recreational and/or scenic values along the

length of the designated segments. The California WSRs are classified as wild, scenic, and recreational along the length of the designated segments (National Wild and Scenic Rivers 2011).

### **Reservoir-Based Recreation**

Numerous opportunities for reservoir and lake-based recreation are available in the vicinity of the Proposed Action area. Table 3.20-4 provides a summary of the lakes and reservoirs in the region, including facilities and use levels. Among Klamath County and Jackson County, Oregon and Siskiyou County, California, there are more than 85 boatable lakes, containing nearly 40 boat ramps (Boat Escape website 2002). The area also has more than 180 high-elevation and wilderness lakes in Siskiyou County (Federal Energy Regulatory Commission [FERC] 2007). In addition to boat ramps, these lakes provide nearly 2,300 developed campsites within less than a two-hour drive from the subject reservoirs. Some reservoirs in the region are also stocked with trout or warm water fish such as perch or bass. Angling occurs at the many lakes and reservoirs in the region and many are known for having excellent fisheries.

### **Federal- and State-Managed National Forests, Public Lands, and Parks** **Klamath National Forest**

The Klamath National Forest consists of about 1.7 million acres, and the 300 miles of rivers within the forest include 202 miles of designated WSR segments (see Section 3.20.3.5). The Klamath River flows for 107 miles through the Klamath National Forest west of Interstate 5 (I-5) to the National Forest's border at Ishi Pishi Falls. The Klamath National Forest provides uncrowded, high quality opportunities for sightseeing, fishing, wildlife viewing, whitewater and flatwater boating, hiking and horseback riding along 1,100 miles of trails, hunting, mountain biking, cross-country skiing, off-highway vehicle (OHV) and snowmobile use, mountain climbing, and spelunking. There are 34 developed campgrounds within the forest, and dispersed day and overnight use occurs in various locations throughout the forest (FERC 2007; U.S. Department of Agriculture [USDA] 2010).

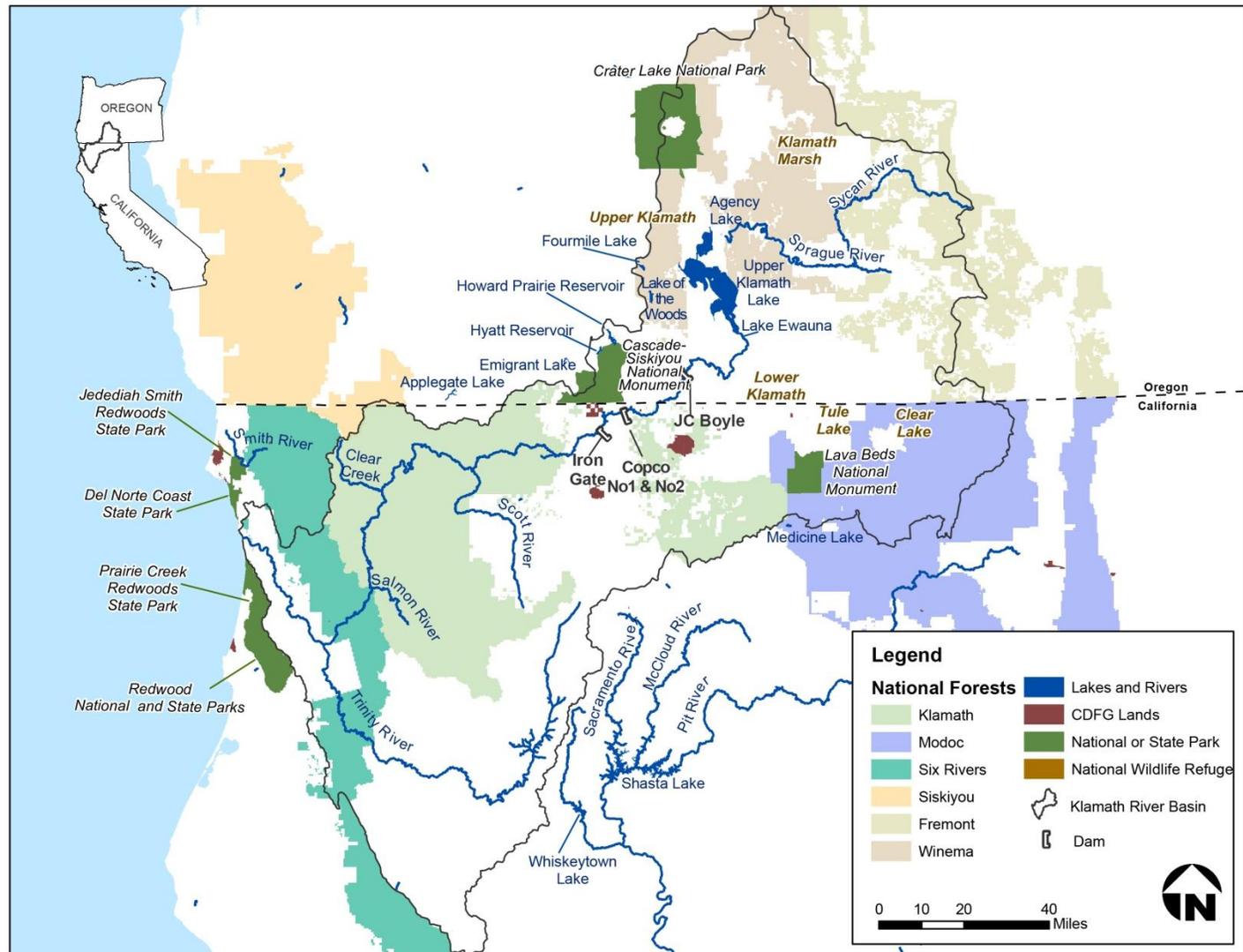


Figure 3.20-1. Regional Recreation Areas

**Table 3.20-1. Public Lands Offering Recreational Opportunities in the Vicinity of the Klamath River**

Name	Size	No. of Campgrounds	Recreational Activities Available											
			Sightseeing	Hiking	Picnic Areas	Fishing	Boating	OHV	Wildlife viewing	Skiing	Rock climbing	Mountain biking	Snow play	Other
Klamath National Forest	1.7 million acres	28	X	X		X	X	X	X	X	X	X	X	hunting, equestrian use, spelunking, golf
Fremont National Forest	1.2 million acres	1	X	X		X				X		X		hunting, equestrian use, backpacking, leisure driving
Winema National Forest	1.1 million acres	6	X	X	X	X	X			X			X	backpacking, snowmobiling
Six Rivers National Forest	1 million acres	5	X	X		X	X			X				hunting, backpacking
Lava Beds National Monument	46,500 acres	1	X	X						X		X		caving
Crater Lake National Park	183,000 acres	2	X	X						X		X		swimming, snowshoeing, snow camping
Klamath Marsh NWR	40,600 acres	0	X							X				waterfowl hunting, photography
Lower Klamath NWR	53,600 acres	0	X							X				waterfowl hunting, photography, automobile touring
Upper Klamath NWR	14,900 acres	0	X		X		X			X				waterfowl hunting, photography

**Table 3.20-1. Public Lands Offering Recreational Opportunities in the Vicinity of the Klamath River**

Name	Size	No. of Campgrounds	Recreational Activities Available											
			Sightseeing	Hiking	Picnic Areas	Fishing	Boating	OHV	Wildlife viewing	Skiing	Rock climbing	Mountain biking	Snow play	Other
Redwood National and State Parks	133,000 acres	4	X	X	X	X	X		X			X		backpacking, equestrian trails, scenic drives
BLM - Cascade-Siskiyou National Monument	53,000 acres	3	X	X		X	X		X	X	X	X		snowmobiling, equestrian use, hunting
BLM - Klamath Falls Resource Area	215,000 acres	5	X	X	X	X	X	X	X				X	rafting, swimming, snowmobiling

Key:  
OHV: off-highway vehicle  
NWR: National Wildlife Refuge  
BLM: Bureau of Land Management

**Table 3.20-2 Rivers Providing Recreational Fishing Opportunities in the Region**

River	Fish Species Caught <sup>1</sup>	Common Types of Fishing
McCloud River	Native trout	Fly fishing, bank fishing
Pit River	Native trout; brown trout; smallmouth bass; rough fish	Fly fishing, bank fishing
Rogue River	Chinook salmon, steelhead	Drift boat, powerboat, fly fishing
Salmon River	Chinook salmon, steelhead, resident trout	Fly fishing, bank fishing
Scott River	Chinook salmon, steelhead, resident trout	Fly fishing, bank fishing
Smith River	Chinook salmon, steelhead	Drift boat, powerboat, fly fishing, bank fishing
Trinity River	Chinook salmon, steelhead, sturgeon, American shad, lamprey	Drift boat, powerboat, fly fishing, bank fishing
Upper Sacramento	Chinook salmon, native and stocked trout, American shad	Fly fishing, bank fishing
Klamath River	Redband trout, salmon	Fly fishing, bank fishing, drift boat

Source: Federal Energy Regulatory Commission 2007

Note:

<sup>1</sup> Information is based on species caught within the 2003-2004 time period.

**Table 3.20-3 Rivers with Whitewater Boating Opportunities in the Region**

River	Generalized Use Levels	Boating Class Type <sup>1</sup>	Miles of Boatable Whitewater	Factors Affecting Use Levels
Clear Creek	Low	III-V	7	Difficult access
Klamath River (above CA/OR state line)	Moderate	III-IV+	31	Remote, not suited for beginner or intermediate boaters, unless accompanied by a commercial outfitter
Klamath River (downstream of Iron Gate Dam)	Moderate	II-V	122	Most skill levels, easy access, 186 miles support multi-day floats, shoreline camping, scenery, many outfitters, commercial use
North Umpqua River	Moderate	II-IV	32	Easy access, most skill levels, scenery, boatable year round, shoreline suitable for camping
McCloud River	Moderate	II-IV	35	Proximity to I-5, most skill levels, low flows in summer
Pit River	Low	IV-V	34	Fragmented/short runs with long stretches of flatwater between, remote location
Rogue River	High	II-V	100+	Easy access, most skill levels, scenery, boatable year round, shoreline suitable for camping, many commercial outfitters
Salmon River	Moderate	II-V	44	Requires advanced/expert boating skills, commercial use
Scott River	Low	III-V	20	Recommended for expert boaters only
Smith River	Low	II-V	100+	Requires advanced/expert boating skills, low summer flows
Upper Sacramento River	Low	III-V	36	Proximity to I-5, average solitude
Trinity River	Moderate	II-V	100+	Most skill levels, easy access, commercial use

Source: FERC 2007

Note:

<sup>1</sup> As rated by the American Whitewater International Scale of Difficulty (American Whitewater 1998).

**Table 3.20-4. Comparison of Subject Reservoirs with Lakes and Reservoirs in the Region**

Lake or Reservoir	Distance from Nearest Subject Reservoir (mi)	Surface Water (acres)	Number of Developed Campsites	Number of Developed/Improved Boat Launches	Number of Developed Picnic Areas	Generalized Use Levels
<b>Subject Reservoirs</b>						
J.C. Boyle	N/A	420	16	2	4	Low
Copco 1	N/A	1,000	0	2	2	Low
Copco 2	N/A	40	0	0	0	Low
Iron Gate	N/A	944	37	3	6	Moderate
<b>Other Lakes and Reservoirs in the Region</b>						
Hyatt Reservoir	15	1,250	172	2	1	Moderate
Emigrant Lake	16	806	110	2	2	Moderate
Howard Prairie Reservoir	17	2,000	303	4	1	Moderate
Upper Klamath Lake	20	85,120	269	6	1	Moderate
Lake of the Woods	21	1,113	190	3	1	High
Fourmile Lake	26	740	25	1	0	Low
Agency Lake	28	5,500	43	3	0	Low
Applegate Reservoir	36	988	66	3	1	Low
Medicine Lake	46	408	72	1	1	Low
Gerber Reservoir	62	3,830	50	2	1	Moderate
Trinity Lake Unit	73	16,535	500	7	2	Moderate
Whiskeytown Lake	87	3,200	139	3	1	Moderate
Shasta Lake	87	29,500	320	7	7	High
Lost Creek Reservoir	178	3,430	202	1	2	N/A
Willow Lake	31	927	66	7	8	N/A
Willow Valley Reservoir	69	200	1	1	1	N/A
Lake Siskiyou	46	160	1			N/A
Juanita Reservoir	14	55	23	2		N/A
McCloud Reservoir	58	520	6	1	1	N/A

Source: PacifiCorp 2004; Jackson County Parks 2010; VisitUsa.com 2010.

Key:

mi: miles

N/A: not available

### **Six Rivers National Forest**

Six Rivers National Forest encompasses more than 1 million acres of land located east of the redwood belt of northwestern California and the Hoopa Valley and Yurok Indian Reservations, and extends from the Oregon border south through Del Norte, Siskiyou, Humboldt, and Trinity Counties. The Klamath River runs for 20 miles through the Six Rivers National Forest west of Ishi Pishi Falls to the boundary of Hoopa Tribal lands. Recreational opportunities in the Six Rivers National Forest include 24 developed campgrounds, 400 miles of trails for hiking and sightseeing along 365 miles of designated WSRs, backpacking, whitewater boating on 100 miles of the Smith River and approximately 50 miles of the Trinity River, and world-class salmon and steelhead fishing and hunting opportunities. The Six Rivers National Forest is also home to many rare and endangered plants and flowers that are attractive for botanical tours (USDA 2009).

### **Redwood National and State Parks**

Redwood National Park is one of four park units jointly managed as Redwood National and State Parks under a cooperative management agreement between the NPS and the California Department of Parks and Recreation (California State Parks). Together with three state parks-Prairie Creek Redwoods, Del Norte Coast Redwoods, and Jedediah Smith Redwoods State Parks-the parks encompass 133,000 acres. These parks preserve the largest remaining sections of ancient coast redwood forest, including some of the world's tallest and oldest trees and provide forest and stream habitat for threatened and endangered birds and salmonids (NPS 2005). Recreational opportunities include four developed campgrounds, hiking, backpacking, horseback riding, scenic drives, visitor centers, and ranger-led programs designed to inform and inspire the public on this unique ecosystem (NPS 2009).

### **Fremont-Winema National Forest**

The Fremont-Winema National Forest is located in south-central Oregon on the eastern slopes of the Cascade Mountain range. The combined forest area consists of 2.3 million acres. The lowest elevations of the forest adjoin Upper Klamath Lake where there are marshes, lakes, forested slopes, and wide basins. There are 22 developed campgrounds and 9 day-use areas across the forest. Recreational opportunities include sightseeing, fishing, wildlife viewing, hiking, downhill skiing, and hang gliding (FERC 2007).

### **Modoc National Forest**

The Modoc National Forest is located along the California-Oregon State Line and is the most northeasterly of the national forest units in the Pacific Southwest Region. The forest area consists of approximately 2 million acres. The Modoc National Forest does not draw as large a volume of recreational travel compared to other forests closer to population centers, with the exception of the one-month open deer season which is known to attract as many as 10,000 hunters. Other recreational opportunities include fishing, camping, hiking, and sightseeing (USFS 2011).

### **BLM Klamath Falls Resource Area**

Located in the BLM Lakeview District, the BLM-administered lands of the Klamath Falls Resource Area are in southern Klamath County on the eastern slope of the Cascade Range. In addition to BLM-administered land (212,000 acres), there are 21,000 acres of non-federally-owned surface land underlain by subsurface federal mineral estate within the Resource Area that are also administered by the BLM (BLM 1995). The two main recreation areas located in the Klamath Falls Resource Area include the Klamath WSR and the Wood River Wetland (BLM 2011a). The Klamath WSR area is located 30 miles southwest of Klamath Falls. While travel is limited to rough gravel roads and jeep trails, the area is utilized for wildlife viewing, hunting, fishing, biking, hiking, and camping, among other recreational activities (BLM 2011a). The Klamath Falls Resource Area Management Plan (BLM 1995) lists 15 developed and semi-developed recreation sites including day-use and campsites, and four developed trails. The Wood River Wetland area is open to the public year-round for day-use only, and includes paved parking, a trail, a canoe launch, picnic areas, toilets, and interpretive signs (BLM 2011a). Recreational activities that take place at the Wood River Wetland area include wildlife viewing, botanical sightseeing, hunting, fishing, canoeing, hiking, and biking (BLM 2011a).

### **Cascade-Siskiyou National Monument**

Located in the BLM Medford District, the Cascade-Siskiyou National Monument was designated a national monument by presidential proclamation in 2000. The national monument is located where the Cascade, Klamath and Siskiyou mountain ranges converge and consists of 54,000 acres of BLM-administered lands (BLM 2011b). The area is recognized for its remarkable biological diversity and varied landscape, as well as important archaeological and historical resources. The Hyatt Lake Recreational Area is the only developed recreational site within the monument and includes many developed campgrounds (BLM 2008). The major recreational activities within the monument include camping, hiking, horseback riding, sightseeing, hunting, fishing, cross-country skiing, snowmobiling, rock climbing, and nature study (BLM 2008). The majority of the monument is undeveloped and visitor use is estimated as light to moderate throughout. The Hyatt Lake Recreational Area receives moderate use during April through October. In 2003, records show that over 14,000 people visited the recreational area (BLM 2008).

#### ***3.20.3.2 Recreation Opportunities along the Klamath River Segment Upstream of J.C. Boyle Reservoir***

##### **Recreation Facilities and Opportunities**

Upstream of J.C. Boyle Reservoir, a small number of developed recreational facilities exist. The following paragraphs provide brief descriptions of each facility and the recreational opportunities available.

Agency Lake is connected to the northern arm of Upper Klamath Lake. Although Agency Lake has no marina, there are two public boat launches and it has a fishery that features trophy redband trout. Other popular recreational activities at the lake are sightseeing, including wildlife viewing of waterfowl, otter, mink, deer, and bald eagles (and waterfowl hunting) (Southern Oregon Directory and Guide 2010). As shown in Table 3.20-4 above, a number of campgrounds surround the lake.

Upper Klamath Lake is the largest freshwater body of water in Oregon. In the northern portion of the lake, Pelican Bay is known for its population of redband trout and is an extremely popular destination for fly-fishing. The bay is also a popular location for canoeing and kayaking, as well as sightseeing and wildlife viewing. Other popular activities in Upper Klamath Lake include sailing and waterfowl hunting. As shown in Table 3.20-4 above, there are numerous campgrounds and boat launches surrounding the lake.

The Link River segment of the Klamath River, an approximately 1-mile stretch downstream from Link River Dam, has only one developed recreational facility, the Link River Nature Trail. This 1.4-mile trail is for pedestrian use only and follows a gated access road on the west side of the Link River Bypass Reach. The Link River Nature Trail is popular for sightseeing, hiking, walking, jogging, trout fishing, and bird watching (FERC 2007).

The Keno Impoundment/Lake Ewuana provides various recreational opportunities, including fishing, picnicking, boating, camping, sightseeing, and wildlife viewing. In the fall, waterfowl hunting is a popular activity at Keno Impoundment/Lake Ewuana. Although most of the land adjacent to the reservoir is privately owned, Lake Ewauna has several public access areas, including the City of Klamath Falls Veterans' Memorial Park/Boat Launch, Miller Island Boat Launch, the Klamath Wildlife Viewing Area, and the Keno Recreation Area and Campground (PacifiCorp 2004). Table 3.20-5 provides a summary of the facilities and estimated annual visitation and capacity as assessed by PacifiCorp as part of relicensing studies for the Klamath Hydroelectric Project (KHP) (PacifiCorp 2004).

**Table 3.20-5. Keno Impoundment/Lake Ewauna Developed Recreation Facilities**

Site Name	Facilities	2001/2002 Est. Annual Use (Recreation Days <sup>1,2</sup> )	Est. Facility Use vs. Capacity
Klamath Falls Veterans' Memorial Park/Boat Launch	Boat launch, day use area	42,500	Exceeding capacity
Miller Island Boat Launch and Klamath Wildlife Viewing Area	Boat launch, wildlife viewing trail, and a portable toilet	7,300	Approaching capacity
Keno Recreation Area and Campground	Campsites (26), day use area, restrooms, boat launch and boarding dock	6,000	Below capacity

Source: PacifiCorp 2004; FERC 2007.

Notes:

<sup>1</sup> Recreation days are defined as one visitor to a recreation area for any reason in a 24-hour period.

<sup>2</sup> Data for PacifiCorp Reservoir use was collected by PacifiCorp in 2001 and 2002. No more recently collected data exists or is available.

The Klamath Falls Veterans' Memorial Park provides a boathouse and boat launch ramp on the northern shoreline of Keno Impoundment/Lake Ewuana and is managed by the City of Klamath Falls, Department of Parks and Recreation. Along the northwestern end of the lake, the Klamath Wingwatchers Lake Ewauna Nature Trail provides opportunities for bird watching and hiking. This 1.8-mile trail connects Veterans' Memorial Park to the Link River trail, along the Link River to the north. Another trail is currently under construction on the northeastern side of the lake (Klamath Birding Trails 2010).

The Miller Island Boat Launch is on the east shore of Keno Impoundment/Lake Ewuana about 6 miles south of Klamath Falls, and is managed by the Oregon Department of Fish and Wildlife. The facility is accessed by Miller Island Road, which runs three miles through the Klamath Wildlife Area and Miller Unit, which provides an entrance station area, parking area, wildlife viewing trail, and a portable toilet. The Keno Recreation Area and Campground on the southwestern shore of the Keno Impoundment/Lake Ewuana provides a campground, day use area, and boat launch. The campground has 26 developed campsites, restrooms, and a recreational vehicle (RV) dump station. Recreational opportunities in this area include camping, fishing, picnicking, sightseeing, and boating. The Keno Recreation Area consists of upper and lower use areas, with the upper area adjacent to the campground and the lower area adjacent to the boat launch (FERC 2007).

### **Whitewater Boating Opportunities**

The Klamath River downstream of Link River Dam provides approximately one mile of river suitable for whitewater boating and other river-based activities. Recreational studies of this reach have not detected whitewater boating use; however, there are anecdotal accounts of boating use occurring in the reach (FERC 2007). There is one short Class III/IV rapid and one Class II/III ledge drop in this segment of the river.

The Klamath River downstream of Keno Dam provides approximately five miles of river suitable for whitewater boating, although not much boating use is reported for this reach, perhaps due to its level of access and short run length. The reach is rated Class III difficulty, and flows acceptable for whitewater boating opportunities range from 1,000 to 4,000 cubic feet per section (cfs). Table 3.20-6 provides a summary of acceptable flow ranges for whitewater boating and other flow-dependent recreational activities in the Klamath River (from the Keno Reach to the ocean).

### **Fishing Opportunities**

Fishing is allowed from September 30 until June 16 on the Klamath River downstream of Link River Dam. The highest use in this area occurs from late winter through spring; this area is mainly used by City of Klamath Falls local residents. At lower flow times, anglers use the river at a few sites where there is access for bank fishing through thick riparian vegetation. Catch records indicate that although angler success is consistently low, there is a greater percentage of larger fish caught in this reach than between J.C. Boyle Dam and the state line. Table 3.20-6 below summarizes flows acceptable for fishing opportunities in the various reaches of the Klamath River.

**Table 3.20-6. Acceptable Flow Ranges for Various River-Based Activities for Reaches of the Klamath River**

River Reach (Length of Reach)	Activity	Low Value (cfs) <sup>1</sup>	High Value (cfs) <sup>1</sup>
Keno Reach (5.0 miles)	Whitewater Boating – Standard	1,000	4,000
	Play Boating	1,100	1,800
	Fishing	200	1,500
J.C. Boyle Bypass Reach (4.3 miles)	Whitewater Boating – Standard	1,300	1,800
	Fishing	200	1,000
Hell's Corner Reach (16.4 miles)	Whitewater Boating/Rafting <sup>2</sup>	1,300	3,500
	Fishing <sup>3</sup>	200	1,500
Copco 2 Bypass Reach (1.3 miles)	Whitewater Boating	600	1,500
	Fishing	50	600
Iron Gate to Scott River (47 miles)	Whitewater Boating/Fishing	800	4,000
Scott River to Salmon River (76 miles)	Boating	800	7,000
	Fishing	800	4,000
Salmon River to Trinity River (23.1 miles)	Whitewater Boating/Fishing	800	10,000
Trinity River to Ocean (43.4 miles)	Whitewater Boating/Fishing	1,800	18,000

Source: Recreation Sub-Team 2010 (See Appendix R of this EIS/EIR); PacifiCorp 2004; FERC 2007.

Notes:

<sup>1</sup> Values were determined by the recreation sub-team (2010) from relicensing documents (PacifiCorp 2004; FERC 2007) and consultation with USFS and BLM representatives.

<sup>2</sup> Flows are within the desirable range during the daily peak hydroelectric operations period (between 10:00 AM and 2:00 PM).

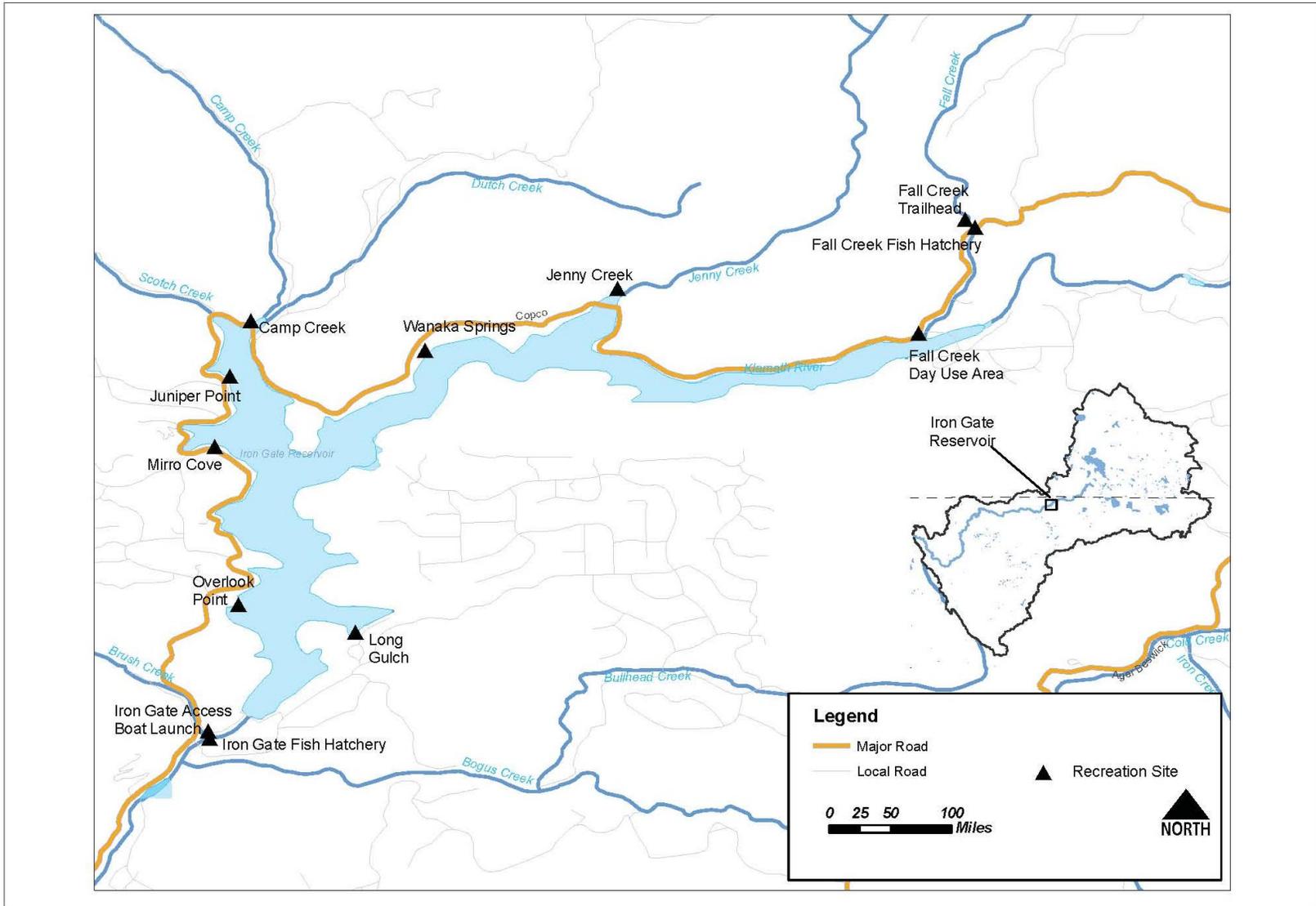
<sup>3</sup> Flows are within the desirable range for at least 4 hours during the daily non-peak hydroelectric operations period (either between 5 AM and 11 AM or between 3 PM and 9 PM).

Key:

cfs: cubic feet per second

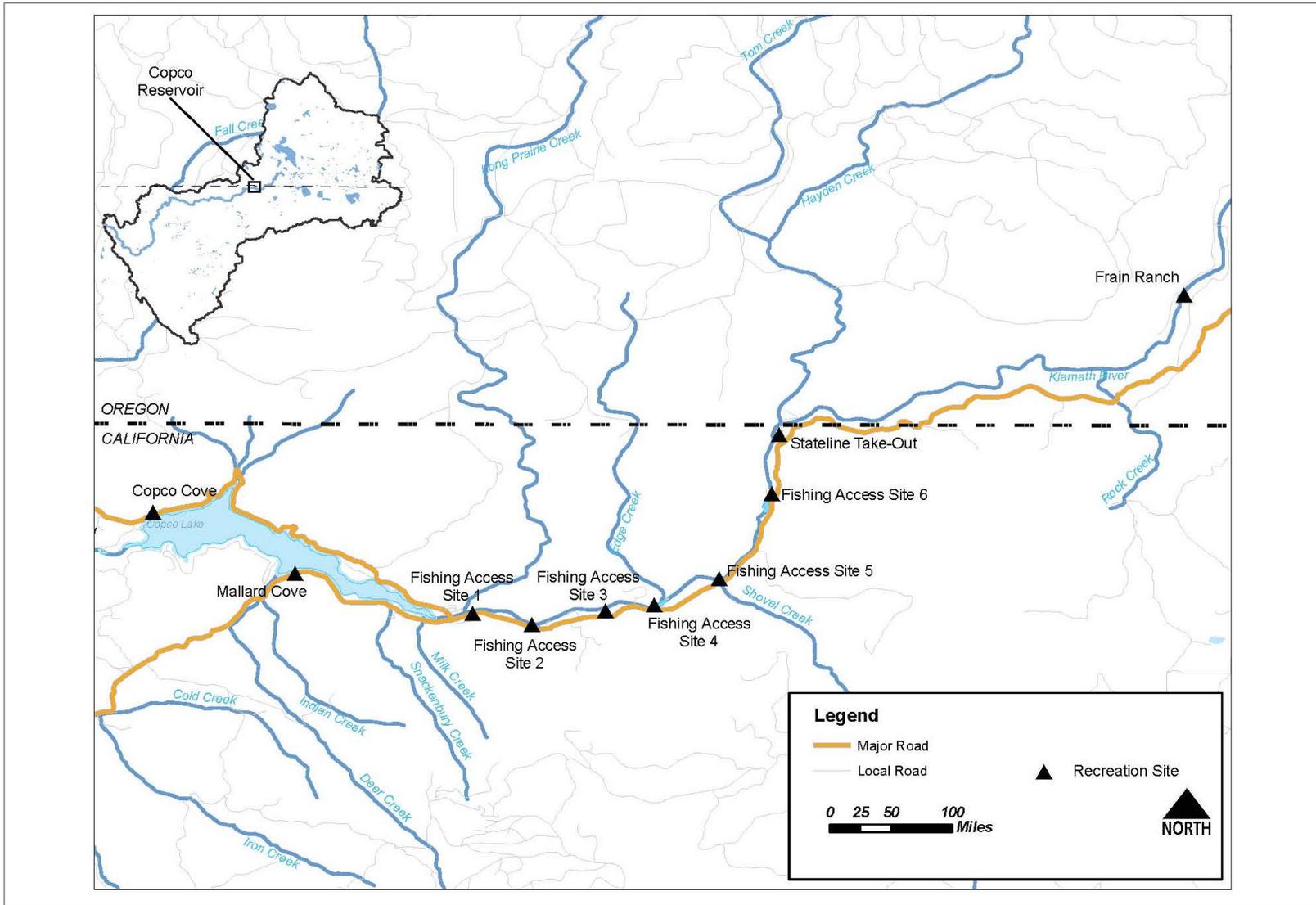
**3.20.3.3 Recreation Opportunities in the Klamath River Segment Between J.C. Boyle Reservoir and Iron Gate Dam  
Recreation Facilities and Opportunities**

The subject dams impound four water bodies on the Klamath River: J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs. In addition to these reservoirs, there is a stretch of unimpounded river between J.C. Boyle Reservoir and Copco Reservoir. Figures 3.20-2(a), (b), and (c) show the locations of these reservoirs, and the following sections describe recreational opportunities at each of these areas.



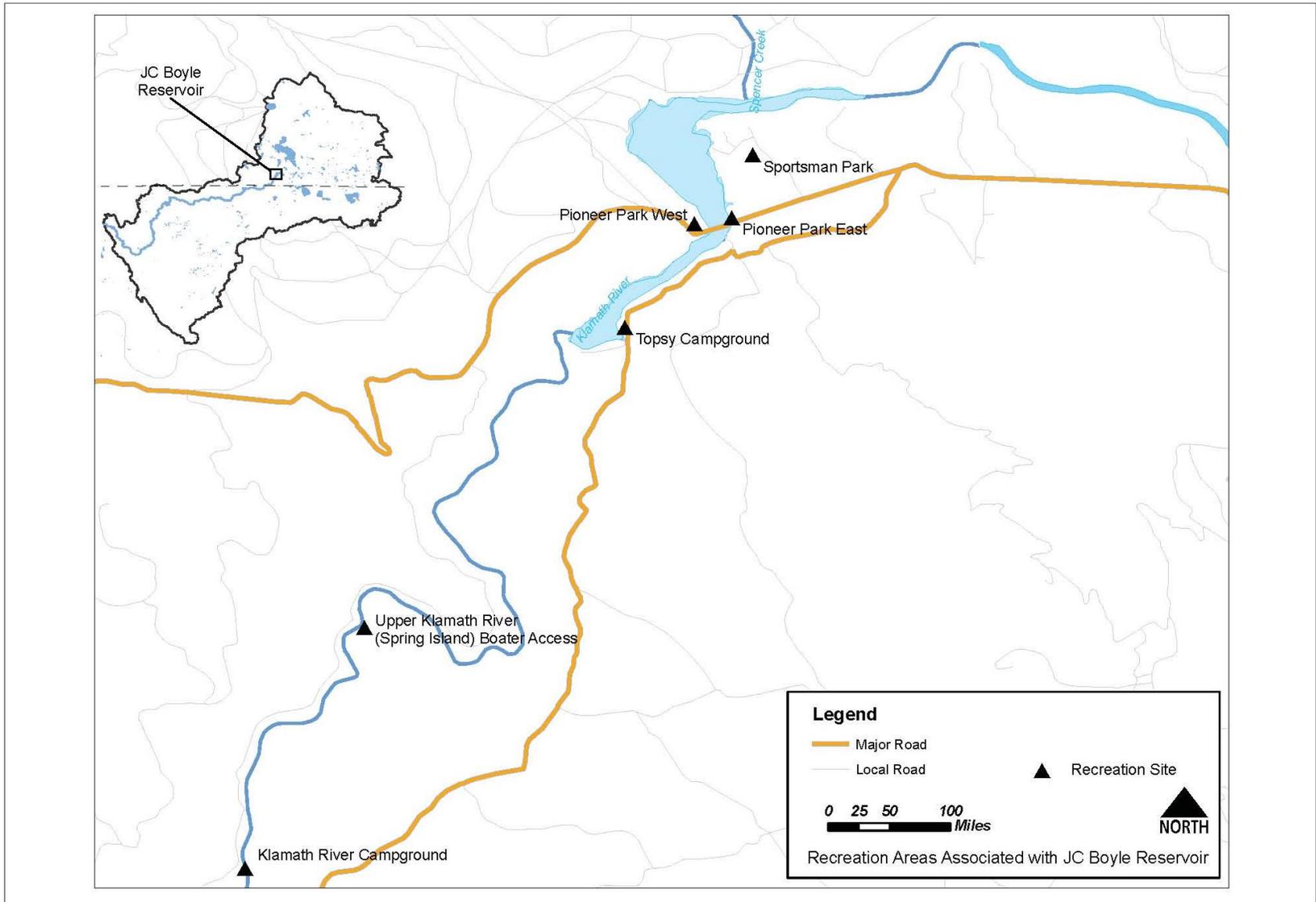
W:\REPORTS\SUS Dept of Interior\_Klamath\Figure 3.22-2a\_Iron Gate\_Recreation Areas.ai TCJR 12/7/10

Figure 3.20-2a. Iron Gate Recreation Areas



W:\REPORTS\SUS Dept of Interior\_Klamath\Figures\Figure 3.26-2b\_Copco\_Recreation Areas.ai TC:JR 12/7/10

Figure 3.20-2b. Copco Recreation Areas



W:\REPORTS\SUS Dept of Interior\_Klamath\Figures\Figure 3.26-2c\_JC Boyle\_Recreation Areas.ai TC:JR 12/7/10

Figure 3.20-2c. J.C. Boyle Recreation Areas

**J.C. Boyle Reservoir**

J.C. Boyle Reservoir encompasses about 420 surface acres and is about 3.6 miles long. Developed public recreational facilities at the reservoir include Pioneer Park, Sportsman’s Park, and Topsy Campground (Table 3.20-7).

**Table 3.20-7. J.C. Boyle Reservoir Developed Recreation Facilities**

Site Name	Ownership	Facilities	2001/2002 Est. Annual Use	Est. Facility Use vs. Capacity
Pioneer Park	PacifiCorp	Picnic areas, boat launches, interpretive signs, restrooms	16,700	Below capacity
Topsy Campground	BLM	Campsites (16), an RV dump, two day use areas, a boat launch with boarding dock, an accessible fishing pier, restrooms	5,600	Below capacity
Sportsman’s Park	Klamath County	Shooting ranges, dirt racetracks, archery courses, a model aircraft flying field, OHV area, restrooms	12,600	Below capacity

*Source: PacifiCorp 2004; FERC 2007.*

Pioneer Park is owned and operated by PacifiCorp and it lies off Oregon State Highway 66 (State Highway 66) east and west of Spencer Bridge. Pioneer Park is a day use area that provides picnic areas, boat launches, interpretive signs, and two restroom facilities. It has an improved boat ramp on the east shore just off State Highway 66, and a picnic area and unimproved boat launch on the west shore. Popular activities at this location include sightseeing, boating, fishing, swimming, and picnicking (PacifiCorp 2004).

Topsy Campground is owned and managed by BLM. The campground is south of State Highway 66 off Topsy Grade Road, a gravel road maintained on an as-needed basis by BLM, private owners, timber companies, and PacifiCorp. This site features a campground with 16 sites, an RV dump, two day use areas, a boat launch with boarding dock, an accessible fishing pier, and two restroom facilities. The campground is available to the public and BLM charges fees for day use and camping at this facility (PacifiCorp 2004).

Sportsman’s Park, approximately 0.25 mile east of the reservoir, is a multi-use recreation area owned by Klamath County and leased long-term to Klamath Sportsman’s Park Association. The facility does not provide developed reservoir access, but does provide river access for fishing. The park contains shooting ranges, dirt racetracks, archery courses, and a model aircraft flying field. The park also has facilities for self-contained RVs and some tent camping. Annual membership passes and single-day passes for use of the park are available to the general public for a fee (PacifiCorp 2004; Klamath Sportsman’s Park 2010).

### Hell's Corner Reach

The Hell's Corner Reach of the Klamath River from J.C. Boyle Reservoir to Copco Reservoir extends about 16.4 river miles. Several public fishing and boat access areas exist along this reach, as summarized in Table 3.20-8.

**Table 3.20-8. Hell's Corner Reach Developed Recreation Facilities**

Site Name	Facilities	2001/2002 Est. Annual Use (Recreation days)	Est. Facility Use vs. Capacity
Spring Island Boater Access	Launch area, shoreline fishing access, restrooms	5,200	Below capacity
Klamath River Campground	Campsites (3), shoreline fishing and boating access, restrooms	1,000	Below capacity
Stateline Take-out	Boat put- in/take-out, shoreline fishing access, restrooms	2,700	Approaching capacity
Fishing Access Sites1-6	Shoreline fishing access, parking	3,600	Below capacity

Source: PacifiCorp 2004; FERC 2007.

The Spring Island boater access is adjacent to (downstream of) the J.C. Boyle Powerhouse and is managed by BLM. This site provides car-top whitewater boat launching and shoreline fishing access. The Klamath River Campground, managed by BLM, is about three miles downstream of the J.C. Boyle Powerhouse. The campground has three developed campsites and the shoreline which can be used for fishing and boater access. The state line take-out access area, at the Oregon/California state line, includes upper and lower areas and is co-managed by BLM and PacifiCorp. The facility provides shoreline fishing and boat launching access. The fishing access sites provide access to the Klamath River in six locations between the stateline take-out access area and Copco Reservoir.

### Copco 1 Reservoir

Copco 1 Reservoir, which covers about 1,000 water surface acres and is about 4.5 miles long, has two publicly available day use facilities: Mallard Cove and Copco Cove. These facilities provide day use access, and although they are not official campgrounds, camping occasionally occurs at both locations. Table 3.20-9 summarizes the facilities and estimated use during 2001/2002 at both of these areas.

**Table 3.20-9. Copco 1 Reservoir Developed Recreation Facilities**

Site Name	Facilities	2001/2002 Est. Annual Use <sup>1</sup>	Est. Facility Use vs. Capacity
Mallard Cove	Picnic area, restrooms, boat launch with boarding dock	7,600	Below capacity
Copco Cove	Picnic area, restrooms, boat launch with boarding dock	1,250	Below capacity

Source: PacifiCorp 2004; FERC 2007.

Note:

<sup>1</sup> Recreation days are defined as one visitor to a recreation area for any reason in a 24-hour period. Estimated use was during the 2001/2002 study period (PacifiCorp 2004).

Mallard Cove, on the south shore of Copco Reservoir, is accessed off Ager-Beswick Road and includes day use facilities, two restrooms, and a boat launch with boarding dock. Copco Cove, on the western shoreline of Copco Reservoir, off of Copco Road, has a small picnic area, two restrooms, and a boat launch with boarding dock (PacifiCorp 2004).

**Copco 2 Reservoir**

Copco 2 Reservoir is relatively small (approximately 40 water surface acres and about 0.3 miles long) and has a narrow configuration with steep and difficult shoreline access. Copco 2 Reservoir has no recreation facilities and no public access (FERC 2007).

**Iron Gate Reservoir**

Iron Gate Reservoir is approximately 944 water surface acres and 6.8 miles long. The reservoir has the highest concentration of recreation sites of all the developments associated with the PacifiCorp facilities. The developed facilities at Iron Gate Reservoir include a trail (Fall Creek Trail), five combination day use and campground areas (Jenny Creek, Camp Creek, Juniper Point, Mirror Cove, and Long Gulch), three day use areas (Fall Creek, Overlook Point, and Wanaka Springs), and a fish hatchery and associated day use area (Iron Gate). Recreational opportunities include sightseeing, swimming, fishing, boating, and day and overnight use. Summer and weekend use is quite high at the reservoir, due to the popularity of bass tournaments, waterskiing, and camping. Table 3.20-10 summarizes the facilities at these sites and PacifiCorp’s estimated annual recreation visitation and capacity during the 2001/2002 study period.

**Table 3.20-10. Iron Gate Reservoir Developed Recreation Facilities**

Site Name	Facilities	2001/2002 Est. Annual Use (Recreation days)	Est. Facility Use vs. Capacity
Fall Creek Day Use Area and Fall Creek Trail	Picnic area, boat launch access, restrooms, hiking trail	4,150	Below capacity
Overlook Point	Restrooms	1,900	Below capacity
Wanaka Springs Day Use Area	Fishing dock, restrooms	4,150	Exceeding capacity
Jenny Creek Day Use Area and Campground	Campsites (6), restrooms	3,700	Approaching capacity
Camp Creek Day Use Area and Campground	Campsites (13), boat launch, boarding and fishing docks, swimming area, a RV dump station, sports field, interpretive display restrooms	15,250	Exceeding capacity
Juniper Point Day Use Area and Campground	Campsites (9), a fishing dock, restrooms	4,700	Exceeding capacity
Mirror Cove Day Use Area and Campground	Campsites (10), a boat launch, restroom	11,140	Exceeding capacity
Long Gulch Day Use Area and Campground	Picnic sites, boat launch, restrooms	5,200	Below capacity
Iron Gate Fish Hatchery	Picnic area, picnic shelter, visitor center/interpretive kiosk, restrooms, trail to river	2,200	Below capacity

Sources: PacifiCorp 2004; FERC 2007.

The Fall Creek Day Use Area is at the upper end of the reservoir and includes a picnic area, boat launch access, and restroom facilities. This small day use area is adjacent to the CDFG Fall Creek Fish Hatchery and provides access to Fall Creek Trail. Fall Creek Trail is a short (0.1 mile) trail located adjacent to the Fall Creek Fish Hatchery where visitors can hike up to Fall Creek Falls.

Wanaka Springs Day-Use Area provides picnic areas, a fishing dock, and restroom facilities, and some informal camping occurs in the area.

Overlook Point is on the west side of the reservoir, approximately 0.75 mile upstream from the dam. The facility has picnic sites on moderately steep topography, providing a good view of the reservoir and surrounding landscape.

Jenny Creek Day Use Area and Campground includes six sites and a restroom facility. Jenny Creek is on the north side of the reservoir and provides a creekside setting for picnicking and bank fishing.

Camp Creek is along a narrow reach on the north side of Iron Gate Reservoir. The surrounding hilly, semi-arid landscape and the reservoir provide pleasant views. Camp Creek has several campsites designed primarily for RV campers, with a large overflow RV camping area. Juniper Point Day Use Area and Campground has several picnic areas that are occasionally used as campsites, a fishing dock and restroom facilities.

Mirror Cove is a day use area and campground centrally located on the west side of the reservoir. The site offers several picnic sites that are occasionally used as campsites, a boat launch, and restroom facilities. This particular location is popular for group camping and is used extensively by local water-ski clubs. This boat launch is the nearest access to a competitive water-ski course placed in the western area of the reservoir.

Long Gulch Day Use Area and Campground is on the east side of the reservoir directly across from Overlook Point. Facilities at this location include picnic sites, restroom facilities, and a boat launch. Land along an adjacent ridge is occasionally used for dispersed camping and day use (PacifiCorp 2004).

Below Iron Gate Dam, the Iron Gate Fish Hatchery is operated by CDFG and includes a public day use area adjacent to the hatchery and an undeveloped boat launch across the river from the hatchery. The day use area includes a picnic area, a picnic shelter, visitor center/interpretive kiosk, restroom facilities, a trail to the river, and seasonal interpretive tours. Fishing is prohibited in this area, in addition to 3,500 feet downstream of the dam.

### **Visitor Use and Perception**

PacifiCorp conducted a visitor survey in 2004 to assess recreational use and visitor perceptions of facilities associated with the Four Facilities, including the subject reservoirs. The majority of visitors surveyed (approximately 60 percent) were from Klamath County and Jackson County, Oregon. The remaining visitors were from California, approximately half of which came from Siskiyou County. When asked to indicate all activities participated in while visiting the subject reservoirs, more than half

of the visitors surveys included resting/relaxing as one of the activities. When surveyed on their perception of crowding at the reservoirs, the mean score of respondents was 3.2 (on a 9-point scale from 1 – not crowded to 9 – extremely crowded), indicating that visitors did not feel overly crowded while participating in recreation activities. Further, approximately 39 percent of respondents had changed their visits to the subject reservoirs from other lakes in the area to avoid crowding. When surveyed regarding management options of the reservoirs, survey respondents indicated opposition to the collection of user fees at either day use sites or facility campgrounds (PacifiCorp 2004).

In response to the survey question “Has water quality ever affected your visit to the Klamath River area?” approximately two-thirds of recreational users of the subject reservoirs had negative perceptions of water quality, commenting on its color, turbidity, and odor. The source of visitor concerns was primarily the brown, foamy water in free-flowing reaches and regular, extensive algae blooms that occur throughout the reservoirs. Visitors reported that the algae produces bad odors, fouls fishing lines, and reduces the area available for fishing, swimming, and wading (FERC 2007).

### **Whitewater Boating Opportunities**

Whitewater boating opportunities are provided on the J.C. Boyle Bypass Reach, the Hell’s Corner Reach, and the Copco 2 Bypass Reach. The J.C. Boyle Bypass Reach includes about 5 miles of the Klamath River downstream of J.C. Boyle Dam and upstream of the J.C. Boyle Powerhouse. This reach provides Class III to IV+ rapids, and acceptable whitewater boating flows range from 1,300 cfs to 1,800 cfs<sup>1</sup>; however, this reach is typically dewatered with only 100 to 300 cfs base flow. Therefore, the majority of the year there is almost no boating use on this stretch of the river.

BLM manages whitewater boating use in the Hell’s Corner Reach, a 16.4-mile reach from below J.C. Boyle Reservoir to the Fishing Access Site 1 take-out (see Figure 3.20-2b). This reach provides Class III to IV+ rapids during daily peaking flows from the PacifiCorp hydropower operations (between 10AM and 2PM), and acceptable whitewater boating flows range from 1,300 cfs to 3,000 cfs. Outside of the daily peaking flows, flow rates within this reach do not meet the acceptable range to create or enhance whitewater boating opportunities.

The average estimated annual whitewater boating use from 1994 through 2009 on this reach was 4,414 recreation days, peaking in the mid-1990s at around 6,000 recreation days per year. Whitewater boating use occurs typically during April through October, with about 80 percent of the commercial rafting use occurring during July through September. Commercial boating use accounted for about 93 percent of the whitewater boating use on this reach (United States Department of the Interior [DOI] 2011a).

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<sup>1</sup> 1,300 cfs was used as the bottom end of the range for acceptable whitewater boating flows because this amount of flow is necessary for whitewater boating by loaded rafts. Therefore, potential impacts measured against this range is representative of outfitted trips along these reaches. More boating days would be available for flows down to 1,000 cfs for smaller craft and highly-skilled amount of flow is necessary for whitewater boating by loaded rafts. Therefore, potential impacts measured against this range is representative of outfitted trips along these reaches. More boating days would be available for flows down to 1,000 cfs for smaller craft and highly-skilled.

Commercial boating use is allowed by permit only. There is a set commercial capacity of 10 outfitters or 200 clients per day on this reach. There is no limit for private boating capacity, although BLM has established 250 persons per day as the overall whitewater boating carrying capacity of the reach. Factors that constrain the carrying capacity of the reach are vehicle congestion at the take-out locations near Copco 1 Reservoir and the limited size and number of areas that are available to scout rapids (FERC 2007). Rafting use in this area, above Copco 1 Reservoir in particular, depends upon operation of the J.C. Boyle Powerhouse upstream (FERC 2007).

The Copco 2 Bypass Reach is approximately 1.3 miles long, extending from Copco 2 Dam to the Copco 2 Powerhouse and whitewater boating opportunities are limited due to lack of flow. However, the reach can provide Class IV whitewater opportunities and acceptable flows range from 600 to 1,400 cfs.

### **Fishing Opportunities**

PacifiCorp conducted a visitor use survey in 2002 to obtain information on existing visitor demand, needs, and recreational activities within the area between J.C. Boyle Reservoir and Iron Gate Dam. The results of the survey indicated that 33 percent of visitors to the area participate in bank fishing, both along the river and reservoirs. Survey respondents also indicated that fishing for trout on river reaches in this area is considered very good, and the two most popular reaches for fishing opportunities are Keno Reach downstream of Keno Dam and J.C. Boyle Bypass Reach downstream of J.C. Boyle Dam. Further downstream, opportunities for trout fishing exist below J.C. Boyle Powerhouse (Hell's Corner Reach). This reach (between J.C. Boyle Powerhouse and the state line) is popular with anglers, and catch records indicate good angler success, although fish size is typically smaller than fish caught below Keno Dam and rarely exceeds 16 inches (FERC 2007).

Recreational opportunities downstream of Hell's Corner Reach, between the California/Oregon state border and Iron Gate Dam, are also quite popular, especially for angling. In 1974, a 6-mile reach of the Klamath River, from the California/Oregon state line to Copco 1 Reservoir, was designated as Wild Trout water and is managed under the Wild Trout Program (CDFG 2010) (see also Section 3.3, Aquatic Resources). Demand for recreational angling is high in this area. The Klamath River between the Copco 1 and Iron Gate Developments has poor public access and no documented fishing activity.

### ***3.20.3.4 Recreation Opportunities along the Klamath River Segment Downstream of Iron Gate Reservoir***

#### **Recreation Facilities and Opportunities**

Most of the Klamath River corridor downstream of Iron Gate Dam flows through land managed by the USFS (Klamath National Forest and Six Rivers National Forest), although the river also crosses some county and city lands. Table 3.20-11 summarizes the river-based recreational opportunities available on the Klamath River downstream of Iron Gate Dam.

One privately developed recreation facility along the river is R Ranch, near Hornbrook. The R Ranch is a large private recreation complex used by RV campers and day users who are members of the R Ranch Landowners’ Association. The R Ranch has two separate campgrounds. Cottonwood Campground is just off of I-5, farther away from the Klamath River and offers full RV hookup sites and an RV dump station. Klamath Campground is a few miles east of Cottonwood and I-5 and 2 miles downstream of Iron Gate Dam along 1.7 miles of the Lower Klamath River. This campground contains a large lodge and provides opportunities to fish, hunt and view natural scenery and wildlife.

**Table 3.20-11. River-Based Recreation Opportunities below Iron Gate Dam**

Reach	Length (miles)	Current Recreation Opportunities
Iron Gate Dam to Shasta River	13	Sightseeing, Fishing (especially from boats), tubing and swimming, whitewater boating (rare), waterplay
Shasta River to Scott River	34	Sightseeing, Fishing, canoeing, whitewater boating, locational playboating, waterplay
Scott River to Indian Creek	36	Sightseeing, Fishing, canoeing, whitewater boating, waterplay
Indian Creek to Salmon River	40	Sightseeing, Fishing, whitewater boating, canoeing, hiking, waterplay
Salmon River to Trinity River	40	Sightseeing, Fishing, waterplay

Source: PacifiCorp 2004.

There are also private land areas near the I-5 corridor, in Seiad Valley, at Happy Camp, and near the mouth of the Salmon River at Sommes Bar. In general, these areas have several homes and associated, sparsely populated, rural development. These areas have considerable opportunities to camp, swim, picnic, or relax along this portion of the river. There are also some opportunities for sightseeing, hiking, walking, or biking along the river. In addition, there are some popular short hikes from the river up the tributaries, such as Ukonom and Clear Creek. Land-based recreation points along the river are generally near developed access points for boaters and anglers and a few developed USFS and private campgrounds (PacifiCorp 2004). In addition, there are two National Scenic byways located along this segment of the river and within the Klamath and Six Rivers National Forests. The “State of Jefferson” National Forest Scenic Byway is located primarily on California State Highway 96 (State Highway 96) between Shasta River to Happy Camp, and the “Bigfoot” National Forest Scenic Byway is located on Highway 96 from Happy Camp to California State Highway 229 (State Highway 229). These byways provide excellent views for sightseers within the Klamath and Six Rivers National Forests and access to numerous other recreational activities (America’s National Scenic Byways 2010). Downstream of the Trinity River confluence, the Klamath River flows through the Yurok, Hoopa and Resighini Indian Reservations and Redwood National Park, as well as some city and county lands. A number of private RV and tent campgrounds are along the river in Redwood National Park, and just outside of the park in the City of Klamath. These campgrounds provide opportunities for bank fishing, camping, and picnicking. Other recreation opportunities in the area are associated with

the national park and the adjacent state parks (Jedediah Smith, Del Norte Coast, and Prairie Creek Redwood State Parks), which offer hiking, hunting, and wildlife viewing. Table 3.20-4 provides a summary of the facilities associated with these parks.

### **Public Health Issues**

As discussed in Section 3.2, Water Quality, concentrations of chlorophyll-a and *Microcystis aeruginosa* have exceeded World Health Organization (WHO) guidelines for protection from adverse effects in recent years, in both Copco 2 and Iron Gate reservoirs, as well as reaches of the Klamath River downstream of Iron Gate Dam. In 2005 and 2008, the North Coast Regional Water Quality Control Board (NCRWQCB), Karuk Tribe, United States Environmental Protection Agency (USEPA) and other local, state, and federal agencies issued a warning to residents and recreational users of the river to use caution when near these algal blooms due to possible health effects of exposure to *Microcystis aeruginosa* and its microcystin toxin. Effects range from mild, non-life threatening skin conditions to permanent organ impairment and death, depending upon exposure time and intensity (FERC 2007). As identified in comments received during the scoping period for this Klamath Facilities Removal EIS/EIR, these water quality issues and public health warnings have resulted in reduced recreational activity in affected river segments in recent years.

### **Whitewater Boating Opportunities**

Extensive whitewater boating opportunities exist downstream of Iron Gate Dam. Depending on the river segment and level of flow, there are opportunities for play, standard, and big water boating on Class II and III waters.<sup>2</sup> These runs are boatable in rafts, kayaks, inflatable kayaks, and open canoes. Table 3.20-6 summarizes the acceptable flow ranges for reaches downstream of Iron Gate Dam.

Although not as challenging as the Hell's Corner Reach upstream, there are a few rapids that are sometimes rated Class IV, including Hamburg and Upper Savage on the Otter's Playpen run, Rattlesnake on the day-use run below Happy Camp, and Dragon's Tooth between Ferry Point and Coon Creek Access. There is also a well-known kayak playboating wave known as the "School House Wave" between Skehan Bar and Gottville. This wave is typically available during low to moderate summer flows and is popular with local kayakers from the Mount Shasta, Klamath Falls, and Ashland areas (PacifiCorp 2004). There is also a Class VI rapid at Ishi Pishi Falls (Somes Bar) that boaters are strongly advised to portage around (Cascade Outfitters 2010).

The primary whitewater boating season is in summer (June through August), when water temperatures are warm; however, the river can be boated in most months of the year (PacifiCorp 2004). There is less whitewater rafting downstream of the Trinity River confluence after the river turns northwest into strong prevailing winds. There are fewer developed river access points along this reach than in the reaches upstream. Also, much of this reach is located within the boundaries of the Yurok Tribe Indian Reservation. Data collected by the USFS and BLM indicate that substantially more whitewater boating

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<sup>2</sup> As rated by the American Whitewater International Scale of Difficulty (AW 1998).

occurs on the Klamath River below Iron Gate Dam than in the Klamath River upstream to J.C. Boyle Dam. From 1994 through 2009, the average annual number of user days was 14,392 per year. However, whitewater boating in this portion of the Klamath River has decreased somewhat in recent years. In part, this decline is due to the presence of microcystin blooms in the river. Total user days from 2000 through 2003 ranged from 13,976 to 15,349 per year, whereas from 2005 through 2009, total user days ranged from 11,751 to 15,279 per year (DOI 2011a).

### **Fishing Opportunities**

The Klamath River downstream of Iron Gate Dam has high quality angling opportunities extending nearly 200 miles to the Pacific Ocean and is open to fishing year-round. This reach, designated a national WSR (see Section 3.20.3.5 below) attracts and supports several fishing outfitter services that focus on salmon, steelhead, and trout fisheries. A review of outfitters conducted as part of the Secretarial Determination process identified over 50 outfitters providing sport fishing, boat fishing, and/or fly fishing trips on the Klamath River. Twenty-seven river access sites within the Klamath National Forest provide access for fishing in this section of the river. Use at the sites varies; however, most are rated as light usage (Klamath National Forest 2010). Tables 3.20-12 and 3.20-13 provide recent use data for Chinook salmon and steelhead fishing on the Klamath River. As shown in the table, angler success varied annually, but was much greater in the first half of the decade than in the latter half. The USFS reported that the decline in fish production in the past few decades triggered a similar decline in the guide and resort industry, as well as sport fisheries (FERC 2007) (see also Section 3.15, Socioeconomics). In addition, decreased abundance of anadromous fish species resulted in restrictions on the fishing seasons for certain runs of Chinook salmon in 2006 and 2008 (National Oceanic and Atmospheric Administration [NOAA Fisheries Service] 2006).

Downstream of the Trinity River confluence, angling in the Klamath River is dependent on the annual status of the fall-run Chinook salmon run, so the number of businesses that offer angling guide services changes from year to year. The main run of Klamath River Chinook salmon peaks in late fall and is normally over by mid-January each year; the steelhead season normally starts in November (see also Section 3.3, Aquatic Resources).

Anglers fish from boats and the bank. Most of the boat fishing occurs from drift boats or rafts. Fishing regulations allow anglers to keep up to five trout per day and most of the fishing activity occurs in summer and fall. Limits on salmon and steelhead have varied over the years, and regulations depend on whether the fish is wild or from the Iron Gate Hatchery. Most anglers catch and release steelhead (PacifiCorp 2004).

**Table 3.20-12. Estimated Number of Recreational Salmon Angler Days and Chinook Salmon Harvest on the Klamath River (excluding the Trinity River), 2001-2010.**

Year	# Angler Days	Chinook Salmon Harvest (# Fish)		
		Adults	Grilse	Total
2001	28,251	9,621	1,044	2,904
2002	24,993	9,769	1,197	4,942
2003	23,259	7,322	1,365	10,986
2004	24,751	3,463	651	10,420
2005	17,789	1,029	589	7,911
2006	12,141	57	2,293	5,756
2007	19,597	4,975	912	1,941
2008	15,249	1,560	5,202	5,259
2009	20,755	4,820	257	5,232
2010	16,219	2,610	4,039	5,599
01-05Avg	23,809	6,241	1,162	7,403
06-10Avg	16,792	2,804	2,620	5,425

**Table 3.20-13. Estimated Number of Recreational Steelhead Angler Days on the Klamath River (excluding the Trinity River), 2003-2008**

Year	# Angler Days
2003	19,183
2004	14,345
2005	13,216
2006	19,371
2007	15,622
2008	21,192
03-08Avg	17,155

### **3.20.3.5 Wild and Scenic Rivers Designation**

Two segments of the Klamath River are designated WSRs, one in Oregon and one in California (Figure 3.20-3). The reach in Oregon, between the J.C. Boyle Powerhouse and the Oregon/California state line was designated a WSR in 1994. In California, the entire river below Iron Gate Dam was designated wild and scenic in 1981 because of the outstandingly remarkable anadromous fisheries, including that of salmon and steelhead trout. WSR boundaries include variable-width linear corridors which typically include not more than 320 acres per linear mile (averaging up to approximately 0.5 miles in width along the river corridor); however, some protections for designated outstanding remarkable values can extend beyond the designated boundaries.

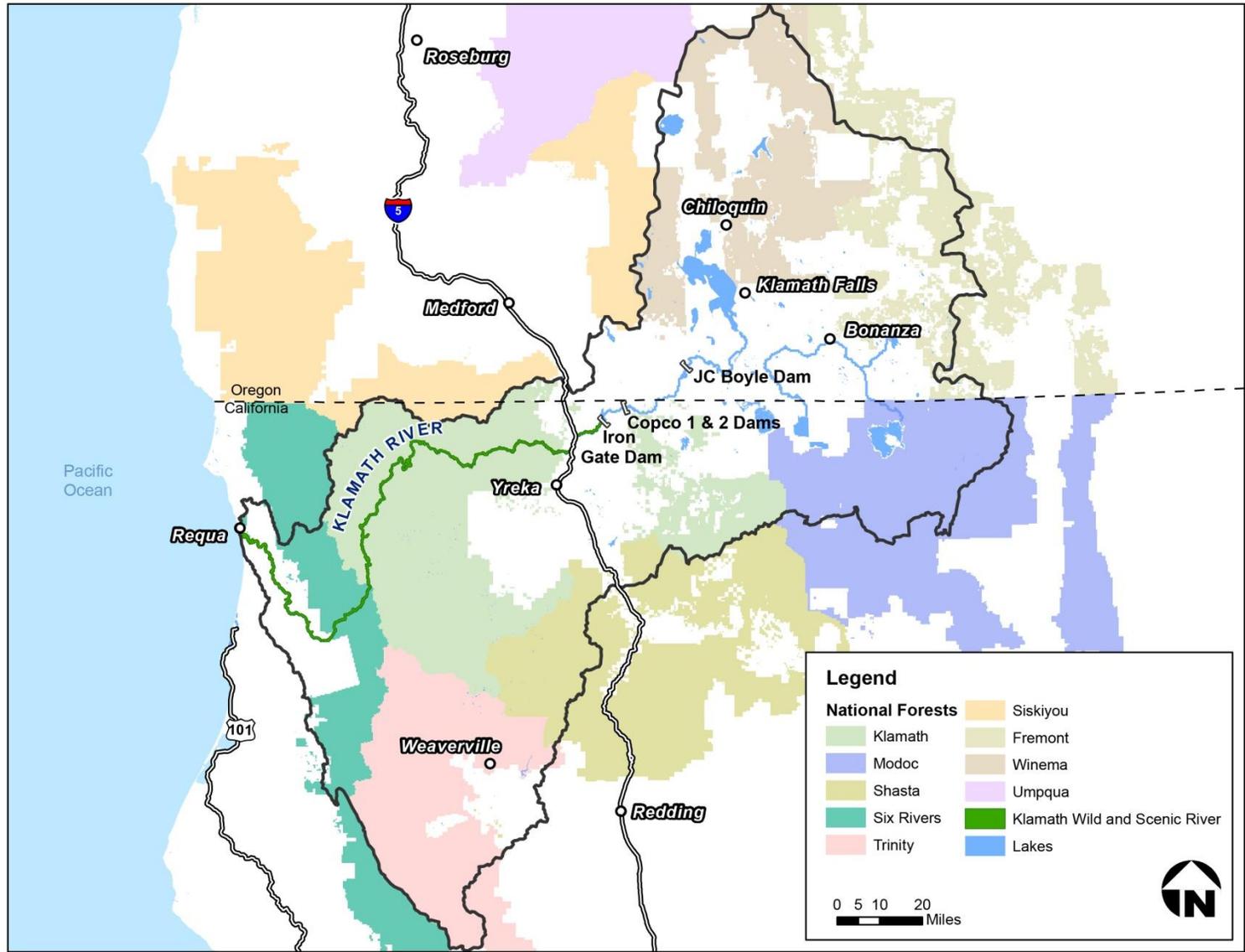


Figure 3.20-3. Klamath Wild and Scenic River Corridor

### **Oregon Klamath River WSR Component**

The segment of the Klamath River in Oregon, beginning immediately downstream of the J.C. Boyle Powerhouse and flowing 11 miles to its terminus at the Oregon/California state line, was added to the NWSRS through Section 2(a)(ii) of the WSR Act. The river is classified as scenic and possesses outstandingly remarkable scenic, recreational, fish, wildlife, pre-history, history, and American Indian Traditional Use values. The following subsections summarize the existing conditions in the Klamath River at the time of the WSR designation (1994) of the Oregon component.

#### **Scenic**

The Upper Klamath River (upstream of Iron Gate Dam) was evaluated by BLM in 1977 and 1981, and received a Scenic Quality Class A rating, the highest scenic quality classification. The 2006 Preliminary Determination Report (completed for the Section 7 WSR requirement during FERC relicensing of the PacifiCorp facilities) stated that scenery associated with the 11 mile Upper Klamath WSR is the main visual element in the region and exhibits more landform variety than the surrounding plateau (Bonacker et al. 2007). As the river canyon cuts across the plateau, it is characterized by cliffs, steep slopes, upland benches, alluvial terraces and the meandering river channel, “which can all be encompassed in a single view” (Bonacker et al. 2007). The unique landforms, water, and vegetation create an ever-changing landscape from desert to more mountainous terrain, and steep canyons and vertical cliffs with diverse vegetation (Bonacker et al. 2007).

#### **Recreation**

In the WSR designation, whitewater boating and recreational fishing were specifically mentioned by the Secretary as outstandingly remarkable values of the Upper Klamath WSR. Other popular recreation activities that occurred and continue within the recreation settings along the WSR reach include sightseeing, camping, hunting, OHV use, river swimming and water play, and upstream reservoir fishing and power boating (Bonacker et al. 2007). However, poor water quality conditions have adversely affected water play and river swimming within the WSR area (see section below). In 1994, at the time of the designation, the typical flow regime consisted of reliable and predictable daily hydropower peaking as provided by the KHP. Releases typically peaked in the mid-morning hours, and base flows typically occurred during the hours from late afternoon/early evening until morning. These releases provide whitewater boating opportunities throughout the summer and fall.

#### **Water Quality**

As stated in the 2006 Preliminary Determination Report, during the fall, winter, and spring, at base flow, the water appearance is not influenced by the addition of spring water because water released from the reservoir has less algae, nutrients, and turbidity. However, at the time of designation, summer base flow resulted in shallow, slow-moving waters with large amounts of visibly algae-covered rocks.

Peaking operations from the KHP change the relative proportions of cool spring water from the Bypass Reach and warm water from the reservoir and powerhouse, which

causes large artificial diurnal temperature fluctuations with higher daily maximum temperatures during power generation as compared to a run-of-river scenario. During peaking events, water appearance changes to a brownish, murky color; it is difficult to see to any depth; and large quantities of algal foam are produced and coalesce in river eddies below major rapids. During off-peak periods the relative contribution of cold clear spring discharge from the bypass reach dominates the flow (Bonacker et al. 2007).

### **Fisheries**

The Upper Klamath River supports a genetically unique population of redband trout and two endangered species, the Lost River and shortnose suckers. The WSR designation report specified redband trout as an outstandingly remarkable value and also listed federally endangered Lost River and shortnose suckers, Klamath largescale suckers, and slender sculpin as “notable species.” At the time of designation, native fish species known or suspected to occur in the Upper Klamath WSR included redband/rainbow trout; Klamath smallscale, Klamath largescale, shortnose, and Lost River suckers; tui and blue chubs; lampreys (perhaps Klamath and Klamath pit brook); sculpins (perhaps marbled only); and Klamath speckled dace (Bonacker, et al. 2007).

### **Wildlife**

The eligibility report identified that the WSR component provided a diversity of habitats for national, regional, and locally important populations of indigenous wildlife species, including exceptional populations of birds of prey, game and other birds, ringtail cats, river otters, and other species. Numerous federal and/or state-designated threatened or endangered species (including federal and state species of concern) including peregrine falcons (*Falco peregrinus*), western pond turtles (*Clemmys marmorata marmorata*), and Townsend's big-eared bats (*Corynorhinus townsendii*) are dependent on the Klamath River. In addition, a high percentage of the wildlife species found in the Oregon WSR component were identified to be directly dependent upon, or disproportionately use, riparian habitat for breeding, foraging, resting, and migration (Bonacker et al. 2007).

### **California WSR Component**

The segment of the Klamath River in California, beginning 3,600 feet below Iron Gate Dam and flowing 189 miles to the Pacific Ocean, as well as portions of three tributaries (Salmon and Scott Rivers and Wooley Creek) were added to the NWSRS in 1981 through Section 2(a)(ii) of the WSR Act. The mainstem Klamath River is classified as recreational with portions of the tributaries classified as scenic and wild. The anadromous fishery is the outstandingly remarkable value for the entire 286 miles of the designated component. The following subsections summarize the existing conditions in the Klamath River at the time of the WSR designation.

### **Scenic**

Scenery within the California Klamath WSR is dominated by natural settings. Its characteristic river flows, water appearance, anadromous fish and riparian vegetation within a forested river canyon are the primary scenic aspects. Since 1981, flow regimes have varied moderately in response to water resource competition within the Klamath Basin. During summer months, these have typically been caused by water diversions

(Van de Water et al. 2006). Also, as described in Sections 3.2, Water Quality, and 3.19, Scenic Quality, reduced water clarity and discoloration resulting from algae blooms has impaired the historic scenic character of reaches downstream of Iron Gate Dam. The level of reduced water clarity and discoloration and resulting scenic quality effects is dependent on viewer location. Views from on-river, in-river, or riverside viewpoints are most likely to display substantial changes to scenic quality indicators, while these changes are less likely to be noticed as viewed from nearby river canyon roadways and communities.

The river's lowest historic flows since the WSR designation can be identified by gage data from United States Geological Survey (USGS) gage no.11516530 near Iron Gate Dam. The lowest monthly summer time flows within the 21-year historical record at Iron Gate Dam before 1981 represents the lower limits of characteristic flow variability, which still expresses its historic scenic character. Before 1981, USGS records show no Iron Gate Dam flow releases of less than 700 cfs; however, flows of less than 700 cfs occurred during 17 months between 1981 and 2004 (Van de Water et al. 2006). Since 2004, no flows of less than 700 cfs have occurred. The lowest monthly mean flows occur in summer (July and August) and have ranged from 823 to 1,373 cfs (USGS 2011). Similar to the scenic quality changes related to water quality conditions described above, seasonal and project-induced changes in flow and resulting scenic quality changes are more likely to be observed by on-water, in-water and riverside viewpoints than nearby river canyon roadways and community viewpoints.

### **Recreation**

The flows released from Iron Gate Dam greatly influence the river's summer recreation season's whitewater boatability, challenge levels, safety hazards, potential for equipment damage, and the opportunity to access and experience the river's full range of rapids and channels. Exceptionally low summer time flow releases are especially adverse to California Klamath WSR boating activities. Table 3.20-14 compares flows at the time of the 1981 designation to flow conditions required for whitewater boating and recreational fishing (see Table 3.20-6 for optimal flow ranges) (Van de Water et al. 2006).

Although precise estimates of available recreation days in 1981 are not available, commercial recreational whitewater boating activity on the Klamath National Forest portion of the California Klamath WSR increased by approximately 34 percent between 1981 and 2005 (Van de Water et al. 2006). However, commercial activity on the lower Klamath River has decreased somewhat since 2005 from a recorded 10,695 user days to 8,230 user days in 2009, a trend consistent with other western rivers. Private recreational whitewater boating activity has followed a similar pattern, with the greatest number of user days between 1995 and 2005 (ranging from 4,193 to 5,230) and decreasing somewhat since 2005 to a low of 3,525 user days in 2009, as summarized in Section 3.15, Socioeconomics (DOI 2011a).

**Table 3.20-14. Comparison of 1981 Flows to the Acceptable Range for Whitewater Boating and Fishing**

Month	Flows (cfs)	Whitewater Boating	Fishing
January	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
February	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
March	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
April	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
May	1,000	In acceptable boating flow range/optimal playboating range	In optimal range
June	710	Does not meet minimum boatable flow or playboating opportunities	Does not meet minimum fishing flow
July	710	Does not meet minimum boatable flow or playboating opportunities	Does not meet minimum fishing flow
August	1,000	In acceptable boating flow range/optimal playboating range	In optimal range
September	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
October	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
November	1,300	In acceptable boating flow range/optimal playboating range	In optimal range
December	1,300	In acceptable boating flow range/optimal playboating range	In optimal range

Source: Van de Water et al. 2006.

Key:

cfs: cubic feet per second

### Water Quality

Water quality issues have existed since the time of WSR designation and there is evidence indicating that these issues may have increased since that time, and even more progressively over the past 5 years (Kann and Corum 2009). Water quality issues in the Klamath, including algae blooms and microcystin toxin from one species of blue-green algae, affect river recreation users (see discussion of Public Health Issues in Section 3.20.3.4 above). Results of the toxic algal monitoring program conducted by the Karuk Tribe between 2005 and 2007 at 16 near shore stations in the Klamath River below Iron Gate Dam indicate that nearly 60 percent of samples taken between June and September exceeded the moderate risk level as defined by the WHO (Kann and Corum 2009). Additional sampling conducted in 2007 shows that the microcystin toxin is found as far downstream as the Yurok Reservation, near the river mouth (Kann 2006). In addition, the entire length of the California WSR currently does not meet NCRWQCB water quality objectives for temperature (NCRWQCB 2007). A detailed description of existing water quality is provided in Section 3.2, Water Quality.

## **Fisheries**

The Klamath River was designated a WSR because of its free-flowing condition and its outstandingly remarkable anadromous fisheries, including that of salmon and steelhead trout. Even at the time of designation, decreasing salmonid trends in the Klamath River system were identified as being affected by various factors, including dam construction and operations related to hydropower generation in the Klamath River. Such factors have resulted in increased summer water temperatures, changed the natural flow regime, decreased dissolved oxygen levels in portions of the river, and blocked access to more than 350 miles of spawning, incubation, and rearing habitat. Scientific evidence shows that Chinook salmon, coho salmon, cutthroat trout, and steelhead trout were historically present above Iron Gate Dam (Hamilton et al. 2005).

According to a 1981 California Department of Water Resources (CDWR) study, spawning conditions in the reach immediately downstream from Iron Gate Dam were already impaired due to a coarsening of the bed below the dam. Although the reach below Iron Gate Dam was historically a prime spawning area, by 1981 the reach produced few salmon and the riffles within the reach contained cobbles too large for salmon to move. Prior to the 1981 WSR designation, the reach between Iron Gate Dam and Shasta River was scoured by daily peak flows from Copco 1 and Copco 2 operations prior to the construction of Iron Gate Dam (Van de Water et al. 2006).

Streambed armoring as a result of low flows and reduced gravel recruitment can decrease habitat diversity within channels, making the river less hospitable to juvenile salmonids. Armoring can also lead to the cementation of spawning gravels, impairing the ability of spawning adults to make redds. Armoring can also decrease the amount of habitat available (interstitial spaces) to macroinvertebrates, an important food source for fish. Given the findings of the 2006 study, it appears that much of the riverbed coarsening had occurred prior to the WSR designation (Van de Water et al. 2006). However, impacts from dams progress over time so one would expect that continued sediment depletion (by the retention of sediment behind the dams) would continue to worsen spawning habitat below the dam (Ligon et al 1995; Kondolf 1997; and Grant et al 2003).

River flows also affect fisheries' population and abundance. Table 3.20-14 shows the monthly flows at the time of the WSR designation. Flows are a key component of cumulative effects from water management on the aquatic environment. The flow regime downstream of Iron Gate Dam affects aquatic resources through instream flow influences on physical habitat (depth, velocity, substrate, and cover) and on water quality that may affect the prevalence of disease pathogens (Bartholow et al. 2005).

Estimates of abundance for anadromous fisheries at the time of the WSR designation are not available for all species. Table 3.20-15 provides estimates of abundance at the time of designation, or as near as possible to the time of designation for those species for which data is available. As discussed in Section 3.3, Aquatic Resources, the abundance of anadromous fisheries has decreased since the time of the WSR designation. Specific units of coho salmon in the Klamath River were listed as threatened under the ESA in 1997. Similarly, the green sturgeon was listed by NOAA Fisheries Service as a Species of

Concern in 2005 and designated as threatened under the ESA in 2010. The Lost River and shortnose sucker were designated as endangered in 1988 after the WSR designation in California and after the designation in Oregon.

**Table 3.20-15. Estimated Abundance of Fish Species at the 1981 WSR Designation**

Species	Estimated Abundance
fall Chinook salmon	Natural spawners – 4,000 (1981)
	Iron Gate hatchery spawners – 21,595 (1981)
coho salmon	3,400 (1984)
summer Steelhead	110,000 (average 1977-1991)
winter Steelhead	20,000 (average 1977-1991)

Source: Van de Water et al. 2006

**Wildlife**

Wildlife populations have not been systematically surveyed on the Klamath River. Baseline data were not collected in 1981; therefore, population numbers or trends are not available for most species in specific areas like the WSR corridor.

Riparian vegetation provides habitat for feeding, breeding, and sheltering for willow flycatchers, western pond turtles (a species of special concern in California) and various other wildlife species along the river. There is no reference condition for the riparian vegetation in 1981 (Van de Water et al. 2006). The project area includes a large number and diversity of wildlife species. Surveys conducted by PacifiCorp in 2002 and 2003 identified five amphibian species, numerous bird species, including 19 species of birds of prey, and numerous mammal species, including black-tailed jackrabbit, mule deer, and California ground squirrels. See Section 3.5, Terrestrial Resources, for further discussion of wildlife populations within the Klamath River corridor.

**Eligible and Suitable WSR Section on the Klamath River**

In 1990, BLM found the 5.3-mile section of the Klamath River from the Oregon/California state line to the slack water of Copco 1 Reservoir to be eligible and suitable for WSR designation. The river segment is free-flowing and possesses outstandingly remarkable scenic, recreational, fish, and wildlife values. This river segment is not a designated WSR and is not protected under the WSR Act and its Section 7(a) requirements. BLM is required within its authorities, to protect this suitable river segment’s free-flowing character, water quality, and outstandingly remarkable river values. This segment of the Klamath River is also listed on the Nationwide Rivers Inventory (NPS 2009).

### **3.20.4 Environmental Consequences**

#### ***3.20.4.1 Effects Determination Methodology***

This discussion of environmental effects considers the implications of the Proposed Action and identified alternatives on the potential changes to river- and reservoir-based recreation opportunities, activities, and settings within the study area. The relocation of the City of Yreka's water supply pipeline would not result in any impacts to recreational resources; therefore, it is not addressed in this section of the EIS/EIR. The analysis presented below includes an assessment of both short-term and long-term effects on access, flow-dependent recreational activities, recreational fishing, and other recreational activities associated with the existing Klamath River corridor and reservoir recreational facilities within the study area.

#### **Recreational Setting, Facilities, and Access**

Likely changes to recreational use and access under each identified alternative were assessed qualitatively, including changes from reservoir-based recreational opportunities to more river-based opportunities in the areas where the dams, recreational facilities, and/or PacifiCorp facilities would be removed. The short-term effects analysis includes a discussion of potential areas where recreational access would be restricted due to construction activities. The assessment of long-term effects discusses potential changes in the recreational setting and experience, changes in water quality and reservoir area revegetation.

#### **Whitewater Boating Opportunities**

Optimal and acceptable flows for whitewater boating opportunities along reaches of the Klamath River were assessed as a part of the technical review completed for the Secretarial Determination. Flow values that fall within these ranges are considered acceptable flow levels for the various activities (see Table 3.20-6).

DOI conducted hydrologic modeling to assess changes in the availability of acceptable flows under the various alternatives. The Lead Agencies subjected the modeling results for each water year type to a statistical analysis (paired T-tests) to determine whether the difference in number of days meeting the acceptable range of flows following dam removal (both on an annual and monthly basis) would be statistically significant. The Lead Agencies used a qualitative approach to assess the effects of the identified alternatives on whitewater boating access and existing whitewater boating opportunities.

#### **Recreational Fishing Opportunities**

The Lead Agencies used the results of DOI's hydrologic modeling to; determine whether changes in flow would affect recreational fishing opportunities (i.e., number of days with optimal flows for recreational fishing), qualitatively assess potential changes in fisheries populations and abundance; and determine effects of changes from reservoir-based fishing opportunities to river-based opportunities.

#### **Other Recreational Opportunities**

The analysis also includes an assessment of other recreational activities, such as sightseeing, swimming/wading/tubing, fish and wildlife viewing, and camping that occur

within the river corridor and a qualitative discussion of the effects of the various alternatives on these activities. The discussion here covers both anticipated short-term effects, such as construction-related effects, and long-term effects, such as changes in reservoir-based swimming opportunities.

### **Wild and Scenic River Assessment**

For each of the four protected resources specified in the WSR Act Section 7 (a) (scenic, recreational, fish, and wildlife), criteria have been developed to assess the effects of the alternatives as compared with conditions at the date of the river's designation into the NWSRS (see Section 3.20.3.5). For each designated river component, the type (positive or negative) and duration (short-term or long-term) of the effects are described. The magnitude of these effects may be analyzed in a future WSRA determination. The effects are characterized as unchanged, increased, or decreased (or similar conclusion), by criteria, for that resource.

#### **3.20.4.2 Significance Criteria**

For the purposes of the EIS/EIR, the following Recreation and WSR impacts would be significant if they would result in the following:

- Substantial restrictions on recreational access or reduction in the quality of recreational experiences in the vicinity of the subject reservoirs;
- Substantial decreases in the availability of reservoir/lake-based recreational opportunities;
- Substantial reduction in the quality of water-contact-based recreational activities;
- Substantial decreases in access for whitewater boating opportunities;
- Substantial changes in the amount of days providing acceptable flows for recreational activities; and/or,
- Diminution of the scenic, recreational, fisheries, and/or wildlife values of the designated WSR as present at the date of designation.

#### **3.20.4.3 Effects Determinations**

##### **Alternative 1: No Action/No Project**

*The No Action/No Project Alternative would not change existing recreation access and opportunities.* Under the No Action/No Project Alternative, no change to existing conditions, recreational facilities or opportunities at J.C. Boyle, Copco 1, or Iron Gate Reservoirs would occur. Similarly, whitewater boating and recreational fishing opportunities in reaches between J.C. Boyle Dam and Copco Reservoir and downstream from Iron Gate Dam would remain as described in the Affected Environment. As described in the Affected Environment, recreation activities in the reaches between J.C. Boyle Dam and Copco Reservoir (e.g., Hell's Corner Reach) are flow-dependent and rely on daily peaking hydropower operations.

Under the No Action/No Project Alternative, these operations would continue and opportunities for whitewater boating and fishing in these reaches would remain as described. Within the subject reservoirs and downstream of Iron Gate Dam, poor water quality conditions and decreased abundance of anadromous fish species have resulted in

adverse existing conditions for recreational activities, including complete closures of fishing seasons for certain species and public health warnings against water-contact-based activities during algal blooms in the summer. **Under the No Action/No Project Alternative, existing impacts on recreational fishing within the river and water-contact-based activities at the subject reservoirs would have no change from existing conditions.**

#### **Ongoing Restoration Actions**

Ongoing restoration actions would continue to take place under the No Action/No Project Alternative. Construction and implementation activities associated with these ongoing projects could result in effects to recreational resources and opportunities in the areas where construction takes place.

Ongoing actions considered for impact to recreational resources under the No Action/No Project Alternative include:

- Ongoing restoration actions
- Agency Lake and Barnes Ranches project

*Construction activities associated with ongoing programs could temporarily restrict access to recreational opportunities.* Construction activities including channel construction, floodplain rehabilitation, fish passage and facilities construction, and breaching levees would likely involve the use of heavy equipment along floodplain and riparian areas and could result in restrictions to public access for recreational activities, such as sightseeing, bank fishing, swimming, and wading. Because restoration activities would occur throughout the entire basin, specific sections of the river could be closed for a period of time throughout implementation of the ongoing restoration programs. However, as described in the Affected Environment section, there are a number of recreational areas offering similar activities and settings throughout the basin. It is likely that for any particular project, there would be an alternative recreational area nearby that could be used during temporary closures. **Thus, potential impacts to recreational opportunities would be less than significant. Implementation of specific projects will require future environmental compliance as appropriate.**

*Construction activities could result in short-term water quality impacts which could affect recreational opportunities.* Erosion and sedimentation during construction activities has the potential to temporarily decrease water quality and reduce water visibility for boaters, swimmers, and fisherman. These short-term water quality impacts would be anticipated to occur throughout the basin where construction activities take place. Specific sections of the river could be affected for a period of time throughout implementation of the ongoing restoration programs. However, following implementation and related construction activities for ongoing restoration programs including the Wood River Wetland Restoration, water quality and clarity in Upper Klamath Lake would be expected to improve. Additionally, as described above, short-term impacts would be offset by the ability of visitors and local recreationalists to use recreational areas with similar activities and settings throughout the basin. **Potential impacts would be**

**short-term and, with implementation of construction best management practices (BMPs), would cause less than significant water quality related recreational impacts. Implementation of specific projects will require future environmental compliance as appropriate.**

*Ongoing actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.* It is expected that correction of fish passage issues throughout the basin would restore fish access to new and historic habitats and result in increased fish populations. Ongoing restoration programs could continue to improve fish passage and habitat conditions in the basin which could benefit recreational fishing opportunities. **It is expected that continued implementation of restoration programs would benefit recreational experiences throughout the Klamath Basin. Implementation of specific projects will require future environmental compliance as appropriate.**

**Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

*Demolition activities could temporarily restrict recreational access in the vicinity of the reservoirs.* Short-term demolition activities associated with dam removal would result in temporary loss of access to recreational facilities at the subject reservoirs and associated reservoir-based recreational opportunities. Access could remain restricted for an additional period following completion of dam removal as restoration activities are conducted on the former reservoir area and existing recreational areas are modified to accommodate the new river channel. However, as described in Section 3.20.3.1, Regional Opportunities, a number of reservoirs and lakes are present within and adjacent to the Klamath Basin and provide similar opportunities for recreational activity. **Therefore, temporary impacts on recreational access in the vicinity of the subject reservoirs would be less than significant.**

*Temporary impacts from demolition activity (i.e., increased noise and dust) could decrease the quality of recreational experiences in the vicinity of the reservoirs.* As described in Section 3.9, Air Quality, and Section 3.23, Noise and Vibration, the use of heavy vehicles and equipment during dam removal would result in a temporary increase in dust and ambient noise in the vicinity of the subject reservoirs. These increases could indirectly result in a decrease in the quality of recreational experiences at nearby facilities that would not have restricted access during construction (e.g., trails and private parks not directly affected by construction). Specific effects related to noise and dust are discussed in detail in their respective sections; with regard to recreational activities, increases in ambient noise and air pollutants could impede visitors' ability to rest and relax, and disrupt bird and wildlife viewing opportunities. These effects would last for the duration of demolition activity; however, as shown in Figures 3.20-2(a-c), the majority of recreation facilities and access points at the subject reservoirs are located a distance away from the dams and would continue to provide opportunities for recreation until drawdown is completed. Further, as described in Section 3.20.3.1, Regional Opportunities, numerous other recreational areas are available within the vicinity of the subject

reservoirs that provide similar recreational opportunities. **Therefore, these temporary noise and dust impacts would be less than significant.**

*Dam removal could permanently decrease the availability of reservoir/lake-based recreational opportunities in the area of analysis.* The removal of the Four Facilities would eliminate existing opportunities for reservoir-based recreation activities, such as power boating, waterskiing, lake swimming, and flat-water boat angling, provided at J.C. Boyle, Copco 2, and Iron Gate Reservoirs. As discussed in the Affected Environment section, the subject reservoirs are popular recreational areas for sightseeing, fishing, camping, swimming, boating, and wildlife viewing and attract visitors primarily from the surrounding communities in Klamath and Jackson County, Oregon and Siskiyou County, California. As indicated in the responses to visitor use surveys conducted by PacifiCorp, the reservoirs are popular recreation areas in part because they are uncrowded relative to other lakes in the area and do not require user fees. While some activities associated with reservoir recreation could still be possible in the newly created river channel (e.g., swimming and wading), due to increased flows, swimming opportunities and flat-water boating may be limited in certain times of year and in wet water years. Thus, there would be a permanent loss of reservoir-based recreational opportunities in the immediate region. However, as shown in Table 3.20-2, a number of other lakes and reservoirs are in the vicinity of the subject reservoir and provide similar opportunities for recreation in an uncrowded setting (e.g., Fourmile Lake, Agency Lake, Applegate Reservoir, Medicine Lake). Therefore, the loss of the subject reservoirs would not result in a substantial decrease in regional lake-based recreational opportunities. Further, recreational opportunities would remain available on and along the newly created river channel. **Therefore, impacts on the regional availability of reservoir-based recreational opportunities would be less than significant.**

*Dam removal could permanently remove recreational facilities associated with the reservoirs.* Under the Proposed Action, the recreational facilities constructed to accommodate reservoir recreation, with the exception of Topsy Campground, Fall Creek and Jenny Creek Day Use Areas, and the Iron Gate Fish Hatchery Day Use Area, would be completely removed and the former recreation areas, parking areas, and access trails would be regraded and revegetated (O'Meira et al. 2010). This would result in a permanent decrease in recreational access since they will be too distant from the newly formed Klamath River to serve as river access points. Dam removal would permanently decrease the availability of reservoir recreational opportunities (as described above), and the removal of existing recreational facilities would limit access to recreational opportunities along and within the newly formed river channel. However, as described in Section 3.20.3.1 Regional Opportunities, a number of reservoirs and lakes are present within and adjacent to the Klamath Basin and provide similar opportunities for recreational activity. **These impacts on recreational facilities associated with the subject reservoirs would be considered permanent however, implementation of Mitigation Measure REC-1 would ensure that these impacts in the long term would be less than significant.**

*Dam removal could not adversely affect developed recreational facilities upstream and downstream of the subject reservoirs.* No impacts on recreational facilities upstream of the dam removal sites would occur as a result of removal of the Four Facilities because any changes to flow and water quality would occur downstream of J.C. Boyle Dam. However, as discussed in Section 3.3, Aquatic Resources, removal of the dams would help restore the presence of anadromous fish to the Klamath River above J.C. Boyle reservoir which would beneficially affect recreational fishing at these upstream facilities. Removal of the dams is expected to result in water quality improvements downstream of Iron Gate Dam (see Section 3.2, Water Quality), which could improve visitor perceptions and attract a greater number of visitors to existing recreational facilities. However, land-based facilities would not be physically affected by removal of the dams and drawdown of the reservoirs, since, as discussed in Section 3.11, Geology, Soils, and Geologic Hazards, the river is largely confined by bedrock and there would be little change to floodplain areas or the river channel itself. **Any impacts on upstream and downstream recreational facilities would be less than significant.**

*Sediment release downstream during reservoir drawdown could decrease the quality of water-contact-based recreational opportunities.* As discussed in Section 3.2, Water Quality, drawdown of the reservoirs would result in short-term increases in turbidity downstream of the PacifiCorp reservoirs. Turbidity would be most pronounced immediately downstream of Iron Gate Dam (between Iron Gate Dam and Bogus Creek), and less so farther downstream, and is expected to be flushed through the system quickly (less than 2 years). This increase in turbidity would reduce visibility for boaters, swimmers, and fisherman during the sediment flushing period and could result in reduced public draw for these activities (e.g., swimmers might be less likely to enter the river and fisherman might be less successful due to the reduced water clarity). Increased turbidity would also affect safety considerations during swimming if swimmers are unable to see the river bottom or navigate around obstacles, such as large boulders or logs beneath the water surface. However, impacts would be temporary; following completion of reservoir drawdown activities, water quality and clarity would be expected to improve as sediments are flushed downstream and into the Pacific Ocean. Impacts would not be widespread throughout the river; opportunities for fishing and swimming in non-turbid waters would remain available during the drawdown period.

Sediment release could also decrease the quality of water-contact-based recreational opportunities if sediment released downstream resulted in longer-term deposition in pools, eddies, slack water, and beaches and decreased the availability of these areas for recreational activity. As discussed in Section 3.11, Geology, Soils, and Geologic Hazards, modeling was conducted to determine the potential for such deposition following dam removal. The results of the modeling indicated that following dam removal, deposition would occur primarily between Iron Gate Dam and Cottonwood Creek and there would be no substantial change in river bed elevation. Depending on the water year type following sediment release, the coarse sediment load would take between 15 months and 2 years to be completely flushed downstream and into the Pacific Ocean. In contrast, if drawdown were to occur during a dry year, modeling indicates that substantial sand deposition would still be present between Iron Gate Dam and Bogus

Creek at the end of the two year modeling period. Therefore, it is unlikely that sediment release would decrease the availability of pools, eddies, or beaches for recreational activity, even temporarily. **Therefore, impacts on the quality of water-contact-based recreational opportunities would be short term and less than significant.**

*Changes in water quality associated with dam removal could positively affect water-contact-based recreational opportunities.* Dam removal is expected to result in long-term improvements in water quality, notably decreased prevalence of microcystin toxin (see Section 3.2, Water Quality). As discussed in Section 3.2, Water Quality and 3.20.3.2 above, microcystin toxin has been associated with public health risks for recreational bathing waters and health warnings issued in 2005 and 2008 by the USEPA and other agencies warned recreation visitors to use caution due to potential health effects. In addition, about two-thirds of recreation visitors to the subject reservoirs had negative perceptions of water quality, stating concerns of bad odors and algae blooms, which restrict areas available for fishing, swimming and wading. These adverse effects related to water quality negatively influenced the quality of the recreational experience for visitors and also resulted in safety risks to the recreational visitors. **Because existing conditions for water-contact-based recreational activities are considered adverse due to water quality, improved water quality conditions would result in long-term beneficial effects.**

*Dam removal could impede access for whitewater boating opportunities.* Dam removal would not affect whitewater boating access locations, as access areas are at established areas along the Klamath River channel, outside of the subject reservoirs and would not be affected by dam removal. As discussed in the impact analysis above and in Section 3.11, Geology, Soils, and Geologic Hazards, drawdown of the reservoirs would not result in substantial changes to the floodplain or river channel. Thus, no impacts to land-based recreational facilities are expected. **Therefore, there would be no adverse impacts on whitewater boating access downstream of Iron Gate Dam.** However, in the reaches between the existing dams, particularly in the Hell's Corner Reach, whitewater boating access would likely be affected due to dam removal activities and sedimentation, as discussed previously. **Impacts in reaches between the existing dams would be short term and less than significant.**

*Dam removal could increase the number of days with acceptable flows for various recreational activities in the Klamath River.* DOI modeled the average number of days providing acceptable river flows in specific reaches each month for specific recreational activities, both with and without dam removal (full modeling data is presented in Appendix R; DOI 2011b). Table 3.20-16 presents a summary of the model results, and Figures 3.20-4 through 3.20-11 show the results for each of the river reaches. The modeling results indicate that the greatest changes would occur in the Bypass Reaches, J.C. Boyle and Copco 2 Reaches, and in the existing peaking reach, Hell's Corner Reach. For the Keno Reach (see Figure 3.20-4) and the reaches downstream of Iron Gate Dam (Figures 3.20-8 through 3.20-11), the changes in the availability of flows within the acceptable flow ranges for whitewater boating and fishing opportunities would be

negligible. Therefore, impacts on whitewater boating and fishing opportunities in these reaches would be less than significant.

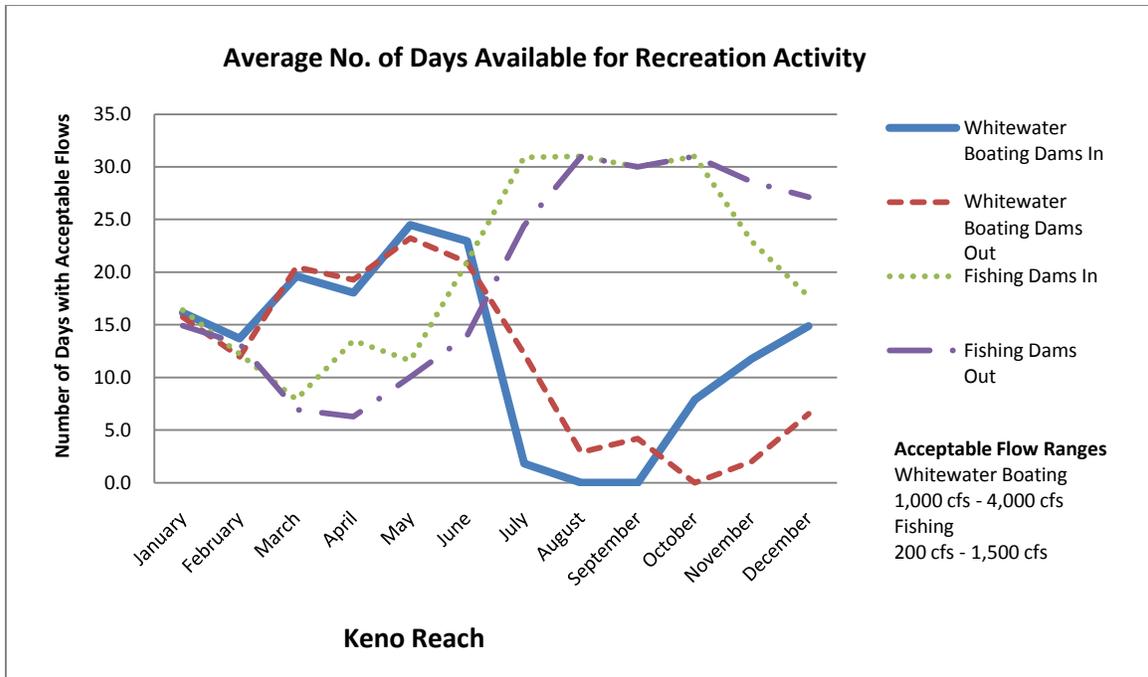
**Table 3.20-16. Estimated Number of Days Meeting the Range of Acceptable Flows for Recreational Activities on the Klamath River**

River Reach	Activity	Acceptable Flow Range		Total Avg. No Days Annually		
		Low Value (cfs)	High Value (cfs)	Dams In	Dams Out	Percent Change
Keno Reach	Whitewater Boating	1,000	4,000	151	139	-7.9%
	Fishing	200	1,500	246	238	-3.5%
J.C. Boyle Bypass Reach	Whitewater Boating	1,300	1,800	5	41	793.6%
	Fishing	200	1,000	107	142	32.6%
Hell's Corner Reach	Whitewater Boating/Rafting	1,300	3,500	278	119	-57.1%
	Fishing	200	1,500	234	228	-2.7%
Copco 2 Bypass Reach	Whitewater Boating	600	1,500	10	223	2,083.8%
	Fishing	50	600	14	3	-79.4%
Iron Gate to Scott River	Whitewater Boating/Fishing	800	4,000	278	281	1.0%
Scott River to Salmon River	Boating	800	7,000	243	246	1.4%
	Fishing	800	4,000	175	182	4.2%
Salmon River to Trinity River	Whitewater Boating/Fishing	800	10,000	207	211	1.8%
Trinity River to Ocean	Whitewater Boating/Fishing	1,800	18,000	239	238	-0.2%

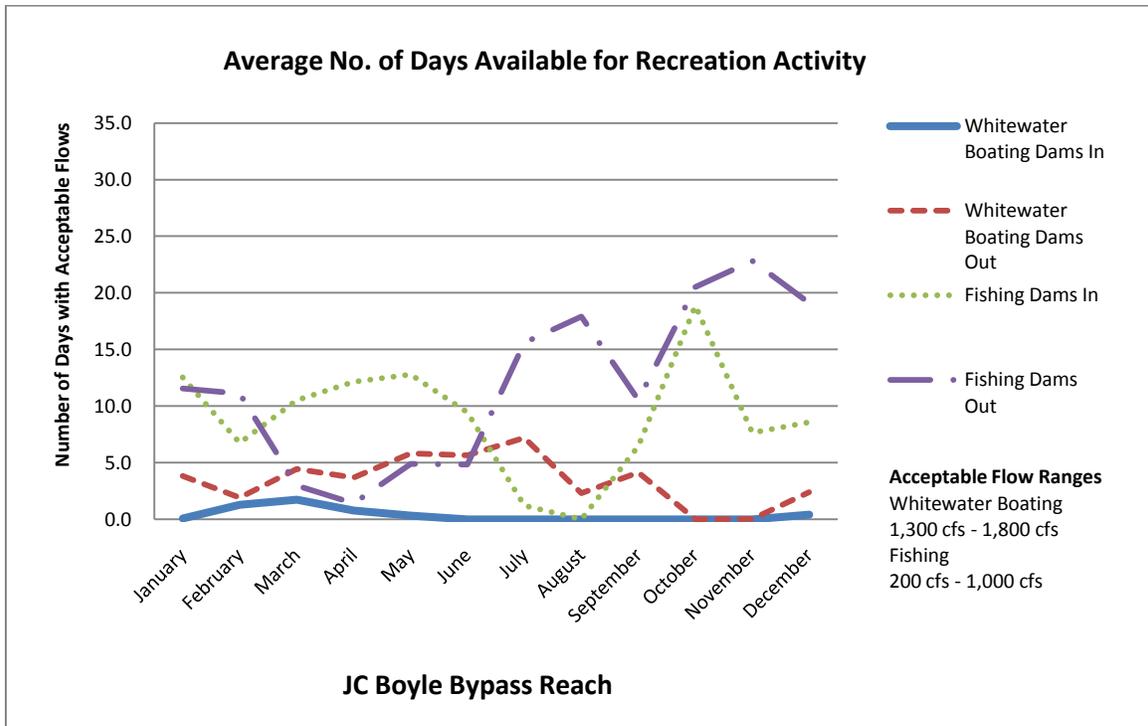
Source: Recreation Sub-Team, Appendix R

Key:

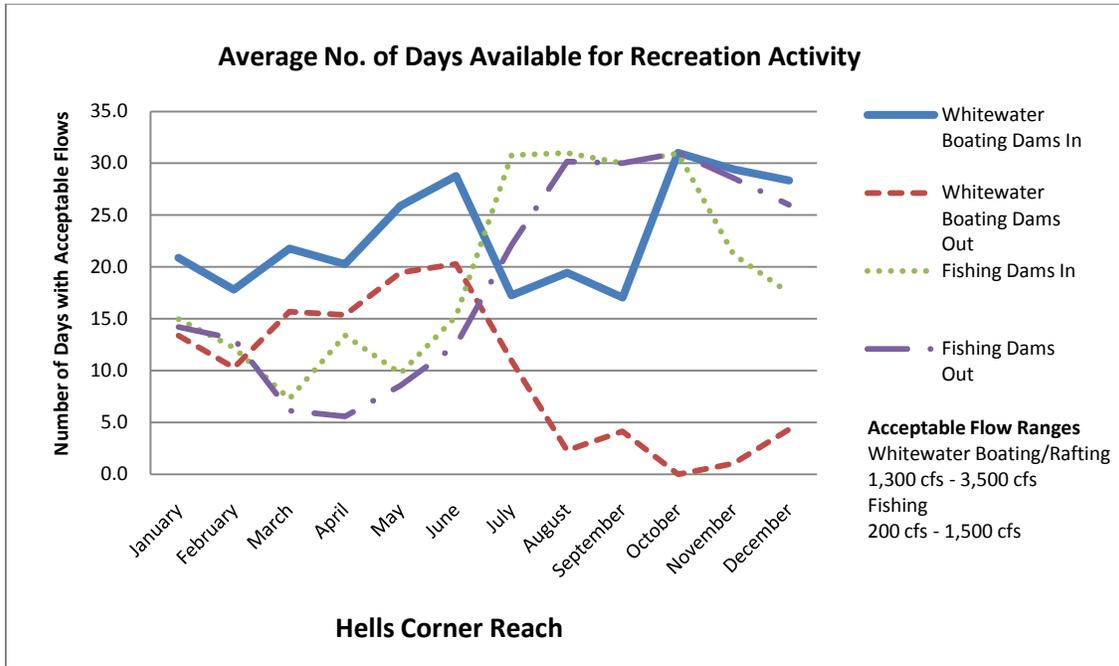
cfs: cubic feet per second



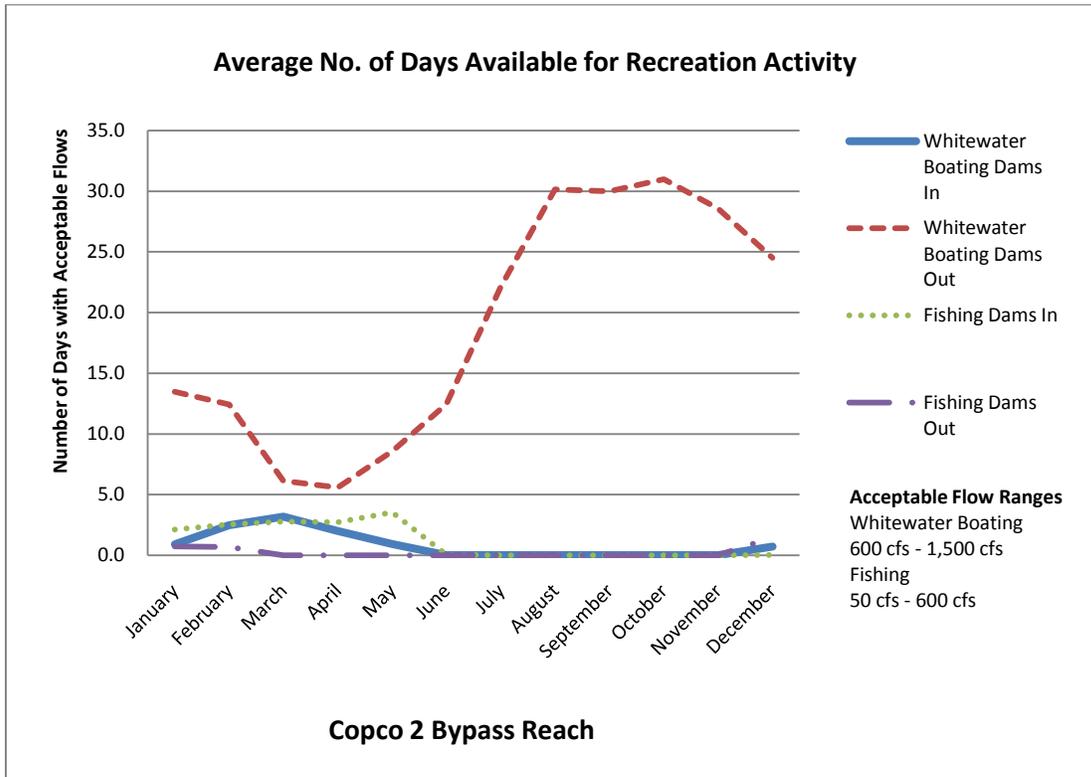
**Figure 3.20-4. Comparison of Available Recreation Flows - Keno Reach**



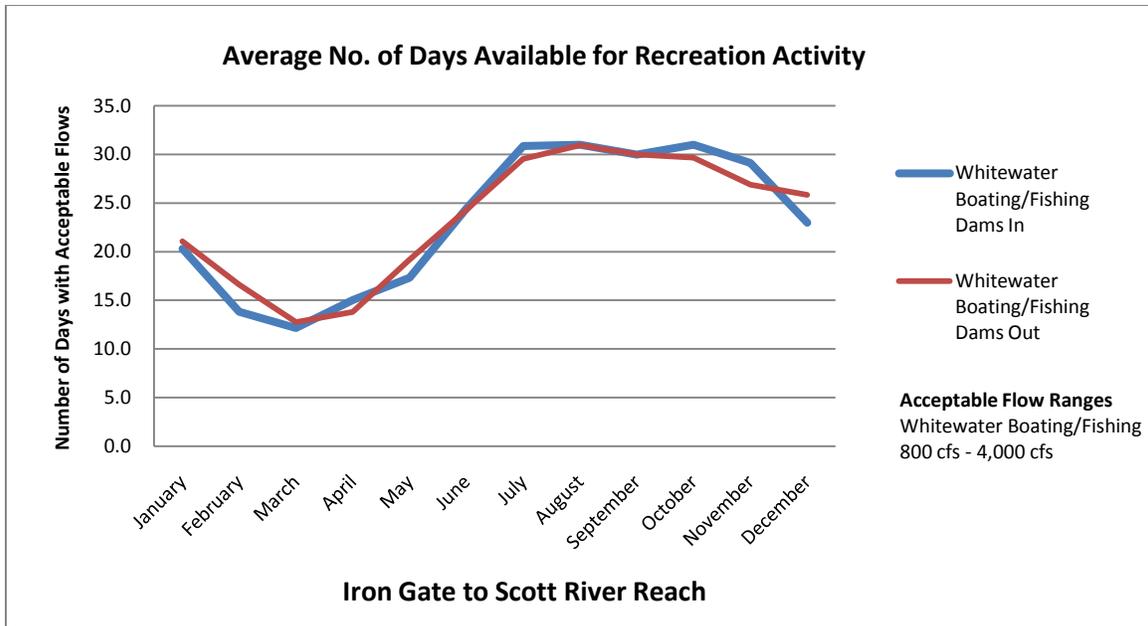
**Figure 3.20-5. Comparison of Available Recreation Flows - JC Boyle Bypass Reach**



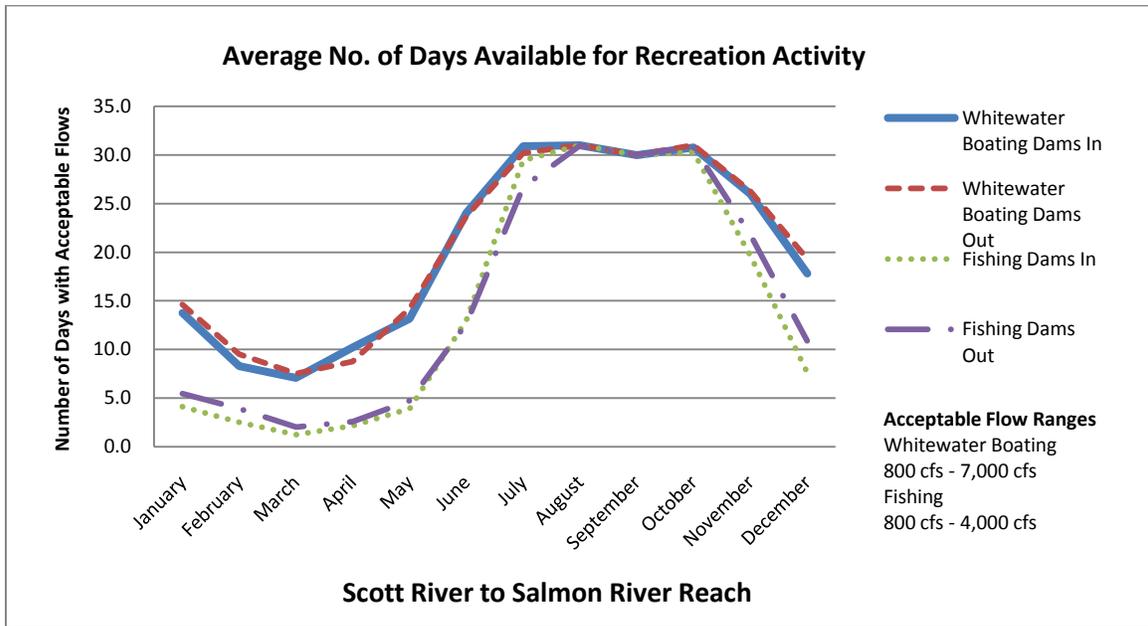
**Figure 3.20-6. Comparison of Available Recreation Flows - Hell's Corner Reach**



**Figure 3.20-7. Comparison of Available Recreation Flows - Copco 2 Bypass Reach**



**Figure 3.20-8. Comparison of Available Recreation Flows - Iron Gate to Scott River Reach**



**Figure 3.20-9. Comparison of Available Recreation Flows - Scott River to Salmon River Reach**

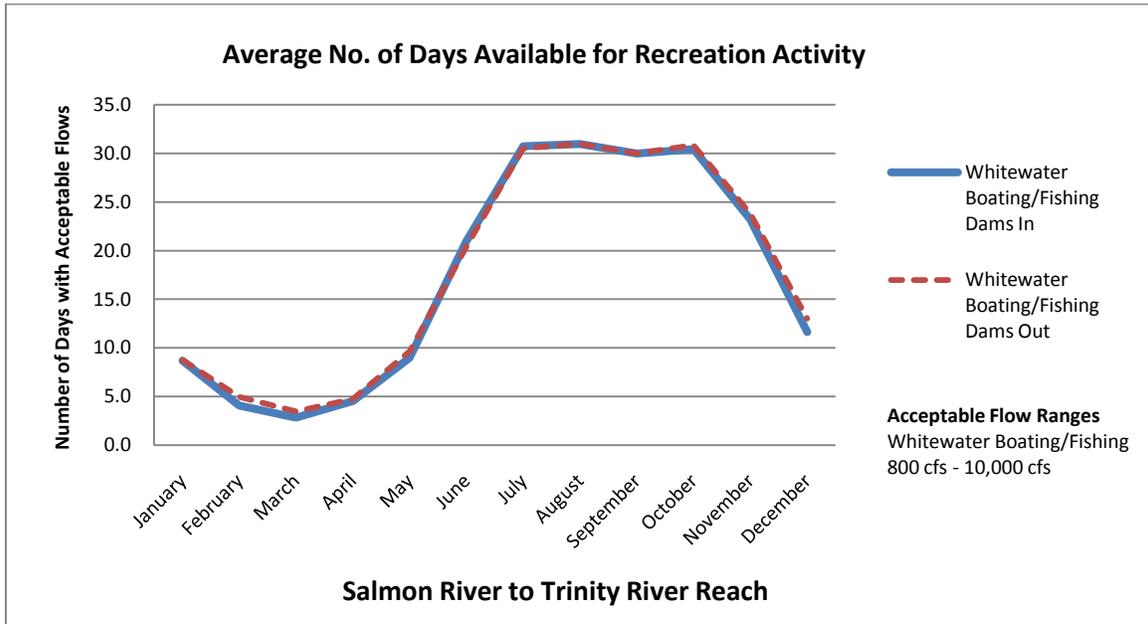


Figure 3.20-10. Comparison of Available Recreation Flows - Salmon River to Trinity River Reach

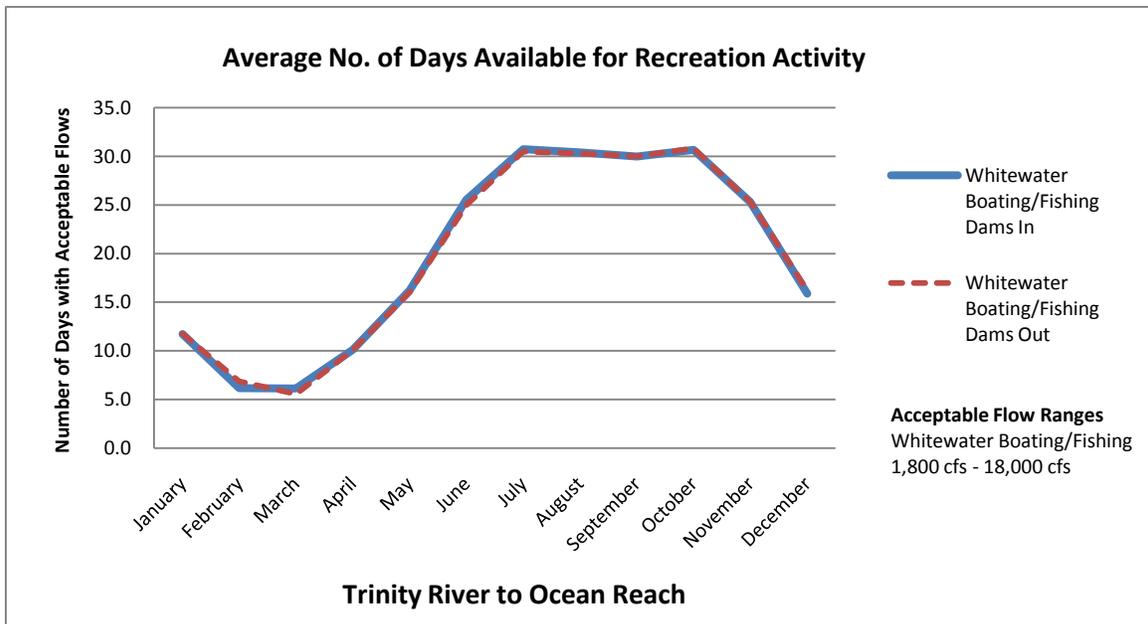


Figure 3.20-11. Comparison of Available Recreation Flows - Trinity River to Ocean Reach

*Dam removal could increase the number of days with acceptable flows for whitewater boating in the J.C. Boyle Reach.* For the J. C. Boyle Bypass Reach, for whitewater boating flows there would be a substantial increase in the availability of whitewater boating flows within the acceptable flow range, particularly during the May through July time period. Based on the modeling results, under the dams out scenario, there would be a shift from the availability of acceptable fishing flows during July/August time period to March through May time period (see Figure 3.20-5 and Appendix R for full data). For the Copco 2 Bypass Reach there would be a substantial increase in whitewater boating opportunities during the July through September time period (see Figure 3.20-7 and Appendix R for full data) and a slight reduction in length of time for Copco 2 for fishing, primarily a reduction during May time period in the availability of acceptable flows. **Therefore, the impacts on whitewater boating in the J.C. Boyle and Copco 2 Bypass Reaches would be less than significant. In regards to, fishing opportunities in these reaches, the impacts would be less than significant.**

*Dam removal could decrease the number of days with acceptable flows for whitewater boating in the Hell's Corner Reach.* For the Hell's Corner Reach (see Figure 3.20-6), there would be loss of acceptable flows for whitewater boating opportunities as compared to existing conditions, particularly during August (a reduction of about 88 percent) and September (a reduction of about 76 percent) (see Appendix R). In addition, there would no longer be predictable flows in terms of known timing for flow releases as under the existing conditions. The known timing of the releases allows the commercial outfitters to provide whitewater boating opportunities on a regular scheduled basis. Currently, the Hell's Corner Reach is the only Class V rapids in the region. The next closest Class V whitewater rafting reach is on the Salmon River (access via Nordheimer Campground in the Six Rivers National Forest) approximately 80 miles from Hell's Corner Reach. Whitewater rafters can boat on the Hell's Corner Reach from April through October due to hydroelectric peaking power and flows historically generated by J.C. Boyle Powerhouse to meet high power demand periods. In terms of fishing opportunities, there would be a reduction in the availability of acceptable flows during April; however, overall, the impacts would be minor. **Impacts on whitewater boating opportunities in the Hell's Corner Reach would be significant and unmitigable. Impacts on fishing would be less than significant.**

*Dam removal could result in increased fisheries populations and abundance, which would improve recreational fishing along the river.* As discussed in Section 3.3, Aquatic Resources, removal of the dams would improve habitat conditions for anadromous fish species and is expected to result in increased populations of these species. The increased fisheries populations and abundance would beneficially affect recreational fishing opportunities. More specifically, the increased abundance would allow for enhanced fishing opportunities and could decrease the number of closures of entire fishing seasons over the long-term. **These effects on recreation-based fisheries would be long-term and beneficial.**

*Implementation of Mitigation Measure REC-1 could permanently reduce recreational opportunities in the Klamath Basin.* As described below in section 3.20.4.4, Mitigation Measure REC-1 involves the development of a plan to develop new recreational facilities and river access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam following dam removal. However, replacement of recreation facilities would not be at a 1:1 ratio and would require the creation of new gravel roads for construction vehicle access and visitor access to the new recreation sites. While there would be a permanent loss of some recreation areas in the vicinity of the existing reservoirs, the combination of the implementation of REC-1 and the presence of regional recreation areas and opportunities (Table 3.20-4) would compensate for the loss of recreation areas at the subject reservoirs. **The impact from implementing Mitigation Measure REC-1, permanently reducing recreational opportunities in the Klamath Basin, would be less than significant.**

#### **Wild and Scenic River Assessment**

The following section provides an assessment of the effects of full facilities removal on each of the four resources specified in the WSR Act Section 7(a) (fish, wildlife, scenery, and recreation river values). The following evaluation criteria were used to assess the effects of the proposed project as compared with conditions present at the time of WSR designation.

#### **Scenic Evaluation**

*Dam removal could result in changes to water flow character (river flows and accompanying river width, depth, and channel inundation or exposure) compared with conditions present when the Oregon component was designated as a National WSR.* Short-term effects would result in a period of increased flows during the time of reservoir drawdown. The changed character of the river width would include areas of exposed substrate where water elevations recede; however, these areas would be outside of the WSR-designated areas. As modeled by the DOI (see Section 3.6, Flood Hydrology), dam removal would not substantially alter existing water flow character. River width and depth are defined by the geology of the region and the surrounding bedrock. As discussed in Section 3.11, Geology, Soils, and Geologic Hazards, river elevation and form downstream from the Four Facilities are primarily controlled by large boulders and bedrock, and only limited adjustment is possible. As described in Section 3.20.3.5, above, the degree of visibility of these scenic quality effects is dependent on viewer location. Views from on-river, in-river, or riverside viewpoints are most likely to display changes to these scenic quality indicators, while views from river canyon roadways and communities are less likely to find these scenic quality changes to be as noticeable or substantial. In the area where reservoirs currently exist, which are currently outside of the WSR-designated areas, but adjacent to the Oregon WSR component, the water elevations would recede and form a narrower channel, changing the conditions from a reservoir-based setting to a free-flowing riverine setting. **Therefore, for these reaches, the long-term scenic quality impacts would be positive due to the reestablishment of free-flowing water conditions, and would result in characteristics that may beneficially affect the potential of these reaches for WSR eligibility.**

*Dam removal could result in changes to water flow character (river flows and accompanying river width, depth, and channel inundation or exposure) compared with conditions present when the California component was designated as a National WSR.* Downstream, in the California WSR component, as discussed in Section 3.11, Geology, Soils, and Geologic Hazards, any substantial adjustment in river elevations or geomorphology would have already occurred in previous floods and no substantial changes to river morphology would occur following removal of the Four Facilities. Further, modeling conducted by DOI indicates that no long-term impacts would occur with regard to sediment deposition in pools, eddies, slack water, or beaches, and short-term effects would be limited to the area immediately below Iron Gate Dam. **Long-term scenic quality impacts would therefore be positive for the California WSR component.**

*Dam removal could result in changes to water appearance (clarity, turbidity, depth of view, color, and prominence of algae) compared with conditions present when the California and Oregon components were designated as National WSRs.* As discussed in Section 3.2, Water Quality, removal of the PacifiCorp facilities would eliminate the major sources of water quality problems associated with the dams. Removal of the dams would enhance downstream water appearance for the Oregon and California WSR scenery through its benefits of superior mixing and oxygenation of waters upstream from the WSR, renewal of streambeds through more frequent, high flow flushing events, and reversal of suspected nutrient increases within J.C. Boyle, Copco 1, and Iron Gate Reservoirs. Section 3.2, Water Quality, provides a detailed discussion of improvements to water quality, including reduced floating algae, and increased water clarity. Although removal of the dams would likely result in short-term increases in turbidity and decreased water clarity due to high suspended sediment concentrations during reservoir releases, particularly in the Oregon WSR component, long-term impacts would result in improved water appearance.

As discussed in Section 3.3, Aquatic Resources, spawning gravels released downstream from within the retired reservoirs would restore some natural sediment processes and contribute to scour of attached downstream algae. The deposited sand and gravel on the downstream reaches would be a less favorable habitat for the algae because of greater particle mobility during high-flow events. This would result in positive long-term impacts on scenic water appearance (improved clarity and algae reduction) within the river between Iron Gate Dam and the Shasta River confluence, and would likely have similar but reduced downstream benefits.

At the time of the Oregon WSR designation, the water appearance during summer base flow conditions was of slow-moving waters with large amounts of visible algae-covered rocks, and during peaking events the water appearance was altered to brown and murky colors with large quantities of algal foam. Information about scenery water appearance condition at the time of California WSR designation is lacking; however, it is likely that the trend of increasing habitat for attached algae with its associated water coloration, cloudiness, and limitations on depth of view was already underway at the time of WSR designation (Van De Water et al. 2006). Removal of the dams would restore natural

sediment movement in the streambed and would reduce opportunities for algae attachment, to a degree not possible in 1981 and 1994 due to the presence of the Four Facilities. **Thus, while there would be short-term negative water clarity impacts on scenic quality due to turbidity and silt which could be exposed on river banks, long-term effects to scenic quality would be beneficial for both the California and Oregon WSR components.**

*Dam removal could result in changes in opportunities for fish and wildlife viewing compared with conditions present when the California and Oregon components were designated as National WSRs.* As discussed in Section 3.3, Aquatic Resources, removal of the Four Facilities would increase the abundance of large anadromous fish in the Klamath River. The potential restoration of the anadromous fish populations would largely be the result of the increase of anadromous fish habitat within the Upper Klamath Basin, along with major water quality improvements within the Klamath WSR downstream of the Four Facilities. The increased population of fish species would improve scenic fish viewing attractions in both the California and Oregon components of the Klamath WSR. Increased fish viewing would be most prominent during fish migration, spawning, or holding periods, when the fish concentrate at particular reaches, pools, riffles, and falls. **Fish and wildlife viewing impacts to scenic quality would be long-term and beneficial as compared to the conditions at the time of the 1981 and 1994 designations for the Oregon and California WSR components.**

*Dam removal could result in changes in opportunities for river-dependent wildlife viewing compared with conditions present when the California and Oregon components were designated as National WSRs.* Specific effects on river-dependent wildlife populations and scenic viewing opportunities are unknown. As discussed in Section 3.5, Terrestrial Resources, riparian habitat within the Oregon WSR component and potentially beyond, in the Iron Gate Dam to Shasta River segment of the California WSR, would be improved by removal of the dams, and proportional increases in wildlife presence, increase in abundance of anadromous fish in the River and scenic wildlife viewing would be expected. **Therefore, impacts on river-dependent wildlife populations and scenic viewing opportunities would be long-term and beneficial as compared to the conditions at the time of the 1981 and 1994 designations.**

*Dam removal could result in changes to riparian vegetation compared with conditions present when the Oregon Klamath River component was designated as National WSRs.* As discussed in Section 3.5, Terrestrial Resources, removal of the Four Facilities would result in alteration of the reservoirs and associated shoreline vegetation, with reduced water elevations and more riverine character, with increases in riparian vegetation in the areas where the existing reservoir substrates would convert and be revegetated over time. **This would therefore result in long-term, beneficial impacts on riparian vegetation aspects of scenic quality within the areas immediately upstream and downstream of the Oregon WSR component as compared to conditions at the time of the 1994 designation.**

*Dam removal could result in changes to riparian vegetation compared with conditions present when the California Klamath River component was designated as National WSRs.* Removal of the Four Facilities would result in a more natural riparian vegetative community immediately downstream of Iron Gate Dam due to sediment deposition and scour and gravel transport. Improved riparian vegetation would increase the presence and scenic variety of the vegetation within the WSR. **This would likely increase overall scenic riparian vegetation aspects of scenic quality over conditions present at the California WSR's 1981 date of designation and result in long-term beneficial effects.**

*Dam removal could result in changes to the natural appearing landscape character as compared with conditions present when the Oregon Klamath River component was designated as National WSRs.* As discussed in Section 3.19, Scenic Quality, removal of the Four Facilities would result in a more natural setting and character in the areas immediately upstream and downstream of the Oregon WSR component of the Klamath River. The visual setting of the area would also change substantially from views of lakes and PacifiCorp facilities to that of a winding riverine system. **The Four Facilities were present at the time of the 1994 WSR designation of the Oregon component; therefore, removal of the Four Facilities would restore the WSR segments to a more natural flow regime and landscape character and would result in long-term beneficial scenic quality effects.**

*Dam removal could result in changes to the natural appearing landscape character as compared with conditions present when the California Klamath River component was designated as National WSRs.* The California WSR component is downstream of the Four Facilities; therefore, removal of the dam and associated facilities would not result in any changes to the overall landscape character in this segment of the river. However, as discussed in Section 3.2, Water Quality, water clarity in the WSR component is expected to improve, as is the quality of the riparian vegetation. **These improvements would result in a more natural flow regime and landscape character for the WSR segments and result in a long term positive scenic quality effect.**

### **Recreation Evaluation**

*Dam removal could improve opportunities for whitewater boating compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* Whitewater boating opportunities relating to river flow following removal of the Four Facilities would likely be similar to conditions in 1981 for the California WSR component. As discussed in the impact analyses above (see Table 3.20-16), for the Oregon WSR component and the Hell's Corner Reach, the number of days acceptable for whitewater boating would decrease by approximately 57 percent following removal of the dams. For the California WSR component, downstream of Iron Gate Dam, following removal of the dams, the number of days available for whitewater boating would be very similar to the number of days currently available. **Therefore, long-term whitewater boating impacts due to changes in flow would be negative for the Oregon WSR component. No impacts to whitewater boating opportunities due to flow would occur for the California WSR component. Removal of the dams would also result in long-term improvements to water quality conditions over existing**

**conditions and the 1981 and 1994 conditions. With improved water quality, the whitewater boating recreation experience would improve in both the Oregon and California WSR components. Therefore, long-term whitewater boating impacts due to improved water quality would be beneficial for both the California and Oregon WSR components.**

*Dam removal could increase opportunities for recreational fishing compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* As discussed in the impact analyses above, removal of the Four Facilities would not affect water flow such that days with acceptable flows for recreational fishing would substantially increase. However, as described in Section 3.3, Aquatic Resources, the geographic extent of the Klamath River fish habitat would be substantially expanded compared to 1981 and 1994 conditions. It is also expected that water quality conditions would improve, thereby reducing fish disease. Increased fish populations would likely result in fewer catch and keep fishing restrictions. **Thus, recreational fishing impacts would be long-term and beneficial for both the California and Oregon WSR components.**

*Dam removal could result in changes to opportunities for other recreational activities (water play, swimming, camping) compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* Removal of the Four Facilities would result in a long-term decrease of lake and reservoir-based recreational activities associated with the Klamath River in the area immediately upstream and downstream of the Oregon WSR component as compared to conditions at the time of the 1994 designation. Activities that would be most affected are water-contact-based activities, reservoir-based fishing, and flatwater boating. Dam removal would also result in removal of camping and day use facilities that would no longer be directly adjacent to the water's edge. Short-term, negative impacts would occur as a result of the construction activities and staging areas and likely restricted access and use of recreation facilities and opportunities during the period and in the areas where dam removal occurred. **Development of new recreational facilities and river access areas as described in Mitigation Measure REC-1 would reduce long-term negative impacts on reservoir-based recreational activities in these areas to a less than significant level.**

**For the California WSR component, dam removal would not affect recreational activities access downstream of the dams. Thus, dam removal would result in no long-term or short-term impacts on recreational activities in these areas as compared to the 1981 conditions.**

*Dam removal could improve the recreational setting (water-quality related aesthetics, odors, tastes, contacts, and public health and safety aspects) compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* Although there would be short-term, negative impacts on water quality due to the increased sediment load in the river during initial drawdown activities, particularly in the Oregon WSR component, as discussed in Section 3.2, Water Quality,

following completion of reservoir drawdown, dam removal would improve water quality conditions as compared with conditions present at the time of the 1981 and 1994 designations. There could be short-term, negative impacts (lasting less than two years) during reservoir drawdown due to the potential for sediment to clog fishing holes, or possibly make the river less navigable, or even less accessible along shorelines temporarily blocked by sediment deposits.

Alternatively, new beaches and riparian areas may become established to increase the variety of shoreline settings. Most of these effects would be temporary and many aspects of the WSR's recreation setting would be considerably improved once the river stabilizes. The improved water quality conditions following completion of drawdown activities would improve the recreational setting overall (i.e., with improved clarity during swimming and fishing and reduced malodors and tastes [Bartholow et al 2005]). With regard to public health, improved water quality would also reduce potential human health risks associated with water-contact-based activities. **Therefore, impacts on the recreational setting would be long-term and beneficial for both the California and Oregon WSR components.**

### **Fisheries Evaluation**

*Dam removal could alter stream flow regime compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* Section 3.6, Flood Hydrology, discusses historic flow rates and discharge statistics for each of the reservoirs. The proposed drawdown rates are consistent with the historic discharge rates from the reservoirs and would be adjusted depending on the water year; therefore, flow rates downstream from the dams are not anticipated to increase substantially above historic rates, if at all. As such, conditions during the drawdown period are expected to remain largely unchanged as compared to stream flow regimes at the time of the 1981 and 1994 designations.

Following removal of the Four Facilities, the Klamath River would return to a natural flow regime in the reaches where the reservoirs currently exist. Restoration of the natural flow regime would improve water quality conditions, likely reducing the occurrence of myxozoan parasites (*Ceratomyxa shasta* and *Parvicapsula minibicornis*) that are known to negatively affect salmonids. Removal of the hydroelectric reservoirs would eliminate populations of blue-green algae that produce toxins that can result in acute and chronic effects on fish, including increased mortality, reduced fecundity, reduced feeding, and habitat avoidance. **Stream flow regime impacts would be long-term and beneficial for both the California and Oregon WSR components.**

*Dam removal could decrease fall water temperature compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* Removal of the Four Facilities would improve water quality conditions over existing conditions and the 1981 and 1994 conditions. As described in Sections 3.2, Water Quality, and 3.3, Aquatic Resources, following dam removal, the temperature regime downstream of Iron Gate Dam would be more suitable for salmon. As part of its relicensing procedure, PacifiCorp modeled changes in water temperature that could result

following removal of the dams. The modeling results show that from Iron Gate Dam to Clear Creek temperatures in the spring and early summer would be as much as 5°C warmer, but cooler in later summer and fall than under existing conditions. Temperatures currently remain greater than 20°C in dry years with little variability in July and August. Although summer temperatures would likely be more variable following dam removal, the median temperatures would be substantially lower than current conditions. Summer and fall temperatures would therefore be more conducive to salmon rearing, migrating, and spawning than the conditions that were probable at the date of designation (Van de Water et al. 2006). However, as discussed in Section 3.2, Water Quality, in reaches above J.C. Boyle Reservoir and downstream of Clear Creek, there would be little to no change in the existing temperature regime. **Water temperature impacts would therefore be long-term and beneficial for the California WSR component, and there would be no change from existing conditions in the Oregon WSR component.**

*Dam removal could improve water quality characteristics (physical, biological, and chemical) compared to conditions present when the California and Oregon Klamath River components were designated as National WSRs. Removal of the Four Facilities would eliminate the major sources of water quality problems in the Upper Klamath Basin and enhance downstream water quality for salmonids. Removal of the dams would also reduce conditions that foster fish disease outbreaks.*

As discussed in Section 3.2, Water Quality, following dam removal, long-term dissolved oxygen levels would be anticipated to meet applicable Basin Plan objectives. However, modeling indicates that nitrogen loading downstream of Iron Gate Dam would increase slightly above existing levels due to the release of sediments from the reservoirs, but the removal of a lacustrine environment in the reservoir area would reduce the abundance of algae that form habitat for the intermediate host for at least two salmon pathogens. The improved water quality conditions would reduce fish crowding, which, as discussed in Section 3.3, Aquatic Resources, would result in reduced temperature-induced stress and could allow for spawning to begin earlier in the fall. **Impacts on water quality characteristics would therefore be long-term and beneficial for both the California and Oregon WSR components.**

*Dam removal could alter geomorphic conditions, sediment transport regime, and substrate quality compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs. As discussed in Section 3.11, Geology, Soils, and Geologic Hazards, and Section 3.3, Aquatic Resources, sediment stored in the subject reservoirs would be released downstream. The released sediment would have short-term, negative effects on aquatic habitat, but following completion of reservoir drawdown, the increased spawning gravel released from upstream could enhance spawning habitat. Restoring natural sediment processes would contribute to scour of attached algae (e.g., *Cladophera* spp.), and deposited sand and gravel would be a less favorable substrate for the algae because of greater particle mobility during high-flow events than the existing armored substrate. A reduction in such algae would lead to reduced habitat for the fish pathogen's alternate host.*

Information about habitat conditions at the time of WSR designation is lacking; however, it is likely that trends of river coarsening, increasing habitat for attached algae, and reduced recruitment and maintenance of riparian vegetation were already underway at the time of WSR designation due to PacifiCorp facilities and operations. The Proposed Action would reduce those trends in the long term, and restore natural sediment transport processes, which were no longer in place by 1981 and 1994. Following the initial drawdown period and flushing of reservoir sediment downstream, aquatic habitat conditions would be expected to be improved from conditions in 1981 and 1994 in the long term. **Therefore, impacts on aquatic habitat conditions would be long-term and beneficial for both the California and Oregon WSR components.**

*Dam removal could improve conditions for anadromous fish species compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* As discussed in Section 3.3, Aquatic Resources, dam removal would result in beneficial long-term effects on anadromous salmonids. However, sediment released during dam removal could be sufficient to cause substantial smothering of spawning gravels, pool infilling, gill abrasion, and changes to holding and migration patterns in the river reaches immediately below Iron Gate Dam. These impacts would be short term (lasting less than two years), as sediment is expected to be flushed through the river system relatively quickly. In the long term, dam removal would eliminate the source of most of the water quality issues on both the California and Oregon WSR components that are influenced by the presence of the PacifiCorp facilities. In particular, dam removal would reduce late summer and fall heating, summertime dissolved oxygen depletion, in-reservoir nutrient cycling with resultant summer releases of nitrogen downstream. Removal of the Four Facilities would also eliminate a fish barrier and allow fish to spawn in a greater number of areas. Consequently, fish disease outbreaks could be diminished. Removal of the Four Facilities would also result in habitat conditions that more closely resemble natural conditions (e.g., flow and temperature ranges would be more reflective of climatic forces than of water regulation). However, continuation of the operation of the Iron Gate Fish Hatchery would reduce some of the beneficial effects of dam removal by continuing pressures on natural stocks that would improve with dam removal. Even so, Chinook salmon, coho salmon, and steelhead abundance would still be expected to increase over 1981 and 1994 levels in the long term. **Long-term beneficial impacts on conditions for anadromous fish species would result for both the California and Oregon WSRs.**

*Dam removal could improve conditions for resident fish species compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* As discussed in Section 3.3, Aquatic Resources, removal of the Four Facilities would improve conditions for native resident fish species by restoring connectivity between the Lower and Upper Klamath River, and by returning a natural flow regime to the reaches where the reservoirs currently exist, thereby improving water quality. Dam removal would also likely result in diminished non-native fish habitat and populations, reducing competition for space and resources with native and resident fish. Because the non-native fish were introduced and occur in other nearby water bodies, their loss would not be considered significant from a biological perspective

and is not included in this effect evaluation. **Therefore these impacts on the conditions for resident fish species would be long-term and beneficial in both the California and Oregon WSR components.**

*Dam removal could improve conditions for species traditionally used and culturally important to Indian Tribes compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* As discussed in Section 3.3, Aquatic Resources, removal of the Four Facilities would improve conditions for culturally important fish species (e.g., Chinook salmon, coho salmon, steelhead, and lamprey) by restoring connectivity between the Lower and Upper Klamath River, and by returning a natural flow regime to the reaches where the reservoirs currently exist and downstream of Iron Gate Dam, thereby improving water quality. Dam removal would also likely result in diminished non-native fish habitat and populations, reducing competition for space and resources with native and resident fish. **Impacts on the conditions for species traditionally used and culturally important to Indian Tribes would be long-term and beneficial in both the California and Oregon WSR components.**

#### **Wildlife Evaluation**

*Dam removal could result in changes to habitat for special status species compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.* Conversion of the reservoirs to free-flowing riverine character in the Oregon WSR component would result in beneficial establishment of riparian vegetation over the long term due to fine sediment released into this section would allow the establishment of such vegetation.

Following dam removal, active restoration would be needed to revegetate the riparian areas along the newly created river channel. Restoration activities would be carried out in accordance with the Reservoir Area Management Plan (DOI 2011c), as described in Section 3.5, Terrestrial Resources. Invasive plant species would be controlled with the use of herbicides such as glyphosate that have low soil mobility and low toxicity to fish and aquatic organisms (DOI 2011c). Additionally, as described in Section 3.5, Terrestrial Resources, active control measures would be required to protect against the colonization of invasive or weedy species on newly exposed areas. A Habitat Restoration Plan and construction specifications would be developed once the Definite Plan is available and would be submitted to the resource agencies for review and approval as part of required permit application packages prior to construction.

Riparian vegetation in the California WSR component downstream of the Iron Gate Dam would also benefit from dam removal, especially in the reach between the Iron Gate Dam and the Shasta River confluence. Special status species that are dependent on riparian habitat, such as the willow flycatcher, northwestern pond turtle, and yellow breasted chat, would benefit greatly from successful riparian habitat recovery from Iron Gate Dam downstream to the Klamath River's confluence with the Shasta River. Downstream from that point, the riparian-dependent wildlife would still benefit from increased diversity and amounts of riparian vegetation, but these benefits might be offset by some potential

short-term impacts as the released sediment moves downstream into areas that are currently in better condition.

In addition to improving riparian habitat, the Proposed Action would result in improvements in fish resources in the long term following dam removal, thus providing increased forage for wildlife species that depend upon fish as a food source. The area currently blocked by dams would provide additional available habitat for anadromous fish. The increase in habitat quality and quantity should allow the number of anadromous fish to increase substantially. Increased numbers of fish would also create greater foraging opportunities for riparian and riverine species such as bald eagle, river otter, osprey and black bear. **Therefore, there would be long-term, beneficial impacts on habitat for special status species in both the California and Oregon WSR components.**

#### **East and West Side Facilities Decommissioning**

*The decommissioning of the East and West Side Facilities could have adverse effects on recreational resources.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the Klamath Hydroelectric Settlement Agreement (KHSAs) will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. **Therefore, there will be no change from existing conditions caused from decommissioning the East and West Side Facilities.**

#### **Keno Facilities Transfer**

*Transfer of the Keno Facility from PacifiCorp to DOI could affect recreational opportunities.* Keno Dam is an unmanned facility which requires minimal operations and maintenance. Recreation facilities owned by PacifiCorp in the vicinity of Keno Impoundment will also be transferred to DOI as described in the KHSAs section 7.5. Operation of Keno Dam and of the recreation areas are expected to continue in their current fashion. **The transfer of the facility and recreation lands will result in no changes from existing conditions.**

#### **KBRA**

The Klamath Basin Restoration Agreement (KBRA) has several programs that could result in short-term and long-term changes to recreational opportunities in the Klamath Basin. Such changes would be the result of temporary construction activities as well as long-term increases in aquatic habitat and fish populations, improvements to water quality, and improvements to terrestrial resources. Specific KBRA programs potentially affecting recreational opportunities include:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration
- Water Diversion Limitations

- On-Project Plan
- Water Use Retirement Program (WURP)
- Climate Change Assessment and Adaptive Management
- Interim Flow and Lake Level Program

*Construction activities associated with the KBRA programs could temporarily restrict access to recreational opportunities.* Construction activities including channel construction, fish passage and facilities construction, breaching levees, and fish hauling would likely involve the use of heavy equipment along floodplain and riparian areas and therefore could result in restrictions to public access for recreational activities, such as sightseeing, bank fishing, swimming, and wading. Because restoration activities would occur throughout the entire basin, specific sections of the river could be closed for a period of time throughout implementation of the KBRA programs. However, as described in the Affected Environment section, there are a number of recreational areas offering similar activities and settings throughout the basin. It is likely that for any particular project, there would be an alternative recreational area nearby that could be used during temporary closures. Construction related to KBRA programs could occur in the same location and time as construction actions for the hydroelectric facility removal and affect access to or availability of recreation resources. However, because of the multitude of resources in the region, effects to recreation under both the KBRA and KHSA would be less than significant. **Thus, potential impacts to recreational opportunities are anticipated to be less than significant. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Construction activities associated with KBRA programs could result in short-term water quality impacts which could affect recreational opportunities.* Erosion and sedimentation during construction activities has the potential to temporarily decrease water quality and reduce water visibility for boaters, swimmers, and fisherman. These short-term water quality impacts would be anticipated to occur throughout the basin where construction activities take place. Specific sections of the river could be affected for a period of time throughout implementation of the KBRA programs. However, following implementation and related construction activities for KBRA programs including the Wood River Wetland Restoration, and the Interim Flow and Lake Level Program, WURP, water quality and clarity would be expected to improve. Additionally, as described above, short-term impacts would be offset by the ability of visitors and local recreationalists to use the recreational areas with similar activities and settings throughout the basin. Construction related to KBRA programs could occur in the same location and time as construction actions for the hydroelectric facility removal and affect water quality at recreation resources. However, because of the multitude of resources in the region, effects to recreation under both the KBRA and KHSA would be less than significant. **Potential impacts would be short-term and, with implementation of construction BMPs, are anticipated to result in less than significant water quality related recreational impacts. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin.* As described above for the No Action/No Project Alternative, it is expected that landscape scale prescribed fire treatments would result in a short-term adverse effect of the visual quality of the burned area, which could directly affect the number of recreational visitors to the area. In the short-term, prescribed fire treatments would be less than significant. Prescribed fire treatment actions would not occur in the same location and at the same time as hydroelectric facility removal actions; therefore, potential for any visual quality improvements generated by these prescribed fire treatment actions would not change effects of facility removal. **Impacts are anticipated to be long-term and beneficial because they are expected to return the forests to a more natural condition. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.* It is expected that correction of fish passage issues throughout the basin would restore fish access to new and historic habitats and result in increased fish populations. KBRA programs such as the Fisheries Reintroduction and Management Plan, and the Wood River Wetland Restoration include actions to restore and create fish habitat and wetlands for endangered fish species. Additionally, projects such as Water Diversion Limitations would increase water availability for fisheries. It is anticipated that these programs and projects would result in increased fish populations and abundance, which would beneficially affect recreational fishing opportunities. More specifically, the increased abundance would allow for increased catch limits and fewer catch and release requirements, as well as decrease the potential of closures of entire fishing seasons as those that occurred on the Klamath River in the recent past. Correction of fish passage issues as a result of the KBRA would support the positive improvements to recreation from increased fish populations due to hydroelectric facility removal. **These changes are anticipated to result in beneficial effects to recreational experiences throughout the Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin.* KBRA programs including the Fisheries Restoration Plans Phase I and II; Fisheries Reintroduction and Management Plan; Wood River Wetland Restoration; WURP; and, Interim Flow and Lake Level Program would result in long-term benefits to water quality throughout the Klamath Basin. As described in Section 3.2, Aquatics Resources, improvements in water quality would enhance fisheries habitat in the Klamath River and tributaries. Improvement of water quality as a result of KBRA actions would support positive improvements to recreation from improved water quality due to hydroelectric facility removal. **It is anticipated that improvements in fish habitat and abundance would benefit recreational opportunities in Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin.* KBRA programs including Fisheries Restoration Plans Phase I and II; Wood River Wetland Restoration; Water Diversion Limitations; On-Project Plan; WURP; and, Interim Flow and Lake Level Programs would result in long-term benefits to terrestrial species as a result of restored floodplain and riparian vegetation and habitat areas. While short-term construction activities involved in the implementation of some of these programs would result in short-term adverse impacts on terrestrial resources, the long-term effects of habitat restoration would be expected to benefit terrestrial species in the Klamath Basin. KBRA programs like the Wood River Wetland Restoration project are anticipated to increase habitat for waterfowl, water birds, and other species utilizing wetland and open water habitat at Upper Klamath Lake. Improvement of terrestrial wildlife and plant resources as a result of the KBRA would support positive improvements to wildlife viewing due to hydroelectric facility removal. **It is anticipated that improvements and increases in terrestrial wildlife habitat would benefit recreational wildlife viewing and recreational hunting opportunities in the Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **Alternative 3: Partial Facilities Removal of Four Dams**

Under this alternative, short-term demolition activities and drawdown of reservoirs would still occur; however, demolition would consist only of in-stream facilities and select ancillary facilities; other ancillary facilities associated with the KHP would remain in place. Recreation facilities would be removed with the exception of Topsy Campground, Fall Creek and Jenny Creek Day Use Areas, and the Iron Gate Fish Hatchery Day Use area, as under the Proposed Action and the impact would therefore be the same as described previously. With regard to the WSR setting, impacts would be the same as for the Proposed Action, with the exception of the magnitude of positive impacts of returning the reservoir areas that are adjacent upstream and downstream of the Oregon WSR component to a more natural visual setting. Because some ancillary facilities associated with the KHP would remain in place, positive impacts as compared to the 1994 Oregon WSR designation would be fewer and at a smaller scale than as described for the Proposed Action.

#### **East and West Side Facilities Removal**

*The decommissioning of the East and West Side Facilities could have adverse effects on recreation.* The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action. **Therefore, the decommissioning activities would have no change from existing conditions on recreation.**

#### **Keno Facilities Transfer**

*Transfer of the Keno Facility from PacifiCorp to DOI could affect recreational opportunities.* Keno Dam is an unmanned facility which requires minimal operations and maintenance. Recreation facilities owned by PacifiCorp in the vicinity of Keno Impoundment will also be transferred to DOI as described in the KHSA section 7.5. Operation of Keno Dam and of the recreation areas are expected to continue in their

current fashion. **The transfer of the Keno Facility and recreation lands will have no change from existing conditions on recreational resources or facilities.**

### **KBRA**

Under this alternative the KBRA would be fully implemented; therefore, impacts on recreation facilities and opportunities would be the same as described for KBRA under the Proposed Action.

### **Alternative 4: Fish Passage at Four Dams**

*The Fish Passage at Four Dams Alternative could change existing recreation access and opportunities.* Impacts under this alternative would be similar to those described under the No Action/No Project Alternative. Because the dams would remain in place, none of the expected beneficial changes to water quality would occur; therefore, beneficial effects with regard to water-contact-based activities described under the Proposed Action would not occur. The recreational setting (campgrounds, day use areas, and water access areas) would remain as described in the Affected Environment section. **Under the Fish Passage at Four Dams Alternative, existing conditions for recreational fishing within the river and water-contact-based activities at the subject reservoirs would have no change from existing conditions.**

*Implementation of the prescriptions provided by the USFWS, DOI, and United States Department of Commerce in the FERC 2007 EIS could change whitewater boating opportunities in the Hell's Corner Reach.* There would be a loss of acceptable flows for whitewater boating opportunities in the Hell's Corner Reach as compared to existing conditions. The prescriptions set minimum streamflow requirements for the Peaking Reach downstream of J.C. Boyle Powerhouse. A minimum streamflow of 1,500 cfs must be provided no more than once per week as opposed to existing conditions where acceptable whitewater flows are maintained a majority of the time. In addition, there would no longer be predictable flows in terms of known timing for flow releases as under the existing conditions. **Impacts on whitewater boating opportunities in the Hell's Corner Reach would be significant and unavoidable.**

*Fish passage facilities would result in increased fisheries populations and abundance, which could improve recreational fishing along the river.* As discussed in Section 3.3, Aquatic Resources, installation of fish passage at the dams would likely beneficially affect anadromous fisheries in the Klamath River, although not to as great a degree as under the Proposed Action. Increased abundance and population of recreational fishery species would likely result in beneficial effects on recreational fishing downstream of Iron Gate Dam. More specifically, the increased abundance would allow for increased catch limits and fewer catch and release requirements, and would decrease the number of potential fishing season closures such as those that occurred on the Klamath River in the recent past. **Impacts with regard to recreational fishing opportunities would be long-term and less than significant.**

**Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

*Dam removal could permanently remove recreational facilities in the area of Copco 1 and Iron Gate Reservoirs.* Under this alternative, Copco 1 and Iron Gate Dams would be removed, but Copco 2 Dam and J.C. Boyle Dam would remain in place. The impacts would be similar to those described for the Proposed Action for the areas surrounding the Copco 1 and Iron Gate Reservoirs; recreation facilities at these sites would be removed. **Impacts on recreational facilities at Copco 1 and Iron Gate reservoirs would be considered permanent and significant; however, implementation of Mitigation Measure REC-1 would reduce these impacts in the long-term to less than significant.**

*Dam removal could permanently decrease the availability of reservoir/lake-based recreational opportunities.* Reservoir-based recreational opportunities (e.g., swimming, bathing, wading, and reservoir-fishing) would be lost at Iron Gate and Copco 1 Reservoirs, although visitors would still be able to travel to J.C. Boyle Reservoir for these activities; thus, adverse impacts would be fewer and smaller in scale than those described for the Proposed Action. **Impacts on the regional availability of reservoir-based recreational opportunities would be less than significant.**

*Dam removal could change whitewater boating opportunities in the Klamath River.* With regard to changes in whitewater boating opportunities, the existing Copco 1 and Iron Gate Reservoirs would be converted to free-flowing riverine reaches over the long term, and depending on the river channel and access, could provide additional opportunities for whitewater boating in these reaches (Appendix R). **Impacts on whitewater boating opportunities would be less than significant.**

*Loss of peaking flows in the J.C. Boyle Peaking Reach could affect whitewater boating opportunities in the Hell's Corner Reach.* The loss of peaking flows in the Hell's Corner Reach would result in the river returning to natural flow conditions, with no ability to re-regulate peaking flows. Thus, there would be diminished whitewater boating opportunities in this reach. **Impacts on whitewater boating opportunities in the Hell's Corner Reach would be significant and unmitigable.**

*Changes in water quality associated with dam removal could positively affect water-contact-based recreational opportunities.* As discussed in Section 3.2, Water Quality, improvements in water quality are expected; however, these improvements would be less than as described under the Proposed Action. Therefore, beneficial effects on water-contact-based recreation would occur as described for the Proposed Action, in the river channel below J.C. Boyle and Copco 2 Dams. Beneficial effects would not be anticipated to occur in the J.C. Boyle Reservoir (as described above, there are little to no recreational facilities at Copco 2 Reservoir). Also, as discussed in Section 3.3, Aquatic Resources, populations and abundance of anadromous fish would increase under this alternative (although not to the same degree described for the Proposed Action); therefore, beneficial effects on recreational fishing would be similar, but less than those described for the Proposed Action. **Because existing conditions for water-contact-**

**based recreational activities are considered adverse due to water quality, improved water quality conditions would result in long-term beneficial effects.**

#### ***3.20.4.4 Mitigation Measures***

##### **Mitigation Measure by Consequences Summary**

REC-1 – At least one year before starting dam removal activities, the DRE will prepare a plan to develop new recreational facilities and river access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. The plan will be developed in consultation with appropriate state and federal agencies (e.g., BLM and CDFG) and stakeholder groups, and will include an implementation schedule for construction of recreational facilities and river access areas.

##### **Effectiveness of Mitigation in Reducing Consequences**

Implementation of Mitigation Measure REC-1 will ensure that access to the Klamath River at the location of the removed reservoirs will remain available following dam removal. The potential for fewer recreational opportunities than currently exist would be less than significant (See section 3.20.4.3)

##### **Agency Responsible for Mitigation Implementation**

The DRE would be responsible for implementing mitigation measure REC-1.

##### **Remaining Significant Impacts**

Following implementation of Mitigation Measure REC-1, no significant adverse impacts associated with Recreation are anticipated.

##### **Mitigation Measures Associated with Other Resource Areas**

*Mitigation Measures AR-1, 2, 5-7 could interfere with river based recreation downstream of Iron Gate Dam.* These mitigation measures involve trap and haul of fish and mollusks to protect them from the reservoir drawdown and dam deconstruction activities. These mitigation measures would include trapping activities in the Klamath River that could interfere with river based recreation between February and April 2020. However, as described in Section 3.20.3.1, Regional Opportunities, a number of other river recreation areas are present within and adjacent to the Klamath Basin and provide similar opportunities for recreational activity. **Temporary impacts on recreational access from Mitigation Measures AR-1, 2, 5-7 would be less than significant.**

*Mitigation Measure TR-1 could interfere with reservoir based recreation in Iron Gate Dam.* The bridge crosses Jenny Creek at the point it enters Iron Gate Reservoir. Relocation of the Jenny Creek Bridge and culverts would occur before the other construction phases of dam removal. In comparison to the dam removal, equipment and time required for this construction would be minimal, but it could affect reservoir based recreation near the bridge. However, as described in Section 3.20.3.1, Regional Opportunities, a number of other reservoir and lake recreation areas are present within and adjacent to the Klamath Basin and provide similar opportunities for recreational activity. **Impacts on recreational access from Mitigation Measure TR-1 would be less than significant.**

**3.20.4.5 Summary of Beneficial Effects**

Table 3.20-17 summarizes the beneficial effects of the Proposed Action and alternatives.

**Table 3.20-17. Beneficial Effects of the Proposed Action and Alternatives**

Effect	Alternatives				
	1	2	3	4	5
Continued existence of the reservoirs could change existing recreation access	NCFEC	-	-	NCFEC	-
Construction activities associated with ongoing programs could temporarily restrict access to recreational opportunities	LTS				
Construction activities associated with ongoing programs could result in short-term water quality impacts which could affect recreational opportunities.	LTS				
Ongoing actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	B				
Construction activities could temporarily restrict recreational access on and in the vicinity of the reservoirs	NCFEC	LTS	LTS	NCFEC	LTS
Construction activities, such as demolition, would generate temporary impacts (i.e., increased noise and dust) and could decrease the quality of recreational experiences in the vicinity of the reservoirs.	-	LTS	LTS	-	LTS
Reservoir removal could permanently decrease the availability of reservoir/lake-based recreational opportunities.	NCFEC	LTS	LTS	NCFEC	LTS
Removal of recreation facilities could limit access to recreational opportunities along and within the newly formed river channel.	-	S	S	-	S
Changes in flow and water quality following dam removal could impact developed recreational facilities upstream and downstream of the reservoirs.	-	LTS	LTS	-	LTS

**Table 3.20-17. Beneficial Effects of the Proposed Action and Alternatives**

Effect	Alternatives				
	1	2	3	4	5
Downstream sediment release during reservoir drawdown could decrease the quality of water-contact-	-	LTS	LTS	-	LTS
Removal of impoundments improves water quality and could impact water-contact-based recreational opportunities.	NCFEC	B	B	NCFEC	B
Changes to the floodplain or river channel and removal of recreation facilities as a result of dam removal could affect access to whitewater boating opportunities.	-	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)	-	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)
Changes in flows following dam removal could increase the number of days with acceptable flows for various recreational activities in the Klamath River.	-	LTS	LTS	-	LTS
Changes in flows could increase the number of days with acceptable flows for whitewater boating and fishing in the J.C. Boule and Copco 2 Bypass Reaches.	-	LTS	LTS	LTS	LTS
Changes in flows could decrease the number of days with acceptable flows for whitewater boating and fishing in the Hells Corner Reach.	-	S (whitewater boating) LTS (Fishing)	S (whitewater boating) LTS (Fishing)	S (whitewater boating)	S (whitewater boating) LTS (Fishing)
Improved habitat for anadromous fish species following dam removal could affect recreational fishing opportunities in the long-term.	-	B	B	-	B
Implementation of Mitigation Measure REC-1 could permanently reduce recreational opportunities in the Klamath Basin.	-	LTS	LTS	-	LTS
<b><i>Keno Transfer</i></b>					
Transfer of the Keno Facility	-	NCFEC	NCFEC	-	-
<b><i>East and West Side Facilities</i></b>					
The decommissioning of the East and West Side Facilities could have adverse effects on recreational resources.	-	NCFEC	NCFEC	-	-

**Table 3.20-17. Beneficial Effects of the Proposed Action and Alternatives**

Effect	Alternatives				
	1	2	3	4	5
<b>KBRA</b>					
Construction activities associated with the KBRA could temporarily restrict recreational access.	-	LTS	LTS	-	-
Construction activities associated with KBRA programs could result in short-term water quality impacts which could affect recreational opportunities.	-	LTS	LTS	-	-
Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin.	-	LTS (short-term) B (long-term)	LTS (short-term) B (long-term)	-	-
KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	-	B	B	-	-
KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin.	-	B	B	-	-
KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin.	-	B	B	-	-

Key:

Alternative 1 = No Action/No Project Alternative

Alternative 2 = Full Facilities Removal of Four Dams (Proposed Action)

Alternative 3 = Partial Facilities Removal of Four Dams Alternative

Alternative 4 = Fish Passage at Four Dams Alternative

Alternative 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

B = Beneficial

LTS = Less than significant

NCFEC = No change from existing conditions

S = Significant

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## 3.21 Toxic/Hazardous Materials

This section describes impacts related to the presence and/or use of hazardous, toxic, and radiological waste (HTRW) within the area of analysis for the Proposed Action and alternatives.

### 3.21.1 Area of Analysis

The area of analysis includes the area in the immediate vicinity of Keno, J. C. Boyle, Copco 1, Copco 2, and Iron Gate Dams, including their associated reservoirs, and areas identified as construction/demolition and staging areas for the alternatives. This section also addresses impacts related to HTRW at a program level within the Klamath Basin Restoration Agreement (KBRA) area of analysis because specific locations of potential construction sites have not been identified.

### 3.21.2 Regulatory Framework

Hazardous materials, substances, and waste within the area of analysis are regulated by several federal, state, and local laws and policies, which are listed below.

#### 3.21.2.1 *Federal Authorities Regulations*

- Resource Conservation and Recovery Act (42 USC 6901 et seq.)
- Hazardous Materials Transportation Act (49 USC Section 1801 et seq.)
- Clean Water Act (33 USC 1251 et seq.)
- Comprehensive Environmental Response Compensation and Liability Act and Superfund Amendment Reauthorization Act (SARA) (43 USC 9601 et seq.)
- 40 CFR 260-279 Federal Regulations on hazardous waste management
- 40 CFR 301 et seq. Emergency Planning and Community Right to Know Act
- Toxic Substances Control Act (15 USC 2601 et seq.)

#### 3.21.2.2 *State Authorities and Regulations*

- California Hazardous Waste Control Law (California Health and Safety Code [HSC] Section 25501 et seq.)
- Carpenter-Presley-Tanner Hazardous Substances Account Act (HSC Section 25300 et seq.)
- Unified Hazardous Waste and Hazardous Materials Management Regulatory Program (HSC Section 25404 et seq.)
- Solid Waste Management (Oregon Revised Statute [ORS] 459, and Oregon Administrative Rule [OAR] 340-093)
- Hazardous Waste and Hazardous Materials (ORS 465 and 466, and OAR 340 Divisions 100 to 106, 109, 111, 113, 120, 124, 135, and 142)
- General Environmental Quality (ORS 468, 468a, and 468b)

### 3.21.3 Affected Environment/Environmental Setting

#### 3.21.3.1 Sites with Potential HTRW Concerns

As described in Section 3.21.4.1, Effects Determination Methods, a database search was conducted by Environmental Data Resources (EDR) of sites within a 1-mile radius of the area of analysis where there is potential concern for the presence of HTRW (EDR 2010a and 2010b). Potential HTRW sites included spill sites, sites with leaking underground storage tanks, emergency response to releases sites, brownfields, hazardous material incidents, and voluntary cleanup sites, among others. No recorded reviews or site inspections were performed on these sites identified from the database searches. Four potential HTRW sites within the area of analysis were identified by the EDR search. Two of the listings only indicated the presence of underground and aboveground storage tanks at the Copco Lake Store and the “Pacific Power – Iron Gate,” respectively; but there was no evidence of spills. One listing referenced health limit exceedences in water samples from the Copco Lake Municipal Water Company for radium-228, arsenic (total), bromodichloromethane, dichloroacetic acid, and total haloacetic acids between 2004 and 2006, and for aluminum in water samples collected since 2004. The remaining listing resulted from a minor spill which was remediated and is no longer a site of concern, as described below:

- **21630 Copco Road (Map Location #2 – 21630 Copco Road, Hornbrook, CA).** This site, which is the Copco 2 powerhouse, had a spill of non-polychlorinated biphenyl (PCB) transformer oil and is listed in the California Hazardous Material Incident Reporting System and the Emergency Response Notification System databases. According to the EDR report, in 1999, a bushing failed at a transformer adjacent to the Klamath River releasing transformer oil. Most of the non-PCB transformer oil was contained, and less than 1 quart made it to the Klamath River. According to PacifiCorp, Siskiyou County conducted the site review and approval of the transformer fire spill cleanup (EDR 2010a).

In addition to the four sites described above, the EDR database research identified 162 “orphan sites,” which are those sites that could not be mapped or “geocoded” due to inadequate address information, along the two corridors of the Klamath River. After further research, seven orphan sites were identified within the area of analysis. Two of these seven were listings of National Pollutant Discharge Elimination System-permitted facilities and a Waste Discharge System facility, which do not present concerns related to HTRW. Another two of the listings indicated the presence of underground and aboveground storage tanks at Iron Gate Salmon & Steelhead and J. C. Boyle Power Plant, but no database-documented evidence of spills. One site, listed on the Emergency Response Notification System, is the Copco 2 powerhouse minor spill described above. The remaining two sites were listed on the California Facility and Manifest Database and the leaking underground storage tank (LUST) databases. No additional information was available on the Regional Water Quality Control Board Geotracker database or the California Department of Toxic Substances Control Envirostor database regarding these sites:

- **DFG Iron Gate Fish Hatchery (Hornbrook, CA).** This site is listed in the California Facility and Manifest Database (HAZNET). No additional information on the presence of HTRW at the site is available.
- **Weyerhaeuser Co., Klamath Mill Site (Highway 66 West, Klamath Falls, OR).** This site is listed in the underground storage tank (UST) and LUST databases. No additional information on the presence of HTRW at the site is available.

In addition to the EDR database search, the following items were found from other sources:

- In 2009, at the Copco 1 Warehouse, soil known to be contaminated by petroleum products was removed from a former lube rack area. The final report and site cleanup were approved by a letter from Siskiyou County in 2010 (personal communication with R. Dean, Siskiyou County, March 30, 2011).
- In 2009, a former landfill site at Copco 2 Dam was removed per Siskiyou County review and approval (personal communication with R. Dean, Siskiyou County, March 30, 2011).
- Copco 2 Dam’s fueling facility has two aboveground storage tanks (1,000-gallon gasoline and 500-gallon diesel). No known spills or cleanups occurred at this facility.

### **3.21.3.2 HTRW at PacifiCorp Dams and Associated Facilities**

The existing dams and hydroelectric facilities have components that contain potentially hazardous materials. This analysis assumes that all painted structures, equipment, and metalwork in the project area contain heavy metals, such as lead. Window caulking, electrical wiring and components, building materials, and some coatings may contain asbestos. Tests for lead paint and asbestos are usually performed to characterize material and equipment prior to equipment removal and structure demolition. As a result, no testing or reporting has been performed since the structures and materials are still in place and the equipment is still in operation. In addition, surrounding soils may contain heavy metal contaminants where coatings have flaked off of the painted structures, equipment, and metalwork.

In the mid-1980s, PacifiCorp tested all of its accessible oil-filled electrical equipment for the presence of PCB materials (personal communication with T. Hepler, Reclamation, December 23, 2010.). All accessible power generation equipment was certified by PacifiCorp as “PCBs-free”, if it had concentrations of PCBs that were less than 50 parts per million. Certain closed systems, such as transformer bushings, cannot be tested until time of disposal. Thus, small quantities of PCBs may be present in hydraulic fluids, soils, and in older fluorescent light fixtures. Old light switches may contain mercury. Other hazardous materials at the dams and hydroelectric facilities may include transformers, batteries, bushings, oil storage tanks, bearing and hydraulic control system oils, lead bearings, and creosote-treated wood in the wood-stave penstocks.

It is unlikely that the dams themselves include any naturally hazardous materials such as schist, which could contain asbestos-like fibers. The closest soil formation in the area with schist is the Franciscan formation, which contains sandstone and blue schist. However, this formation is not at the dam locations, but is 40 miles downstream of the Klamath River in a completely different geomorphic province. It is unlikely that materials from this formation were used in the construction of the dams. However, based on the age of the structures at Iron Gate and J.C. Boyle Dams, the concrete in the structures may contain fly ash, which has raised concerns about the presence of mercury or other toxic substances. However, the United States Environmental Protection Agency (USEPA) recognizes the beneficial uses of fly ash and considers it safe when it is encapsulated in concrete or other building materials (USEPA 2011).

As part of the Secretarial Determination studies, reservoir sediment cores are being analyzed for a suite of inorganic and organic contaminants to assess the potential environmental and human health impacts of sediment release. Sediment contaminant levels in samples from the Klamath River were collected at multiple sites and at various sediment depths per site in J.C. Boyle Reservoir, Copco Reservoir, Iron Gate Reservoir, and the Klamath River Estuary, for a total of 77 samples (Department of the Interior (DOI) 2010). To date, the sediment evaluation process has followed screening protocols of the Sediment Evaluation Framework (SEF)<sup>1</sup> for the Pacific Northwest, issued in 2009 by the interagency Regional SEF Team.

Thus far, the SEF sediment chemistry screening process indicates that the sediment deposits in the Klamath River reservoirs are not highly contaminated. There are few positive exceedances of relevant screening values, and therefore little positive indication that substantial aquatic toxicity, or ecological or human health risk, would likely result from exposure to the sediments. For the few compounds that positively exceeded relevant screening levels, as well as the greater number of compounds for which it could not be determined whether screening levels were exceeded, further evaluations must be conducted before conclusions about the potential for contaminant-related impacts and risks can be reached. This includes direct laboratory testing of the sediments to assess their toxicity to sensitive aquatic organisms (i.e., toxicity bioassays), and direct laboratory testing of the sediments for the bioavailability of the contaminants present (i.e., whether contaminants are available to be taken up by organisms directly exposed to the sediments for extended periods of time, or bioaccumulation assays). Each of these biological testing approaches have been conducted on the same reservoir sediment samples evaluated in the chemistry screening described above. The results of this biological testing are pending.

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<sup>1</sup> The SEF is a regional guidance document that provides a framework for the assessment and characterization of freshwater and marine sediments in Idaho, Oregon, and Washington (Regional Sediment Evaluation Team 2009).

As shown in Figure 3.21-1, the closest existing schools to the area of analysis are Hornbrook Elementary School, Willow Creek Elementary School, Bogus Elementary School, and Keno Elementary. All four of these schools are located more than a mile away from the dam facilities. Keno Elementary is 0.25 miles from the Keno Impoundment at its nearest point.

### **3.21.3.3 Hazardous Waste Disposal Facilities**

Any hazardous waste generated from the demolition of the dams and associated hydroelectric facilities would need to be disposed of in designated hazardous waste landfills. This would include treated wood waste, PCBs present in transformers and other electrical equipment, asbestos-containing materials in building materials, fuels and oils, and soils or other material contaminated with lead from the use of lead-based paint.

The Anderson Landfill in Anderson, California, located 122 miles from Hornbrook, California, is permitted to accept hazardous waste, including treated wood waste. The Anderson Landfill had an estimated remaining capacity of 4,925,975 cubic yards (70 percent of capacity remaining) in 2000, with an anticipated closure date of 2055.

## **3.21.4 Environmental Consequences/Environmental Impacts**

### **3.21.4.1 Effects Determination Methods**

To evaluate whether the construction/demolition areas contain existing hazardous materials, EDR conducted a search of regulatory databases to identify facilities within the vicinity of the dams where hazardous materials are known to be present based on regulatory records of investigation and/or remediation conducted under the oversight of federal, state, or local agencies. The area of analysis was divided into three corridors along the Klamath River within Oregon and California (EDR 2010a, 2010b, and 2011). The first corridor starts where Keno Impoundment and Lake Ewauna meet Oregon and follows approximately 18 miles of the Klamath River within south central Oregon to the Keno Dam in Keno, Oregon. The second corridor includes the northeastern point of the J.C. Boyle Reservoir to the J.C. Boyle Powerhouse, and covers approximately 8 miles of the Klamath River within south central Oregon. The third corridor study includes the northeastern point of the Copco 1 Reservoir, Copco 1 Dam, Copco 2 Dam, Iron Gate Reservoir, and Iron Gate Dam, and covers approximately 12.5 miles of the Klamath River within northern California. A 2-mile buffer was added for the records research to account for groundwater migration and contaminant transport and to account for the width of the reservoirs. Figures 3.21-2, 3.21-3, and 3.21-4 show the area searched and an overview of the identified HTRW sites.

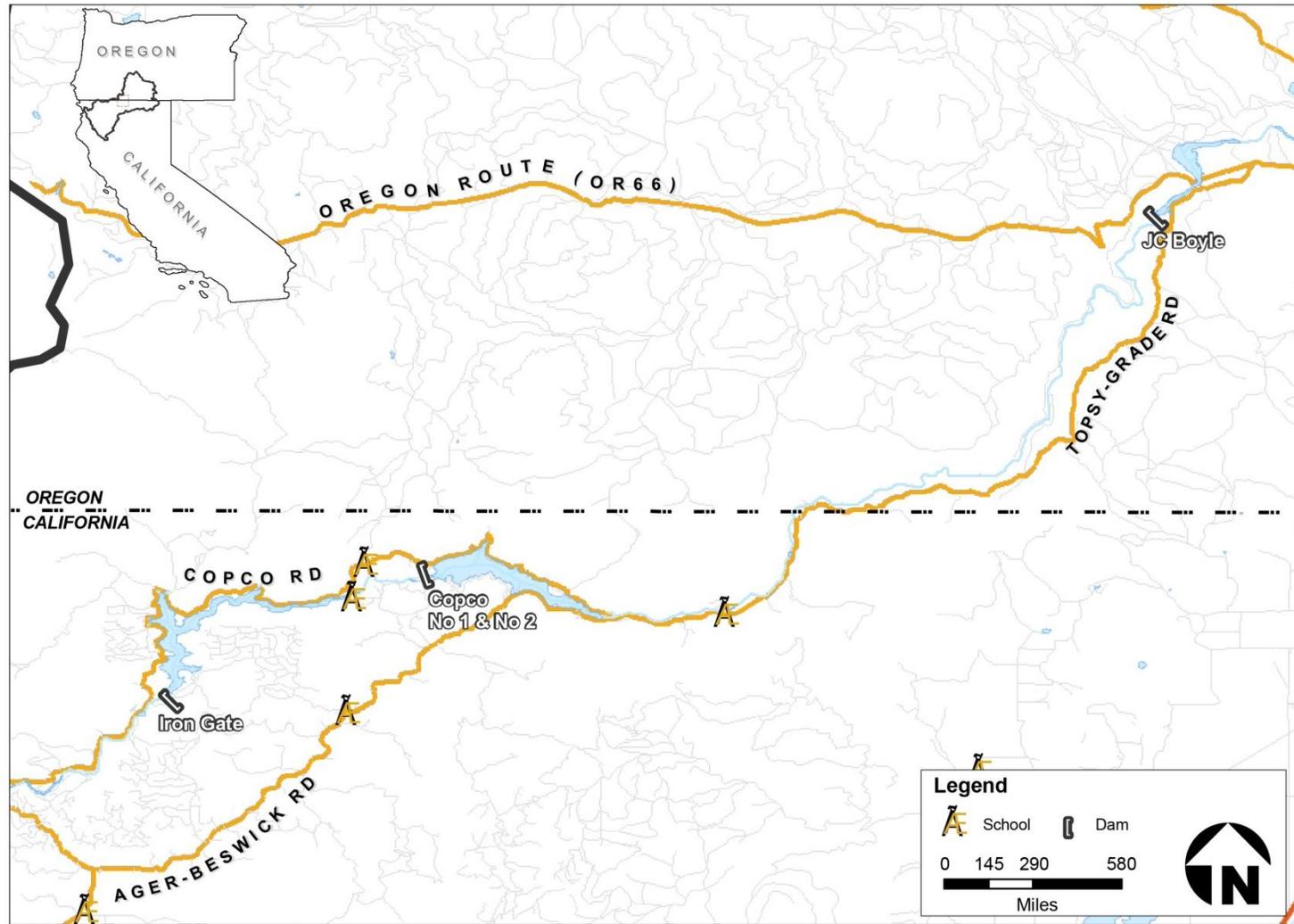


Figure 3.21-1. School Sites in the Project Area

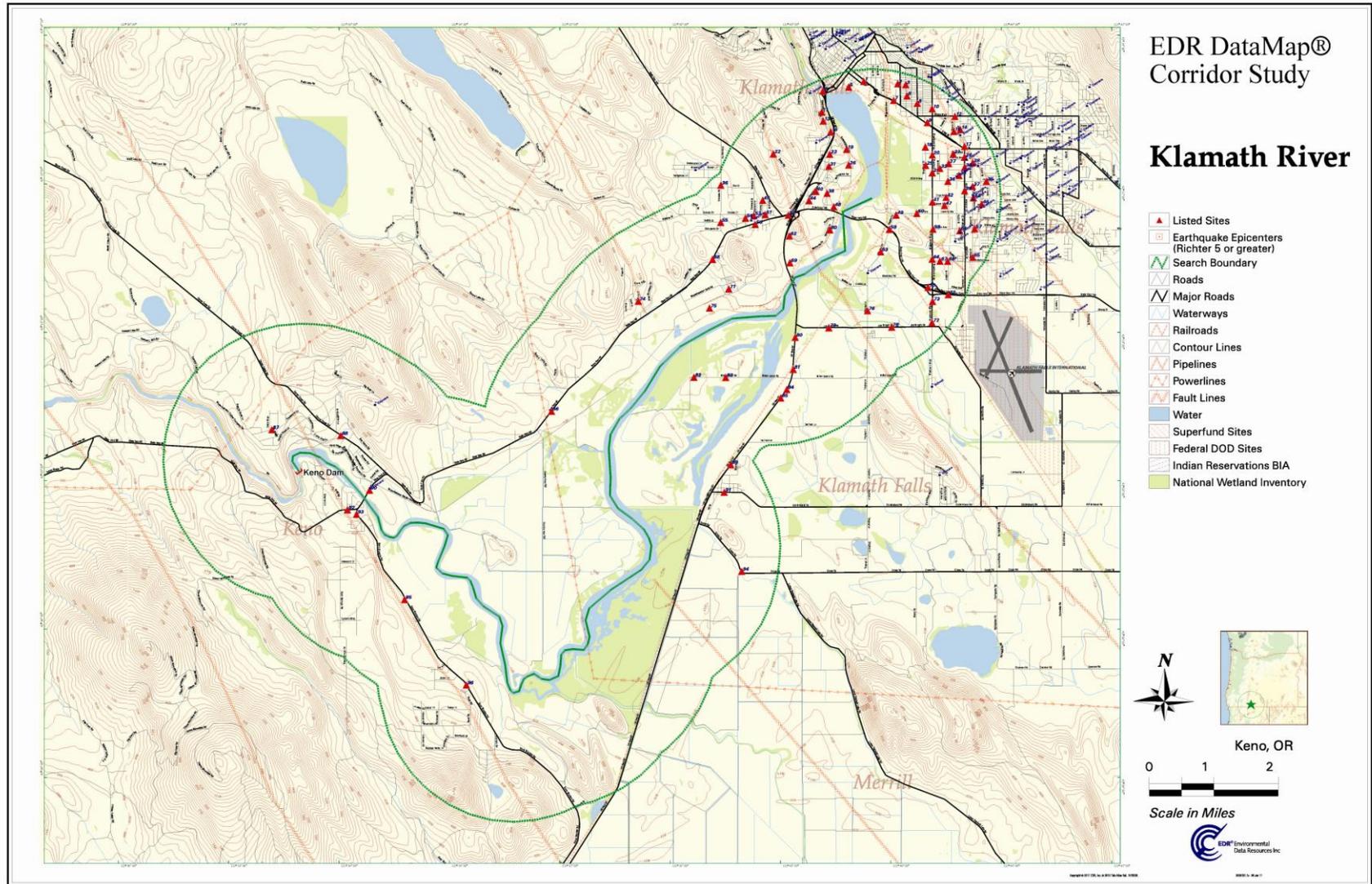


Figure 3.21-2. HTRW Sites, Keno Dam and Reservoir

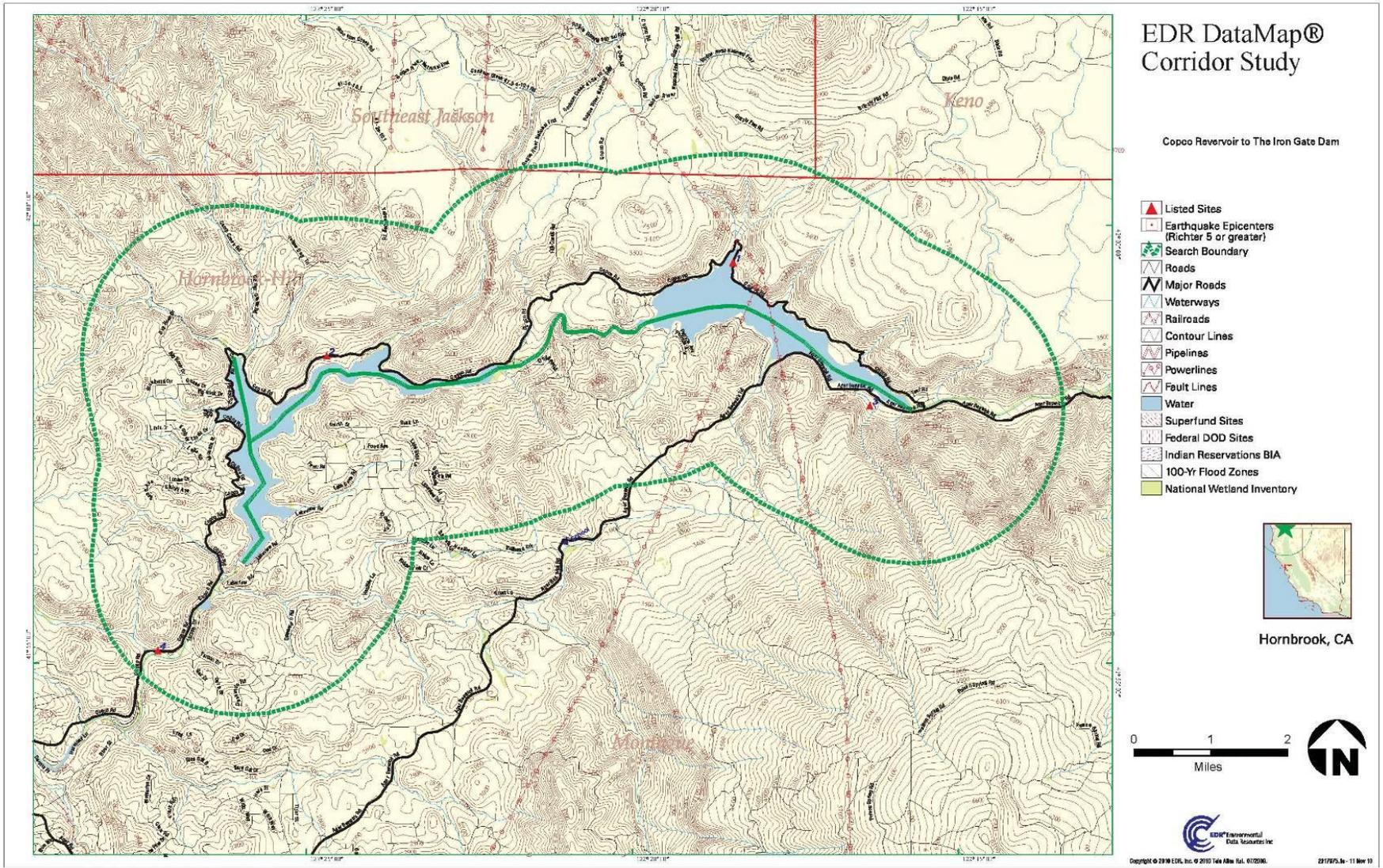


Figure 3.21-3. HTRW Sites, Iron Gate and Copco Dams and Reservoirs

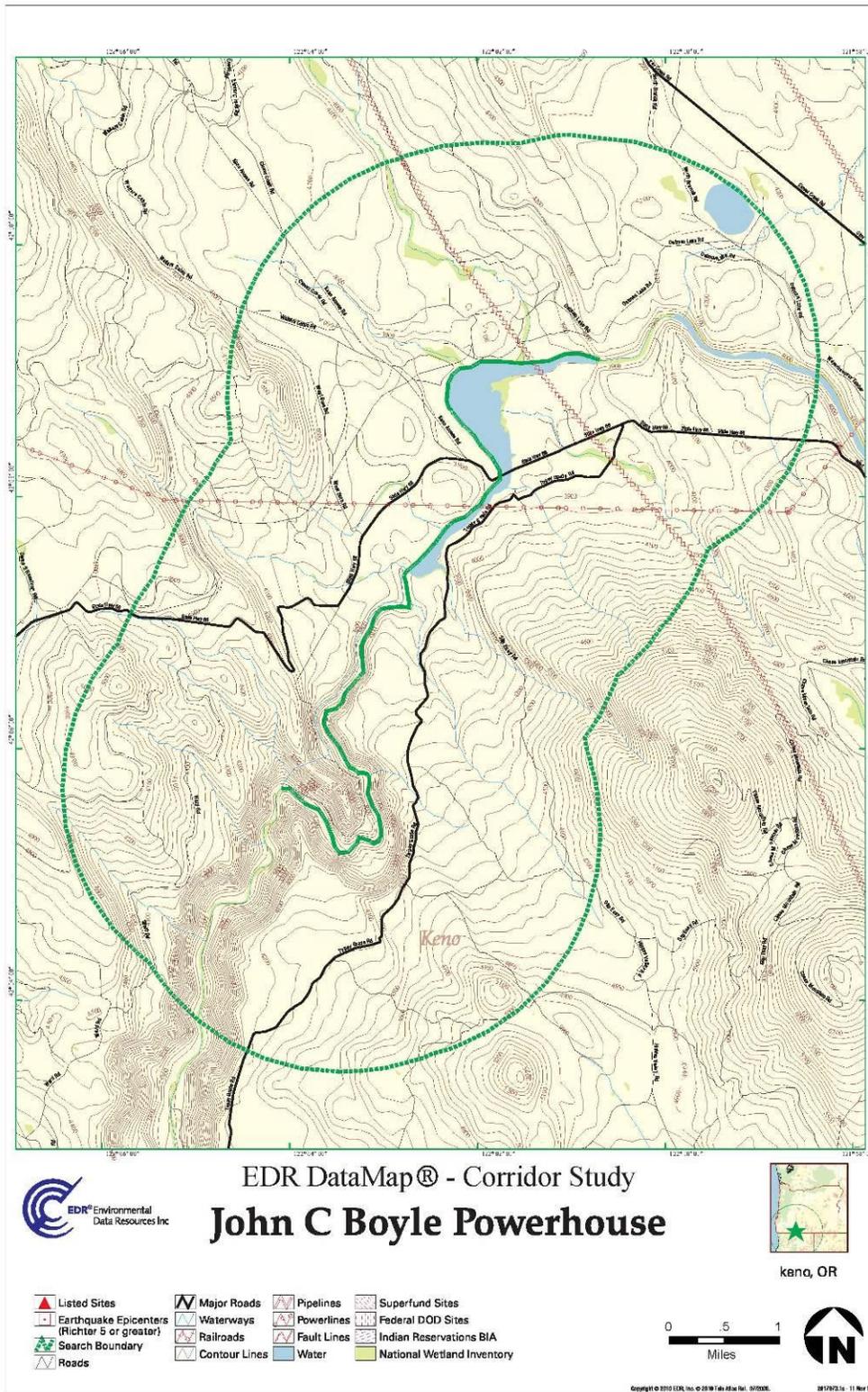


Figure 3.21-4. HTRW Sites, J.C. Boyle Dam and Reservoir

Database information on these sites was augmented by searching online databases of regulatory agencies to verify the closure status of sites or obtain information on the type and extent of contamination at the sites. Information on hazardous materials associated with existing dam components was obtained from PacifiCorp.

Although the databases search by EDR are updated regularly, there may be contaminated sites that have not yet been identified and are absent from the databases. A complete Phase I Environmental Site Assessment was not performed because such investigations tend to remain valid for only 6 months and, as a result, are typically done after selection of the preferred alternative and closer to construction.

#### **3.21.4.2 Significance Criteria**

For the purposes of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR), impacts related to HTRW would be significant if an alternative would result in any of the following:

- Creation of a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials;
- Creation of a significant hazard to the public or the environment through reasonably foreseeable accident conditions involving the release of hazardous materials into the environment;
- Generate hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school; or
- Be located on a site which is included on a list of hazardous materials sites and, as a result, create a significant hazard to the public or the environment.

#### **3.21.4.3 Effects Determinations**

The following sections contain descriptions of the hazardous waste effects that would occur under each alternative.

There are no schools located within one quarter mile of construction areas; the nearest schools are located more than 3 miles away. Therefore, there would be no impacts related to emissions or handling hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. For this reason, the third significance criterion listed above does not apply to any of the alternatives and will not be considered further in this analysis.

To assess hazardous waste effects that could occur under each alternative, the analysis focused on potential hazards that could be encountered during deconstruction of the dam facilities, construction of fish passageways, and resultant restoration of the deconstruction/construction areas. The potential resulting risk to the public from these activities are described qualitatively. To identify potential hazards to the public from the alternatives, the inventory of existing hazardous materials at the dams and associated facilities was reviewed to assess potential risks associated with their deconstruction and removal. In addition, the EDR database search was used to identify known hazardous

material sites within the area of analysis that could be disturbed during deconstruction/construction activities.

According to the information provided in the EDR search, construction areas for the Proposed Action and the other action alternatives are not located near sites where hazardous materials are known to occur. Since the EDR report identified a very small number of sites of concern located within one mile of the construction areas, the potential for hazards related to encountering contaminated soil or groundwater from these sites is low, however, this risk is discussed below.

**Alternative 1: No Action/No Project**

*The No Action/No Project Alternative could create a hazard to the public or the environment through the handling, transport and disposal of HTRW.* Under the No Action/No Project Alternative, no new construction or demolition would occur at the four Klamath dams so existing known hazardous sites would not be disturbed and would not pose a threat to public safety. Hazardous components of the existing dams, such as transformers, bushings, tanks, lead bearings, creosote-wood staves, and asbestos-based insulating products, would not be disturbed. Any hazardous waste generated or used during operation of the existing dams and hydroelectric facilities and during construction of the Ongoing Restoration Actions (e.g., at Wood Creek, Barnes, etc.) would be the same as under existing conditions. **Therefore, there would be no change from existing conditions related to HTRW under the No Action/No Project Alternative.**

**Alternative 2: Full Facilities Removal of Four Dams (the Proposed Action)**

The Proposed Action involves removal of all appurtenant features, with the exception of buried features, at the Four Facilities.

*Facility deconstruction could occur on sites included on a list of hazardous materials sites and, as a result, create a significant hazard to the public or the environment.* As summarized in Section 3.21.3.1, the EDR database search identified two listed hazardous sites within one mile of the area of analysis. One site involved a spill of non-PCB transformer oil on Copco Road in 1999, but less than one quart reached the Klamath River. Siskiyou County conducted the site review and approval of the transformer fire spill cleanup. The other reported site was the Copco Lake Municipal Water Company reporting health limit exceedances of radium-228, arsenic (total), bromodichloromethane, dichloroacetic acid, and total haloacetic acids in 2004 and 2006 and detections of aluminum exceeding both the health and legal limits since 2004. Due to the distance of these two sites from the PacifiCorp facilities and construction areas, there is no potential to encounter HTRW from these two sites during construction and demolition activities under all of the action alternatives. The EDR database search did not identify any other reported spills within the area of analysis; however, the databases searched by EDR are constantly being updated and require reporting by others to be complete. As such, there is the possibility that an unknown (i.e., unreported and unlisted) contaminated site could be encountered. **There would be no change from existing conditions related to posing a hazardous chemical risk from materials currently at the dam sites.**

*Facility deconstruction could create a significant hazard to the public or the environment through the transport, use, or disposal of HTRW during construction.* Hydroelectric facilities operate using a variety of chemicals (e.g., lubricants, transformer oils, bearing oils, etc.) that would be removed under decommissioning. The presence of a UST at the J.C. Boyle Power Plant does not indicate a spill; however, care should be exercised when conducting work in these areas. As part of the decommissioning plan, prior to initiation of deconstruction or construction activities, the contractor will be required to prepare a Hazardous Material Management Plan (HMMP) for review by the Dam Removal Entity in case contaminated media are encountered. The purpose of this plan is to have an established plan of action if known or unknown hazardous materials (e.g., soil or groundwater contamination, asbestos and hazardous coatings requiring abatement, etc.) are encountered during construction and to establish best management practices (BMPs) to reduce the potential for exposure to hazardous wastes. The HMMP will contain the following:

- Definition of a protocol for proper handling, transport, and disposal of hazardous materials (e.g., creosote-treated wood staves) if they are encountered during construction.
- Definition of a protocol for proper emergency procedures and handling, transport, and disposal of hazardous materials if an accidental spill occurs during construction.
- Establishment of BMPs to reduce the potential for spills of HTRW. Typical BMPs to reduce the potential for spills may include, but are not limited to:
  - Having a spill prevention and control plan with a designated supervisor to oversee and enforce proper spill prevention measures;
  - Providing spill response and prevention education for employees and subcontractors;
  - Stocking appropriate clean-up materials onsite near material storage, unloading and use areas;
  - Designating hazardous waste storage areas away from storm drains or watercourses;
  - Minimizing production or generation of hazardous materials on-site or substituting chemicals used on-site (e.g., herbicides during restoration) with less hazardous chemicals;
  - Designating areas for construction vehicle and equipment maintenance and fueling with appropriate control measures for runoff and runoff; and
  - Arranging for regular hazardous waste removal to minimize onsite storage.

Hazardous materials at the dam settings could include creosote-treated wood staves, asbestos, batteries, transformers, bearing and hydraulic control system oils, oil storage tanks, mercury light switches, and PCBs. In addition, coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, surge tanks, bulkhead gates, and generator gantry crane would require specialized abatement and disposal. The volumes of most of these materials requiring special

disposal (e.g., asbestos insulation and lead-based paint) have not been estimated because they cannot be easily quantified before abatement activities have been conducted.

Removal of Copco 2 Dam would generate an estimated 725 tons of treated wood material (creosote wood staves) that would require transport and disposal. In addition, if it is determined that the Lakeview Bridge just downstream of Iron Gate Dam is not adequate to support construction traffic from the decommissioning activities and needs to be replaced, creosote-treated wood from the bridge would require transport and disposal. Because the Anderson Landfill has an estimated remaining capacity of 4,925,975 cubic yards, the regional landfills in the surrounding counties should be capable of handling the additional generated waste hazardous waste. Licensed contractors would be selected to transport any waste designated as hazardous. The contractors would be required to comply with all hazardous waste laws for transport and disposal of hazardous materials. **With implementation of the HMMP during construction, impacts from the transport, use, and disposal of HTRW from dam removal would be less than significant.**

*Facility deconstruction could create a significant hazard to the public or the environment through the abatement and disposal of asbestos and lead-based paint during construction.* In addition, as noted under existing conditions, paint coatings on the buildings and structures may have flaked off into the surrounding soil, creating localized areas of soil contamination that would need to be properly excavated and disposed. However, as part of the decommissioning plan, the demolition contract will require evidence be provided to the responsible federal agency prior to issuance of demolition permits that a qualified asbestos and lead-based paint removal contractor/specialist has been procured to remove or otherwise abate asbestos and lead-based paint prior to or during demolition activities in accordance with federal, state, and local regulations. In addition, evidence will be provided to the responsible federal agency that the demolition contract provides for construction contracts and/or land/building leases, provisions shall be included requiring continuous compliance with all applicable government regulations and conditions related to hazardous materials and waste management. **Therefore, impacts associated with abatement and disposal of asbestos and lead-based paint would be less than significant.**

*Facility deconstruction could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction.* Construction equipment would require the use of hazardous materials (e.g., diesel and gasoline fuels, hydraulic oil). Restoration activities under the Proposed Action would require trucks for hauling equipment and raw materials including spawning-size pea gravel, aircraft for applying hydromulch, discing equipment, backhoes, and other equipment. Fuels, oils, and other hazardous materials used during construction could be accidentally released within construction, staging, and access areas through spills, fueling, and equipment repair.

As part of the decommissioning plan, the contractor will be required to prepare and implement a worker Health and Safety Plan (HASP) prior to the start of construction activities. The HASP will, at a minimum, identify the following:

- All contaminants that could be encountered during excavation activities
- All appropriate worker, public health, and environmental protection equipment and procedures
- Proper housekeeping and BMP procedures to prevent spills
- Emergency response procedures
- Most direct route to a hospital
- Site Safety Officer

The plan will require documentation that all workers have reviewed and signed the plan.

**With implementation of the HMMP and the HASP during construction of the Proposed Action, impacts from the accidental introduction of hazardous materials would be less than significant.**

*Removal of Iron Gate Reservoir would require the relocation of the Yreka water supply pipeline, which could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction.* The existing water supply pipeline for the City of Yreka passes under the Iron Gate Reservoir and will have to be relocated prior to the decommissioning of the reservoir to prevent damage from deconstruction activities or increased water velocities once the reservoir has been drawn down. The pipeline will either be suspended from a pipe bridge across the river near its current location, or rerouted along the underside of the Lakeview Bridge just downstream of Iron Gate Dam. Construction equipment used for the relocation would require the use of hazardous materials (e.g., diesel and gasoline fuels, hydraulic oil). Fuels, oils, and other hazardous materials used during construction could be accidentally released within construction, staging, and access areas through spills, fueling, and equipment repair. An HMMP and HASP would be prepared, as described above. **With implementation of the HMMP and the HASP during construction of the Proposed Action, impacts from the accidental introduction of hazardous materials during the pipeline relocation would be less than significant.**

*Drawdown of the reservoirs would require removal of recreational facilities currently located on the banks of the existing reservoirs.* The existing recreational facilities provide camping and boating access for recreational users of the reservoirs. Once the reservoirs are drawn down, these facilities will be removed. Construction equipment used for the relocation would require the use of hazardous materials (e.g., diesel and gasoline fuels, hydraulic oil). Fuels, oils, and other hazardous materials used during construction could be accidentally released within construction, staging, and access areas through spills, fueling, and equipment repair. An HMMP and HASP would be prepared, as described above. **With implementation of the HMMP and the HASP during construction of the Proposed Action, impacts from the accidental introduction of**

**hazardous materials during the removal of the recreational facilities would be less than significant.**

**Keno Transfer**

*The transfer of the Keno Facility to DOI could result in affects to HTRW.* The Keno Transfer would result in a transfer of ownership of the facility to DOI. There would be no changes in operations or land use of the Keno Facility with the Keno Transfer. In addition, the EDR search did not identify any sites of concern related to HTRW that would change ownership under the Keno Transfer. Due diligence would be required prior to the Keno Transfer to ensure that any hazardous or toxic wastes and materials present on the properties are identified and fully disclosed. Should any be discovered, proper management would be necessary for PacifiCorp or DOI to manage the materials. **Therefore, the implementation of the Keno Transfer would result in no change from existing conditions.**

**East and West Side Facilities**

*The decommissioning of the East and West Side Facilities could have adverse effects in terms of toxics and hazards.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the Klamath Hydroelectric Settlement Agreement (KHSAs) will redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. Appropriate health and safety plans would be created to limit the potential of toxic releases during decommissioning. **Therefore, there would be less than significant effects from the decommissioning activities.**

**KBRA**

The following KBRA programs would entail construction, and therefore could result in impacts related to HTRW:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration Project
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction

*Construction activities associated with the KBRA programs could create a hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered during construction.* Exact locations and construction plans have not yet been determined for the KBRA construction activities. Impacts related to creating a hazard through routine transport, use, and disposal of hazardous materials would be comparable to those described above for the Proposed Action. The potential for encountering contamination during construction activities for KBRA programs and the extent and frequency of excavation, transport, and disposal are unknown. At the time of

implementation of KBRA programs, the entity acting as the surrogate for KBRA would follow environmental compliance guidelines with regards to applicable toxic and hazardous material laws. These construction actions would not be in the same location or occur at the same time as the hydroelectric facility removal actions. As a result, KBRA construction actions would not contribute to the potential hazardous material effects of facility removal actions. **Therefore, impacts from hazardous materials encountered during construction for KBRA would be less than significant.**

*Construction activities associated with the KBRA programs could create a significant hazard to the public or the environment through the accidental release of hazardous materials during construction activities.* Construction could require the use of equipment that use hazardous materials (e.g., fuels and oils) and an accidental release of these hazardous materials could occur. BMPs described in the affected environment would reduce any likelihood of accidental release. As noted above, at the time of implementation of KBRA programs, the entity acting as the surrogate for KBRA would follow environmental compliance guidelines with regards to applicable toxic and hazardous material laws. These construction actions would not occur in the same place or at the same time as the hydroelectric facility removal actions. As a result, these actions would not contribute to the effects of facility removal actions. **With implementation of standard BMPs during construction for the KBRA, impacts from the accidental introduction of hazardous materials would be less than significant.**

### **Alternative 3: Partial Facilities Removal of Four Dams**

*The Partial Facilities Removal of Four Dams Alternative could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered during construction or the accidental release of HRTW during construction.* Under the Partial Facilities Removal of Four Dams Alternative, certain project features at the Four Facilities would be retained. Impacts related to HTRW for the Partial Facilities Removal of Four Dams Alternative would be the same as that associated with the Proposed Action. Table 2-16 in Chapter 2, Proposed Action and Description of the Alternatives, lists features that would be removed under the Proposed Action, but would remain in the Partial Facilities Removal of Four Dams Alternative that could potentially reduce the amount of hazardous waste requiring abatement or disposal. Although all of the specifically identified powerhouse hazardous materials (transformers, batteries, and insulation) would be removed under both alternatives, some materials that contain hazardous coatings could be retained under the Partial Facilities Removal of Four Dams Alternative and would be stabilized through ongoing maintenance activities (e.g., painted penstocks that are left in place under this alternative would be recoated periodically as maintenance). **With implementation of the HMMP and the HASP during construction, impacts associated with the handling, transport, and disposal of hazardous materials and the accidental release of hazardous materials during construction of the Partial Facilities Removal of Four Dams Alternative would be less than significant.**

### **Keno Transfer**

The effects of the Keno Transfer would be the same as those described for the Proposed Action.

### **East and West Side Facilities**

The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action.

### **KBRA**

The KBRA would be fully implemented under this alternative. Effects would be the same as the Proposed Action.

### **Alternative 4: Fish Passage at Four Dams**

Under the Fish Passage at Four Dams Alternative, no facilities removal would be conducted. This alternative would include the construction of fish passageways at each of the Four Facilities. Known hazardous materials associated with the facility structures would remain in place and there would be no anticipated handling, transport, or disposal of HTRW.

*The Fish Passage at Four Dams Alternative could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction.* Construction would require the use of hazardous materials (e.g., fuels and oils) within construction areas. The scale of the construction would be much smaller for the construction of the Fish Passage at Four Dams Alternative than it would be under the Proposed Action and Partial Facilities Removal of Four Dams Alternatives. **With implementation of the HMMP and the HASP during construction, impacts from the accidental release of hazardous materials would be less than significant.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

*The Fish Passage at Two Dams Alternative could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered during construction or the accidental release of HRTW during construction.* Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the Dam Removal Entity would remove the facilities at Copco 1 and Iron Gate Dams. Fish passage facilities would be constructed at J.C. Boyle and Copco 2 Dams. Impacts related to hazardous materials for the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be the same as for the Proposed Action at the Copco 1 and Iron Gate Dams, and would be the same as for the Fish Passage at Four Dams Alternative at J.C. Boyle and Copco 2 Dams. **With implementation of the HMMP and the HASP during construction, impacts associated with the handling, transport, and disposal of hazardous materials and the accidental release of hazardous materials would be less than significant.**

#### **3.21.4.4 Mitigation Measures**

##### **Mitigation Measure by Consequence Summary**

Impacts associated with hazardous materials under each of the alternatives would be less than significant with the implementation of the HMMP and HASP; therefore, no mitigation measures would be required.

##### **Mitigation Measures Associated with Other Resource Areas**

*Construction of new recreation facilities could release hazardous materials.* Mitigation measure REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoir is removed. Construction equipment used for the relocation would require the use of hazardous materials (e.g., diesel and gasoline fuels, hydraulic oil). Fuels, oils, and other hazardous materials used during construction could be accidentally released within construction, staging, and access areas through spills, fueling, and equipment repair. An HMMP and HASP would be prepared, as described above. **With implementation of the HMMP and the HASP, impacts from the accidental release of hazardous materials during construction of new recreation facilities would be less than significant.**

#### **3.21.5 References**

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## **3.22 Traffic and Transportation**

This section describes how the Proposed Action and alternatives could affect the area's transportation and circulation. This section includes a description of the area of analysis, the local and direct access routes identified to be used during construction, the existing non-motorized transportation network, and transit resources. This section also contains an analysis of future traffic volumes resulting from each alternative and describes mitigation measures to reduce impacts during construction. Appendix S includes tables that support this transportation and circulation analysis, and Appendix T describes 2020 Traffic Volume Projections.

### **3.22.1 Area of Analysis**

The area of analysis for the Klamath Hydroelectric Settlement Agreement (KHSA) includes roadways in Siskiyou County in California and Klamath and Jackson Counties in Oregon. The area of analysis for the KHSA is rural with very low-density development. Most of the private property is undeveloped and/or used as grazing land for cattle with the exception of several small communities in the vicinity of Copco 1 and Iron Gate Reservoirs. Figure 3.22-1 depicts the transportation network in the area of analysis for the KHSA. The area of analysis for the Klamath Basin Restoration Agreement (KBRA) constitutes the entirety of the Klamath Basin and can be characterized as both urban and agricultural.

Table 3.22-1 lists the dam sites within the KHSA along with the corresponding regional and local roads that access each site.

### **3.22.2 Regulatory Framework**

This analysis uses Oregon Department of Transportation (ODOT) and California Department of Transportation (Caltrans) accepted methods for measuring impacts on roadways. The Lead Agencies used these guidelines in the absence of county level guidelines. Caltrans measures traffic capacities in terms of a Level of Service (LOS). In California, the Siskiyou County General Plan is used as a guide in determining significance (1988). The ODOT system of congestion measurement is different from the LOS system that Siskiyou County and Caltrans use. The ODOT, Klamath County, and Jackson County, use a volume-to-capacity (v/c) ratio.

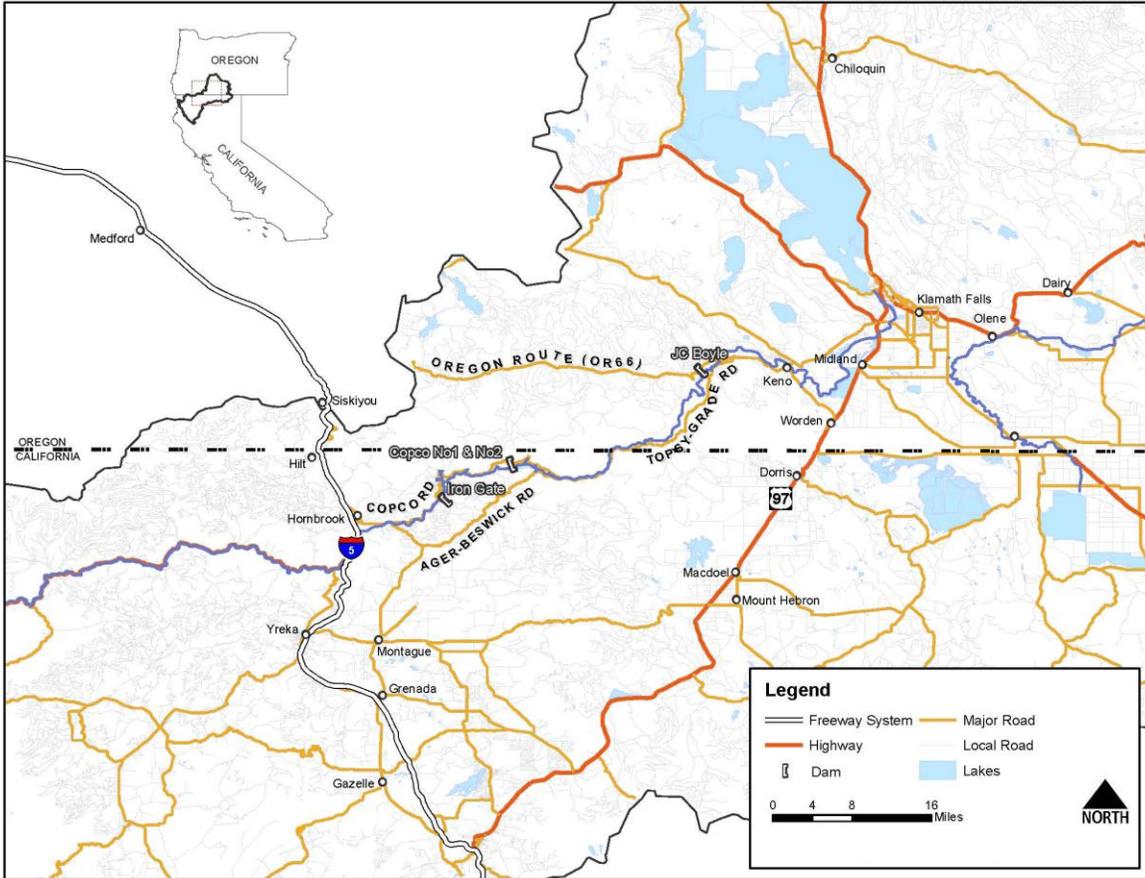


Figure 3.22-1. Regional Access Routes Relative to the KHS

Table 3.22-1. Local and Regional Access Roads Relative to KHS

Dam Site	Interstate Access Road	Regional Access Road	Local Access Road
J.C. Boyle	Interstate 5 (in Oregon) and US97	Oregon Route 66	Topsy Grade Road
Copco 1	Interstate 5 (in California)	Copco Road	Ager-Beswick Road
Copco 2	Interstate 5 (in California)	Copco Road	Ager-Beswick Road
Iron Gate	Interstate 5 (in California)	Copco Road	Lakeview Road

Source: CDM field observation, Oct 2010.

Where roadway planning level capacities were desired, and were not available from ODOT, Caltrans or County sources, the Lead Agencies used Caltrans accepted guidelines developed by the Florida Department of Transportation (FDOT) to outline roadway planning capacities in the project area.

### 3.22.2.1 Significance Criteria

For the purposes of the Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report (EIS/EIR), effects would be significant if they resulted in the following conditions or situations:

- An alternative conflicted with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system.<sup>1</sup> (Traffic Flow Effects)
- Non-compliance with county planning regulations. (Traffic Flow Effects)
- Traffic related to implementation of the alternative resulted in a LOS worse than level C in Siskiyou County.<sup>2</sup> (Traffic Flow Effects)
- Traffic related to implementation of the alternative resulted in a v/c ratio of more than 0.75 for OR66 or 0.70 for US97.<sup>3</sup> (Traffic Flow Effects)
- Traffic related to implementation of the alternative traversed blind corners or sharp turns; if large trucks would be turning onto and off of roadways with high speed limits; and/or if conflicts would occur at existing recreation sites where passenger cars may consistently turn in and out. (Traffic Safety Effects)
- An alternative conflicted with adopted policies, plans, or programs regarding public transit. (Public Transit Effects)
- Project-related vehicle volumes were great enough to exceed the capacity of a road in the area of analysis. This would slow or impede general vehicle traffic along a roadway and delay public transit service. Effects would also be significant if construction activities were adjacent to public transit passenger pick up/drop off facilities and inhibited vehicle travel or transit vehicle turning movements. (Traffic Flow Effects)
- An alternative resulted in the following Non-Motorized Transportation Effects:
  - Substantial degradation of road conditions that interfered with non-motorized vehicle use.
  - Conflict with adopted policies, plans, or programs regarding bicycle or pedestrian facilities.
  - Deconstruction or construction traffic crossing or running along existing non-motorized transportation facilities.

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<sup>1</sup> Taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit.

<sup>2</sup> In California, progressively worsening traffic conditions are given the letter grades “A” through “F.” While most motorists consider an “A,” “B,” or “C” LOS as satisfactory, LOS “D” is considered marginally acceptable. Congestion and delay are considered unacceptable to most motorists; these conditions would result in LOS “E” or “F” ratings. LOS analyses can be very detailed but for the purposes of this analysis LOS will only be discussed when referring to industry-accepted general planning standards for roadway capacity. LOS C is the threshold for capacity for California roads in this analysis. According to the Siskiyou County General Plan, LOS worse than level C is not acceptable (Siskiyou County 1988).

<sup>3</sup> In Oregon, several different thresholds apply to various roads. A v/c ratio of 1.0 is equivalent to a poor LOS (E or F) with long delays. Klamath and Jackson Counties and ODOT are willing to accept a certain amount of congestion during peak periods to encourage drivers to find other modes of transportation or other times to travel. Jackson County requires that I-5 have a v/c ratio no higher than 0.85 (Jackson County 2005). Klamath County requires that OR66 have a v/c ratio no greater than 0.75 and US97 have a v/c ratio of no greater than 0.70 (Klamath County 2004).

- A need for the narrowing or rerouting of non-motorized transportation infrastructure such as a bicycle lane or sidewalk.

### 3.22.3 Existing Conditions/Affected Environment

#### 3.22.3.1 KHSA – River Reach Road Network

The following describes the characteristics of the roadways within the KHSA transportation analysis area. The Lead Agencies recorded these characteristics during site visits and collected existing traffic volume data for the subject roadways from three sources: ODOT, Caltrans, and field observations.

- **Interstate 5 (I-5)** – a major north/south interstate highway that runs the length of California and continues through Oregon. This is a main regional access road for the Four Facilities on the Klamath River. Through Siskiyou and Jackson Counties, I-5 has four lanes. The posted speed limit is 70 miles per hour (mph) in California and 65 mph in Oregon. The portion of I-5 in California closest to the Iron Gate Dam has more than 17,000 vehicles per day in Annual Average Daily Traffic (AADT) in its peak month, and averages 15,200 AADT. In Oregon, near the intersection with OR66, traffic volumes are closer to 14,300 AADT.
- **Oregon Route 66 (OR66)** – Known locally as Green Springs Highway, this road also carries the ODOT designation of Highway Number 21. OR66 is a two lane, east/west, asphalt state highway. It is approximately 32 feet wide and the posted speed limit is 55 mph in some locations. Some sharp curves on OR66 require posted speed reductions. OR66 connects I-5 to the J.C. Boyle Dam and to US Highway 97 (US97) and intersects I-5 approximately 14 miles north of the California border. Traffic counts from 2009 along OR66 show 9,500 AADT just east of I-5 and 500 AADT closest to the J.C. Boyle Dam.
- **US97** – Known locally as the California-Dalles Highway, this road carries the ODOT designation of Highway Number 4 and is a four lane, north/south, asphalt US highway. A barrier divides the northbound and southbound lanes and it has a wide shoulder. The posted speed limit is 65 mph and AADT in 2009 was 9,700 vehicles.
- **Copco Road** – a minor collector that leads from I-5 to the Iron Gate, Copco 1 and Copco 2 Dams. Copco Road is a paved, two-lane road in good pavement condition with few pavement cracks or ruts and is approximately 27 feet wide. Copco Road maintains this character from its intersection with I-5 east to a point about 10 miles from the Copco Developments near the Juniper Point Picnic Area. The section between the intersection of Copco Road with Ager Road and the Juniper Point Picnic Area, contains intermittent pavement surfacing that has not been as well maintained as the portions to the west of Ager Road. The final 3 miles, from Camp Creek Road near the Juniper Point Picnic Area to the Copco Dams, are gravel and narrow, and less than 18 feet wide in some locations. The

posted speed limit on Copco Road from I-5 to the Juniper Point Picnic Area is generally 55 mph with a few sharp curves, especially in the portions that run along the Iron Gate Reservoir. AADT for this analysis is based on field observation. See Figure 3.22-2 for a photo of a portion of Copco Road.



Source: CDM 2010

**Figure 3.22-2. Copco Road (north of river, facing west)**

- **Topsy Grade Road/Ager-Beswick Road** – This road is known as Topsy Grade Road in Oregon and Ager-Beswick Road in California. It runs along the southern side of the Klamath River and while it is the most direct route from the Copco 1 Reservoir to the J.C. Boyle Dam, between those two locations the road is mostly unimproved, natural surfacing. While this road has several different surfacing and sizing characteristics along it, the relevant portion, Topsy Grade Road near the J.C. Boyle Dam, is partially gravel and partially paved. It provides access to the Topsy Grade Recreation Area from OR66. Topsy Grade Road would give access to OR66 from the J.C. Boyle construction site, and Ager-Beswick Road would provide haul access, via Patricia Avenue, from Copco 1 and Copco 2 Dams to Yreka, California.
- **Unpaved access roads** – each dam has a small network of one lane, gravel access roads leading from either Copco Road or OR66 to the dams themselves. These roads are no wider than 15 feet and are no longer than ½ mile. Most of the traffic along these roads consists of PacifiCorp’s technicians accessing the facilities.

- **J.C. Boyle unpaved access roads** – While this road network shares the same characteristics of the other unpaved access roads, it has a small bridge linking the north and south sides of the dam. This is a key link and might play a role in construction activities. Figure 3.22-3 is a photo of this bridge.



Source: CDM 2010

**Figure 3.22-3. Access Bridge at J.C. Boyle Dam**

- **Lakeview Road** – a local road that accesses the Iron Gate Dam itself. Lakeview Road intersects with Copco Road at the entrance to the Iron Gate Recreation Area. A one-lane bridge crosses the river (see Figure 3.22-4) at this intersection linking to Lakeview Road. Lakeview Road is a gravel road that leads up to the top of Iron Gate Dam. It is approximately 24 feet wide and has a steep embankment on the east side, without a guardrail. Lakeview Road connects to an unnamed bridge access road. The narrow, gravel access road leads onto the top of Iron Gate Dam. For the purposes of further analysis, Lakeview Road would be considered an unpaved access road except when discussing the bridge.



Source: CDM 2010

**Figure 3.22-4. Bridge Accessing Lakeview Road (looking south)**

- **Baseline Transit Service** - The Siskiyou Transit and General Express is the only transit service in the KHSA area of analysis. It is a regional service that connects the downtowns of Dunsmuir, Weed, Mt. Shasta, Grenada, McCloud, Yreka, Montague, Fort Jones, Greenview, Etna, Klamath River, Horse Creek, Hamburg, Seiad Valley and Happy Camp. Service is very limited, sometimes running only one or two times a week. One route branches into the area of analysis and currently runs twice a week: the Hornbrook route. The Hornbrook route follows I-5 north into Hornbrook, turns east on Copco Road and then turns south (well before reaching the Iron Gate Dam) at Ager Road heading towards Montague, California.

In addition, Greyhound bus service runs on US97 connecting Klamath Falls to other cities in the region and to nearby Amtrak stations (Siskiyou County 2008). As with the Siskiyou Transit and General Express, this service is limited and is along a major US highway.

- **Non-motorized Transportation Network** – The area of analysis has very few or no sidewalks and no designated bicycle routes of any kind. Because various camp and recreational sites exist throughout the KHSA area of analysis, it should be expected that bicycle riders and pedestrians travel along Copco Road will be limited in capacity.

Specific information about the haul routes needed for construction and deconstruction activities as well as potential right-of-way requirements would be provided in the Detailed Plan for Facilities Removal. There would be subsequent environmental analysis on this plan to analyze traffic and transportation impacts from the Proposed Action.

### **3.22.3.2 KBRA –Road Network**

The Upper Basin road network exhibits many of the same characteristics of the local access roads and other routes described for the KHSA area of analysis. Activities to be implemented that would likely affect transportation include the Phase I and Phase II Fisheries Restoration Plans. KBRA activities might include decommissioning local access roads, upgrading and/or replacing culverts to improve fish passage, and using backhoes and dump trucks to reshape channels and deliver gravel to augment fish spawning. Exact locations of these activities are currently undefined.

## **3.22.4 Environmental Consequences**

### **3.22.4.1 Environmental Effects Determination Methods**

#### **Traffic Flow Effects**

The scope of this analysis includes all roads that would experience construction related traffic. Routes were identified between each construction site and anticipated disposal sites. The greatest traffic flow effects would be nearest to the construction sites and those portions of the road were used during this analysis to assess potential impacts.

The Lead Agencies considered two components of traffic growth in evaluating future year conditions. First, the team determined an annual background growth rate based on historical data from 2000 through 2009. The Lead Agencies used that data to create a trend line and project baseline traffic volume to 2020. See Appendix T for the graphs showing these projections. Second, the Lead Agencies collected construction data including the number of construction trucks, construction truck routes and timing, number of workers, and worker traffic routes and timing. Lead Agencies provided this data for the project alternatives and added to the network any increases in traffic expected from each of the alternatives.

In addition to construction trucks hauling materials, construction workers accessing the sites may affect traffic flows in the area. Using construction worker forecasts and the current traffic volumes along available access roads, Lead Agencies projected traffic increases from workers. To access Iron Gate, Copco 1 and Copco 2 Dams, workers must travel along I-5 to Copco Road or Ager-Beswick Road. The worker access trip counts were assigned to these two roads. The J.C. Boyle Dam has two different directions from which workers might originate. In consideration of the current traffic volume to the east and west of J.C. Boyle Dam along OR66, this analysis uses the percentages of AADT to indicate how many workers might originate their trips from the east or from the west. Based on this analysis, the Lead Agencies assume that 12 percent of workers traveling to J.C. Boyle Dam would come from the west, taking I-5 to OR66 and 88 percent would come from the east, taking US97 to OR66.

The Lead Agencies used Caltrans accepted guidelines developed by the FDOT, along with road characteristics, to outline roadway planning capacities in the project area. The FDOT publishes a concise LOS Planning Handbook (2009) with service volume tables correlated to different roadway types and geometries, based on the Highway Capacity Manual (HCM). The HCM contains vast technical data that is very specific to traffic engineering technical analysis. The FDOT LOS Planning Handbook takes the detailed technical data from the HCM and summarizes it into a user friendly format that is appropriate for planning level analyses, such as is the case with this assessment.

Because the project area is remote and not generally considered to have peak commute times, the Lead Agencies assumed that existing traffic would largely be uniform throughout various times of day.

### **Traffic Safety Effects**

Based upon site visit and map analysis, combined with review of planned truck hauling routes, the Lead Agencies identified roads with potentially hazardous points along them. Safety hazards include blind corners or turnouts and sharp turns or areas where slow construction traffic might conflict with high roadway speed limits. The Lead Agencies also assessed potential visibility hazards due to dust.

### **Public Transit Effects**

The Lead Agencies examined the local and regional deconstruction traffic routes for each alternative and compared them to existing local and regional transit service routes to determine potential conflicts. The analysis relates traffic volumes to transit service because any road segments with projected traffic volumes over their functional LOSs could have disruptions in transit service.

### **Non-Motorized Transportation Effects**

The Lead Agencies identified existing bikeways within the area of analysis and categorized them by class (bike path, bike lane, or bike route). The team also compared bikeways to construction traffic routes and timing to determine potential effects on the mobility and safety of cyclists. The team also reviewed available local or county planning documents addressing bicycle planning in the area of analysis to evaluate potential effects on planned bikeways. Although the project area would be a low pedestrian traffic area, the analysis addressed potential areas of conflict between trucks and pedestrians as well.

### **Road Condition Effects**

In order to adequately assess the structural integrity and load carrying capacity of each road's surfacing section, a detailed geotechnical analysis would need to be conducted; this is out of the scope of this analysis.

#### ***3.22.4.2 Effects Determinations***

##### **Alternative 1: No Action/No Project Alternative**

##### **Traffic Flow Effects**

*Changes in traffic volumes could affect traffic flow.* Any increase in traffic flow associated with the No Action/No Project Alternative would not exceed the planned LOS or v/c ratios for any roads in the area of analysis. **There would be no change from existing conditions from traffic flow effects.**

##### **Traffic Safety Effects**

*Implementation of the Interim Measures (IMs) could cause traffic safety effects associated with sharp turns along Copco Road and OR66.* Implementation of several interim measures, including IM 7 – J.C. Boyle Gravel Placement and Habitat Enhancement (for one year) and IM 8 – J.C. Boyle Bypass Barrier Removal could result in increased traffic from haul trucks and construction workers; however, any increases in traffic flow would be minor and would not contribute substantially to the number of vehicles on the road. **This fact combined with the installation of signage at sharp turns along OR66 and Copco Road would reduce traffic safety effects associated with implementation of the interim measures to less than significant.**

##### **Road Condition Effects**

*Changes in the road conditions could occur.* Roads in the area of analysis would not experience wear greater than that for which they were designed under the No Action/No Project Alternative. Any minor traffic safety conflicts would be mitigated through best management practices. **There would be no change from existing conditions from road condition effects.**

### **Public Transit Effects**

*Changes in public transit could occur.* Public transit service would experience no negative effects from the No Action/No Project Alternative. Any minor public transit effects would be mitigated through best management practices. **There would be no change from existing conditions from public transit effects.**

### **Non-motorized Transportation Effects**

*Changes in non-motorized transportation could occur.* There are no anticipated negative effects on non-motorized transportation due to the No Action/No Project Alternative. Any non-motorized transportation effects would be mitigated through best management practices. **There would be no change from existing conditions from non-motorized transportation effects.**

### **Ongoing Restoration Actions**

While the KBRA would not be fully implemented under the No Action/No Project Alternative, ongoing restoration actions from Fish Habitat Restoration could have traffic and transportation impacts during construction activities.

*Construction activities associated with the continued implementation of ongoing restoration actions could cause temporary effects to traffic and transportation.*

Construction activities including channel construction, floodplain rehabilitation, fish passage and facilities construction, and breaching levees would likely involve the use of heavy equipment and construction vehicles. **Construction activities that would occur for the ongoing restoration programs are anticipated to result in potentially significant impacts to traffic and transportation. It is assumed that the use of best management practices incorporated into the project would minimize any traffic impacts to less than significant.**

### **Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

#### **Traffic Flow Effects**

*Transportation of equipment and supplies associated with dam facility deconstruction activities could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.* No long-term or permanent traffic volume increases or long-term changes in traffic patterns are expected as a result of the Proposed Action. Therefore, any transportation impacts associated with the Proposed Action would be limited in duration to the proposed deconstruction or construction period. The deconstruction and reservoir restoration schedule for the Proposed Action extends 18-months starting in May 2019. Work completed in 2019 would include small scale construction staging activities and analysis of road and bridge condition and any repair work that might be identified during this analysis. The peak deconstruction activity and associated traffic would be generated in 2020; therefore this analysis is focused on the year 2020 when the largest effects would be anticipated.

The traffic projections for 2020, based on data from 2000 through 2009, indicate a decrease in baseline traffic on I-5 in California and OR66. In light of the recent increases in the cost of fuel and other economic factors, the years 2007 to 2009 may be an

anomaly. When that data was excluded, I-5 showed an increase, but OR66 still showed a small decrease in the 2020 projection compared to baseline. In each case, the combined total of the projected baseline traffic volumes and the traffic that would result from implementation of each of the alternatives would not exceed the significance criterion for I-5, OR66, or US97 for any of the alternatives.

Table 3.22-2 consolidates the roadway planning capacities and the anticipated traffic for each alternative, and contains projected LOSs and v/c ratios. Appendix S presents a detailed analysis of the hauling and worker trips for each alternative. Hauling trips include trips to a local recycling facility in Yreka, California as well as truck trips for additional deconstructed materials to disposal sites outside of the project boundaries. As Table 3.22-2 shows, none of the main roads in the area of analysis would experience volumes in excess of their planned LOS or v/c ratio due to traffic resulting from implementation of the Proposed Action or the other alternatives. **Traffic flow effects on I-5, OR66, US97, and access roads would be less than significant.**

*Transportation of equipment and supplies associated with dam facility deconstruction activities could result in temporary traffic flow effects on on-site roads.* The only routes of concern with respect to traffic effects are the on-site gravel roads at each dam. The short but frequent heavy vehicle trips anticipated as part of dam deconstruction and reservoir restoration (the Proposed Action could generate over 1,500 AADT at some locations) could cause traffic flow concerns. Signage and construction traffic management to reduce construction traffic generated impacts would be implemented. **Traffic flow effects on on-site roads would be less than significant.**

*Construction activities associated with the demolition of recreation facilities could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.* The demolition of recreation facilities would take place following dam deconstruction activities. Truck trips associated with construction activities at recreation sites would occur after the peak traffic period calculated for dam deconstruction activities. **Therefore, traffic flow effects on I-5, OR66, US97, and access roads would be less than significant.**

*Construction activities related to the relocation of the Yreka water supply pipeline could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.* Relocation of the City of Yreka's water supply pipeline would occur prior to the start of dam deconstruction. Therefore, related construction activities for pipeline relocation would take place well before the peak deconstruction activity involved in dam removal. **Traffic flow effects on I-5, OR66, US97, and access roads would be less than significant impact.**

**Table 3.22-2. Traffic Flow Projections**

Roads	Road Type	Planning Capacity			No Action/No Project			Full Facilities Removal of Four Dams (Proposed Action)		
		LOS	v/c Ratio	AADT	LOS	v/c Ratio	AADT	LOS	v/c Ratio	AADT
Interstate-5 (California)	Limited Access Interstate Highway	C	--	49,900	A	--	18,350	A	--	18,597
Interstate-5 (Oregon)	Limited Access Interstate Highway	--	0.85	63,700	--	0.24	15,100	--	0.24	15,112
OR66	State Highway	--	0.75	40,800	--	0.01	490	--	0.01	582
US97	US Highway	--	0.70	48,000	--	0.19	9,300	--	0.20	9,380
Copco Rd	Major Roadway	C	--	5,500	A	--	250	A	--	515
Topsy Grade Rd	Major Roadway	--	0.85	5,500	--	0.04	200	--	0.04	202
Unpaved Access Roads	Site Internal Gravel Roads	--	0.95	N/A	--	N/A	30	--	N/A	1,240
Roads	Road Type	Partial Facilities Removal of Four Dams			Fish Passage at Four Dams			Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate		
		LOS	v/c Ratio	AADT	LOS	v/c Ratio	AADT	LOS	v/c Ratio	AADT
Interstate-5 (California)	Limited Access Interstate Highway	A	--	18,593	A	--	18,454	A	--	18,530
Interstate-5 (Oregon)	Limited Access Interstate Highway	--	0.24	15,111	--	0.24	15,104	--	0.24	15,104
OR66	State Highway	--	0.01	574	--	0.01	514	--	0.01	514
US97	US Highway	--	0.20	9,373	--	0.20	9,320	--	0.19	9,320
Copco Rd	Major Roadway	A	--	511	A	--	354	A	--	430
Topsy Grade Rd	Major Roadway	--	0.04	202	--	0.04	200	--	0.04	200
Unpaved Access Roads	Site Internal Gravel Roads	--	N/A	1,240	--	N/A	102	--	N/A	966

Source: 1. Caltrans Traffic Data Branch, 2. FDOT 2009, 3. Klamath County 2004, 4. ODT 2010, 5. Amador County Transportation Commission, 2004.

Key:

v/c: volume-to-capacity ratio

AADT: Annual Average Daily Traffic

LOS: Level of Service

*Implementation of the IMs could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.* Implementation of several IMs, including IM 7 – J.C. Boyle Gravel Placement and Habitat Enhancement (for seven years) and IM 16 – Water Diversions could result in increased traffic from haul trucks and construction workers; however, any increases in traffic flow would be minor and would not contribute substantially to the number of vehicles on the road. **Traffic flow effects on I-5, OR66, US97, and access roads from implementing the interim measures would be less than significant impact.**

### **Traffic Safety Effects**

Activities associated with the Proposed Action, would cause traffic safety effects at each deconstruction site, on Copco Road, Topsy Grade Road, and on OR66. The Lead Agencies have identified three potential areas of concern within the area of analysis.

*Haul truck movement on unpaved roads could cause traffic safety effects associated with dust along gravel roads.* High trip volumes would create a substantial amount of dust in dry conditions on Copco Road, Lakeview Road, Topsy Grade/Ager-Beswick Road, and the roads leading to and surrounding each dam. Parts of these roads have gravel surfaces. The dust would create a substantial visibility hazard for vehicles on the deconstruction sites throughout the area. Installation of signage, dust abatement and proper construction traffic management that would be implemented as a part of the Proposed Action would reduce the severity of this effect. **Visibility hazards caused by traffic-related dust generation would be a less than significant impact.**

*Transportation of materials to and from the dam sites could cause traffic safety effects associated with vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road and OR66.* If Copco Road and the Topsy Grade, Iron Gate and Copco 1 Reservoir Recreation Sites are open,<sup>4</sup> there would be substantial safety concerns regarding traffic at the entrance to each small recreation parking area; this includes the boat launch downstream of Iron Gate Dam. The access road for the J.C. Boyle Dam is immediately off of OR66, where the posted speed limit is 55 mph. This location, while providing a clear view of oncoming traffic, would have a safety conflict related to speed differentials between construction vehicle traffic and normal vehicular traffic. Construction vehicles could pose safety risks to passenger and other vehicles traveling on roads in the project area. Construction vehicles travel at slower speeds, require more acceleration and deceleration time, and slow or stop traffic to make turns. Left turns across oncoming traffic could pose safety risks if truck acceleration is slow and oncoming speed limits were high. The following locations could experience traffic safety hazards related to conflicts between construction vehicles and regular traffic:

- Three boat launches and three camp sites along Copco Road.
- The recreation area accessed from Topsy Grade Road.

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<sup>4</sup> With the removal of the facilities, reservoir recreation opportunities would no longer exist. It is possible that Copco and Topsy Grade Roads may be completely closed to non-project related traffic during deconstruction.

- One boat launch (access to the Klamath River) downstream of Iron Gate Dam, immediately adjacent to the bridge.

The installation of construction signage on OR66 and Copco Road in accordance with the Manual of Uniform Traffic Control Devices would reduce all traffic conflicts and alert oncoming traffic to slow merging construction traffic. **Traffic conflicts at vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road, and OR66 would be a less than significant impact.**

*Vehicles associated with dam removal could cause traffic safety effects associated with sharp curves along Copco Road and OR66.* Both OR66 and Copco Road have several sharp turns that could require large construction vehicles to travel at very slow speeds. Copco Road narrows along certain portions of the roadway, and has many winding turns, mirroring the shore of the lake. **The installation of signage at sharp turns along OR66 and Copco Road would reduce this impact to less than significant.**

*Activities associated with relocation of the City of Yreka's water supply pipeline and relocation or demolition of recreation facilities could cause traffic safety effects associated with sharp curves along Copco Road and OR66.* These construction activities would occur at different times than dam removal deconstruction activities; thus, there would be no overlap in traffic volumes associated with deconstruction of the dams. **This fact combined with the installation of signage at sharp turns along OR66 and Copco Road would reduce traffic safety effects to less than significant.**

*Implementation of the interim measures could cause traffic safety effects associated with sharp turns along Copco Road and OR66.* Implementation of several interim measures, including Interim Measure (IM) 7 – J.C. Boyle Gravel Placement and/or Habitat Enhancement, IM 8 – J.C. Boyle Bypass Barrier Removal, and IM 16 – Water Diversions could result in increased traffic from haul trucks and construction workers; however, any increases in traffic flow would be minor and would not contribute substantially to the number of vehicles on the road. **This fact combined with the installation of signage at sharp turns along OR66 and Copco Road would reduce traffic safety effects associated with implementation of the interim measures to less than significant.**

*The relocation of existing recreation facilities from the banks of the existing reservoirs down slope to the new river bed could result in traffic impacts along adjacent roadways.* Recreation facilities, such as campgrounds and boat ramps, currently located on the reservoir banks would need to be relocated down slope to be near the new river bed once the reservoir is removed. These construction activities would occur at different times than dam removal deconstruction activities; thus, there would be no overlap in traffic volumes associated with deconstruction of the dams. **This fact combined with the installation of signage at sharp turns along OR66 and Copco Road would reduce traffic safety effects to less than significant.**

### **Road Condition Effects**

*Existing roads and bridge structures near the dam sites may not have adequate strength capacity for construction vehicles.* Under the Proposed Action, further analysis of road conditions and bridge weight capacities would be necessary. Roads in the area of analysis do not have heavy traffic volumes and some do not have traffic from heavy vehicles, such as construction trucks. Some of the roads in the area of analysis may not have been designed to sustain heavy loads.

Three existing bridges in the area of analysis might be important for deconstruction efforts, but could be incapable of supporting and withstanding the weight of heavy deconstruction and hauling vehicles. Initial analysis of these bridges by the Lead Agencies indicated the potential need for repair or replacement prior to dam removal. Siskiyou County's schedule for maintenance of these facilities is unknown. Bridges include:

- A bridge at Iron Gate Dam connecting Copco Road to Lakeview Road. This is the only route that provides access to the south side and top of Iron Gate Dam.
- A bridge at J.C. Boyle Dam that provides access to the south side and top of that dam from OR66. At this location, an alternate route via Topsy Grade Road would allow construction vehicles to access the dam and avoid the bridge.
- Daggett Road Bridge used to access the Copco 2 Powerhouse.
- Jenny Creek Bridge was constructed on accumulated sediment. Preliminary engineering assessments identified the potential for movement of sediment during reservoir draw down that could deem the bridge structurally unsound. Replacement of the bridge at an alternate location would be necessary.

While many of these roads and bridges were put in place to facilitate the construction of the Four Facilities, it is unknown whether they are in good enough condition to withstand the weight and frequency of trips during deconstruction. As part of the development of the construction plan, an in depth analysis of bridge and road capacity and state of repair would be conducted by the dam removal entity (DRE), with remedial actions taken prior to the commencement of facility deconstruction. Following completion of dam deconstruction additional analysis of road condition would be completed and where needed, as a result of wear generated by deconstruction repairs and or replacement actions would be completed. **Construction traffic could have significant impacts on roads and bridges in the project area. Analysis of road and bridge condition and repair prior to and following dam deconstruction along with implementation of Mitigation Measure TR-1 would reduce any impacts to less than significant.**

### **Public Transit Effects**

*Trip volumes and routes of material hauling and worker trips could affect regional transit service.* While there are small overlaps between minor haul routes and public transit routes, deconstruction traffic is not expected to interfere with public transit service. **Effects on regional transit service would be less than significant.**

### **Non-motorized Transportation Effects**

*Heavy vehicle traffic could cause non-motorized transportation (pedestrian) effects.* Although the area of analysis has no non-motorized transportation facilities, cyclists and pedestrians might travel along Copco and Topsy Grade/Ager-Beswick Roads in a limited capacity due to the recreational nature of the area. These pedestrians and cyclists would have to travel along the road itself, and could encounter safety hazards when sharing the road with large hauling vehicles, which could occupy much of the available road width, generate dust, or vary speeds around corners. Development of appropriate signage to notify of potential conflicts within the area would reduce this impact by warning drivers and non-motorized users. **The safety hazard for non-motorized transportation would be a less than significant impact.**

### **Keno Facilities Transfer**

*The transfer of the Keno Facility to United States Department of the Interior (DOI) could result in effects to traffic and transportation.* The Keno Transfer, which would also be part of the Proposed Action, is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on transportation compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance consistent with agreements and historic practice (KHSa Section 7.5.4). **The transfer of the facility and recreation lands would result in no change from existing conditions from traffic or transportation.**

### **East and West Side Facilities Decommissioning**

*The decommissioning of the East and West Side Facilities could generate adverse traffic and transportation effects.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSa would redirect water flows currently diverted at Link River Dam into the two canals, back in to Link River. Decommissioning of the facilities would generate some construction traffic. Routes used by this construction traffic would be signed and appropriate safety measures would be incorporated. **Decommissioning the facilities would have less than significant effects on traffic or transportation.**

### **KBRA**

Construction activities associated implementation of several KBRA programs could cause traffic effects including increases in traffic, the presence of increased numbers of heavy construction equipment, and temporary road closures or detours. The following programs could cause these impacts:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration Project
- On- Project Plan
- Water Use Retirement Program

- Fish Entrainment Reduction
- Klamath River Tribes Interim Fishing Site

*Construction activities associated with the above-listed KBRA programs involving construction could cause temporary traffic effects.* KBRA program implementation could result in temporary closures and/or traffic detours associated with culvert upgrades or replacement. In some cases, local access roads could be decommissioned. Minor amounts of vehicular traffic might need to identify alternate routes. Gravel augmentation activities for streambeds could result in gravel deliveries to various locations using dump trucks and placement using backhoes, which could cause traffic flow and safety effects and road condition effects. Construction activities including channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling could cause temporary increases in traffic and traffic safety effects. It is assumed that construction related to some of these programs could occur on the same roads as the hydroelectric facility removal actions and could contribute to the effects of facility removal on traffic and transportation. **Due to the potentially large amount of construction activities that would occur for the various KBRA programs could generate adverse traffic effects; however, the implementation of best management practices would minimize any traffic impacts to less than significant. Additional traffic analysis and environmental compliance would be completed as appropriate.**

*Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary traffic effects associated with trap-and-haul activities.* Haul trucks would be required to seasonally relocate anadromous fish species around the Keno Impoundment and Link River during periods of poor water quality. Haul trucks would carry upstream-migrating fish from the downstream side of Keno Dam to areas in Upper Klamath Lake and its tributaries. They would also carry downstream-migrating fish from Link River Dam to areas downstream from Keno Dam. Haul trucks would increase traffic on the roads between these sites. Haul trucks may travel on OR66 and US97, access roads, and on-site roads. As shown in Table 3.2-2, area roads carry substantially fewer vehicles in the Proposed Action than the Planning Capacity; adding a small number of additional truck trips each day for trap and haul operations would not substantially change traffic conditions. Hauling activities would occur after the peak traffic-generating period of facility removal because fish cannot access Keno Dam until after removal of the Four Facilities; however, some construction traffic associated with completing removal activities and reservoir restoration may occur at the same time as hauling operations. Construction traffic related to dam removal and hauling operations, taken together, could increase the severity of the traffic effects, but the combined traffic would likely still be less than the peak traffic during dam deconstruction. The timing of these trap and haul operations from the hydroelectric facility removal actions analyzed above reduce the potential for any negative traffic effects generated by these trap and haul actions from contributing to the effects of facility removal actions. **The traffic flow effects on OR66 and US97, access roads, and on-site roads would be less than**

**significant. Implementation of specific plans and projects described in the KBRA would require future environmental compliance as appropriate.**

### **Alternative 3: Partial Facilities Removal of Four Dams Alternative**

#### **Traffic Flow Effects**

Traffic flow effects for the Partial Facilities Removal of Four Dams Alternative would be the same as those for the Proposed Action. **Traffic flow effects on I-5, OR66, US97, and access roads would be a less than significant impact. Traffic flow effects on on-site roads would be a less than significant impact.**

#### **Traffic Safety Effects**

Traffic safety effects for the Partial Facilities Removal of Four Dams Alternative would be the same as those for the Proposed Action. **Implementation of Alternative 3 would be less than significant.**

#### **Road Condition Effects**

Road condition effects for the Partial Facilities Removal of Four Dams Alternative would be the same as those for the Proposed Action. **Construction traffic could have significant impacts on roads and bridges in the project area. Analysis of road and bridge condition and repair prior to and following dam deconstruction along with implementation of Mitigation Measure TR-1 would reduce any impacts to less than significant.**

#### **Public Transit Effects**

Public transit effects for the Partial Facilities Removal of Four Dams Alternative would be the same as those for the Proposed Action. **Implementation of Alternative 3 would be less than significant.**

#### **Non-motorized Transportation Effects**

Non-motorized transportation effects for the Partial Facilities Removal of Four Dams Alternative would be the same as those for the Proposed Action. **Implementation of Alternative 3 would be less than significant.**

#### **Keno Facilities Transfer**

The effects of the Keno Transfer would be the same as those described for the Proposed Action.

#### **Eastside and Westside Facilities Decommissioning**

The effects of decommissioning the Eastside and Westside Facilities would be the same as those described for the Proposed Action.

#### **KBRA**

The Partial Facilities Removal Alternative would include full implementation of the KBRA. Therefore, impacts related to KBRA actions would be the same as under the Proposed Action, discussed above.

#### **Alternative 4: Fish Passage at Four Dams**

##### **Traffic Flow Effects**

*Construction activities associated with the Fish Passage at Four Dams Alternative could result in temporary traffic flow effects on I-5, OR66, US97, access roads, and on-site roads.* Under this alternative there would be no daily construction hauling trips on I-5, OR66, and US97. The only roads experiencing daily heavy vehicle trips would be the local unpaved roads adjacent to each dam. These roads would have 18 daily vehicle trips for fish passage construction, comprised of mainly concrete delivery from nearby batch plants. Material hauling trips would be limited, and worker trips would make up the majority of construction-related traffic. If concrete delivery were not provided at batch plants near the construction sites, then concrete delivery could come from either Klamath Falls, Oregon or Yreka, California. In this case, the estimated 18 daily vehicle trips accounting for concrete delivery would not only access the local roadways, but would be added to traffic on the other major roadways, as shown in Appendix T, 2020 Traffic Volume Projections. The addition of an additional 18 daily vehicle trips to the AADT volumes would not cause deterioration in levels of service.

No long-term or permanent traffic volume increases or long-term changes in traffic patterns would occur as a result of this alternative. Any incremental transportation impacts associated with this alternative would be temporary and would occur during the one-year construction period. The number of construction days at J.C. Boyle and Copco 2 Dams would both be less than 130 days; Copco 1 and Iron Gate Dams would have fewer than 290 construction days.

Traffic associated with this alternative would cause none of the roads in the area of analysis to have a LOS worse than A or a v/c ratio greater than 0.25. The combined total of the projected baseline traffic volumes and the traffic that would result from implementation of this alternative would not exceed the significance criteria for traffic flow impacts. **Traffic flow effects on I-5, OR66, US97, access roads, and on-site roads would be a less than significant impact.**

*Implementation of the prescriptions provided by the United States Fish and Wildlife Service, DOI, and Department of Commerce in the Federal Energy Regulatory Commission (FERC) 2007 Environmental Impact Statement and seasonal trap and haul operations implemented at Keno Dam could result in temporary traffic flow effects on OR66 and US97, access roads, and on-site roads.* Following construction of fishways to provide for volitional fish passage, interim seasonal trap and haul operations would be implemented at Keno Dam between June 15 and November 15 if dissolved oxygen and water temperatures no longer meet certain water quality criteria. As vehicle trips associated with trap and haul operations would take place following fishway construction, there would be no overlap between these trips and peak construction traffic. These activities would be similar to those described above under the Proposed Action in the KBRA Fisheries Reintroduction and Management Plan; however, the haul distance under Alternative 4 would be less. **Thus, traffic flow effects on OR66 and US97, access roads, and on-site roads would be less than significant.**

### **Traffic Safety Effects**

*Activities associated with the Fish Passage at Four Dams Alternative would cause traffic safety effects at each construction site, on Copco Road, Topsy Grade/Ager-Beswick Road, and on OR66.* Traffic safety effects for the Fish Passage at Four Dams alternative would be almost exactly the same as those for the Proposed Action, with two differences: 1) the recreation sites along Copco Road from Iron Gate Dam to Copco Dams would remain open; and 2) construction related traffic would be much lighter than that of the Proposed Alternative. While the traffic volume under this alternative would be lower than under the Proposed Action, the safety impacts would be the same. Installation of signage, dust abatement and proper construction traffic management would minimize impacts. **This impact would be less than significant.**

*Activities associated with the implementation of the prescriptions and seasonal trap and haul operations would cause traffic safety effects on OR66 and US97, access roads, and on-site roads.* As described under the analysis of traffic flow effects, vehicle trips associated with trap and haul operations would take place following dam deconstruction. There would be no overlap between these trips and peak deconstruction traffic. These activities would be similar to those described under the Proposed Action in the KBRA Fisheries Reintroduction and Management Plan; however, the haul distance under Alternative 4 would be less. **Thus, traffic flow effects on OR66 and US97, access roads, and on-site roads would be less than significant.**

### **Road Condition Effects**

Road condition effects for the Fish Passage at Four Dams Alternative would be the same as those for the Proposed Action. As part of the development of the construction plan, an in depth analysis of bridge and road capacity and state of repair would be conducted by the Hydropower Licensee, with remedial actions taken prior to the commencement of construction. Following completion of construction, additional analysis of road condition would be completed and where needed, as a result of wear generated by construction repairs and or replacement actions would be completed. **Construction traffic could have significant impacts on roads and bridges in the project area. Analysis of road and bridge condition and repair prior to and following construction would reduce any impacts to a less than significant level.**

### **Public Transit Effects**

Public transit effects for the Fish Passage at Four Dams Alternative would be the same as those for the Proposed Action. **Implementation of Alternative 4 would be less than significant.**

### **Non-motorized Transportation Effects**

Non-motorized transportation effects for the Fish Passage at Four Dams Alternative would be the same as those for the Proposed Action. Development of appropriate signage to notify of potential conflicts within the area would reduce this impact by warning drivers and non-motorized users. **The safety hazard for non-motorized transportation would be a less than significant impact.**

### **Trap and Haul – Programmatic Measure**

*Operation of trap and haul measures could result in temporary traffic effects.* Haul trucks would be required to seasonally relocate anadromous fish species around the Keno Impoundment and Link River during periods of poor water quality. Haul trucks would carry upstream-migrating fish from the downstream side of Keno Dam to areas in Upper Klamath Lake and its tributaries. They would also carry downstream-migrating fish from Link River Dam to areas downstream from Keno Dam. Haul trucks would increase traffic on the roads between these sites. Haul trucks may travel on OR66 and US97, access roads, and on-site roads. As shown in Table 3.22-2, area roads carry substantially fewer vehicles in the Fish Passage at Four Dams Alternative than the Planning Capacity; adding a small number of additional truck trips each day for trap and haul operations would not substantially change traffic conditions. **The traffic flow effects on OR66 and US97, access roads, and on-site roads would be less than significant.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate**

Because Copco 1 and 2 Dams are adjacent to one another, they share local access roads, and the greatest traffic effects at either of the dams would apply to both. Under this alternative, the traffic and transportation effects at Iron Gate, Copco 1 and Copco 2 Dams would be the same as Proposed Action and would be less than significant after mitigation, and the traffic and transportation effects at J.C. Boyle Dam would be similar to that of the Fish Passage at Four Dams Alternative and would be less than significant.

*Activities associated with the implementation of the prescriptions and seasonal trap and haul operations could cause traffic safety effects on OR66 and US97, access roads, and on-site roads.* As described under the analysis of traffic flow effects, vehicle trips associated with trap and haul operations would take place following dam deconstruction and fishway construction. There would be no overlap between these trips and peak construction-related traffic. These activities would be similar to those described under the Proposed Action in the KBRA Fisheries Reintroduction and Management Plan; however, the haul distance under Alternative 5 would be less. **Thus, traffic flow effects on OR66 and US97, access roads, and on-site roads would be less than significant.**

### **Trap and Haul – Programmatic Measure**

*Operation of trap and haul measures could result in temporary traffic effects.* The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. **The traffic flow effects on OR66 and US97, access roads, and on-site roads would be less than significant.**

#### **3.22.4.3 Mitigation Measures**

##### **Mitigation Measures by Consequence Summary**

*Mitigation Measure TR-1 – Relocate Jenny Creek Bridge and culverts away from sediment deposits potentially susceptible to down cutting as a result of reservoir drawdown to prevent bridge foundation failure.*

### **Effectiveness of Mitigation in Reducing Consequences**

All of the mitigation strategies identified herein would reduce potential impacts to less than significant. Other actions that mitigate potential impacts would be standard, best management practices incorporated into project design activities. Such practices include construction zone signing and dust abatement, coupled with the periodic grading of roadways during construction. Implementation of these during project design and construction would reduce potential impacts to less than significant.

### **Agency Responsible for Mitigation Implementation**

The DRE would be responsible for implementing mitigation measure TR-1.

### **Remaining Significant Impacts**

Mitigation measures TR-1 would reduce traffic and transportation impacts to less than significant levels.

### **Mitigation Measures Associated with Other Resource Areas**

*Implementation of Mitigation Measure AR-1 could result in temporary traffic flow, traffic safety, and road condition effects on access roads and on-site roads.* Mitigation measure AR-1 would relocate mussels in the Hydroelectric Reach and in the Lower Klamath River, downstream of Iron Gate Dam, to tributary streams or upstream of the Hydroelectric Reach. Relocation would take place prior to dam deconstruction activities and reservoir drawdown. Following dam deconstruction, mussels would be moved back to their approximate location or to other suitable habitat in the river. Given the timing of vehicle trips associated with relocation activities, there would be no overlap with peak construction traffic during dam removal. **Thus, the impact to traffic flow, traffic safety, and road conditions on access roads and on-site roads would be less than significant.**

*Implementation of Mitigation REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam.* Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoir is removed. Recreation facility construction would take place following dam deconstruction activities and reservoir drawdown. Given the timing of vehicle trips associated with relocation activities, there would be no overlap with peak construction traffic during dam removal. **Thus, the impact to traffic flow, traffic safety, and road conditions on access roads and on-site roads would be less than significant.**

Several other mitigation measures may require construction, including mitigation measures H-2 (move or elevate structures with flood risk), GW-1 (deepen or replace wells), and WRWS-1 (modify water intakes). These measures could produce vehicle trips associated with construction activities. These activities would take place before or after the primary construction and deconstruction activities associated with the Proposed Action and other alternatives; therefore, they would not add to these construction traffic impacts. These construction activities are generally smaller efforts that would not cause a substantial increase in vehicle trips. **Thus, the impact to traffic flow, traffic safety,**

**and road conditions on access roads, on-site roads, and on roads would be less than significant.**

### **3.22.5 References**

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## 3.23 Noise and Vibration

This section addresses the noise and vibration impacts of the Proposed Action and alternatives. It includes a description of the area of analysis, the affected environment, and existing conditions. This section also describes the criteria used to define and determine noise and vibration impact significance and the assessment methods. The potential impact from noise and vibration are evaluated for each alternative, and possible mitigation measures are listed. Appendix U describes basic noise and vibration concepts, detailed methods and calculations, and modeling results.

### 3.23.1 Area of Analysis

The area of analysis for noise and vibration effects associated with the Klamath Hydroelectric Settlement Agreement (KHSA) includes areas near the Four Facilities and the haul routes in Klamath and Jackson Counties, Oregon, and Siskiyou and Shasta Counties, California. Figure 3.23-1 shows the locations of the Four Facilities and haul routes. The area of analysis for the Klamath Basin Restoration Agreement (KBRA) constitutes the entirety of the Klamath Basin.

### 3.23.2 Regulatory Framework

Noise and Vibration levels in the area of analysis are regulated by local laws and policies. There are no federal or state regulations applicable to noise and vibration levels from construction activity in the area of analysis.

#### 3.23.2.1 Local Authorities and Regulations

- Siskiyou County General Plan Noise Element (1978)

The Siskiyou County General Plan Noise Element contains criteria for maximum allowable noise levels from construction equipment. Table 3.23-1 lists the maximum allowable noise levels in A-weighted decibels (dBA) for construction equipment applicable to the Proposed Action. There are no other applicable state or local regulatory levels for noise or vibration in the area of analysis.

Although the Proposed Action does not involve highway construction, federal and state highway traffic noise criteria provide a basis for analyzing project traffic noise impacts. The Federal Highway Administration (FHWA) requires highway agencies to define a “substantial” noise increase as an increase of 5 to 15 dBA over existing noise levels (23 CFR Part 772). The California Department of Transportation (Caltrans) defines “substantial” as a predicted increase greater than or equal to 12 dBA over existing 1-hour equivalent noise levels (Leq) (Caltrans 2006). The Oregon Department of Transportation (ODOT) defines substantial noise increase as greater than or equal to 10 dBA above the existing 1-hour Leq (ODOT 2009).

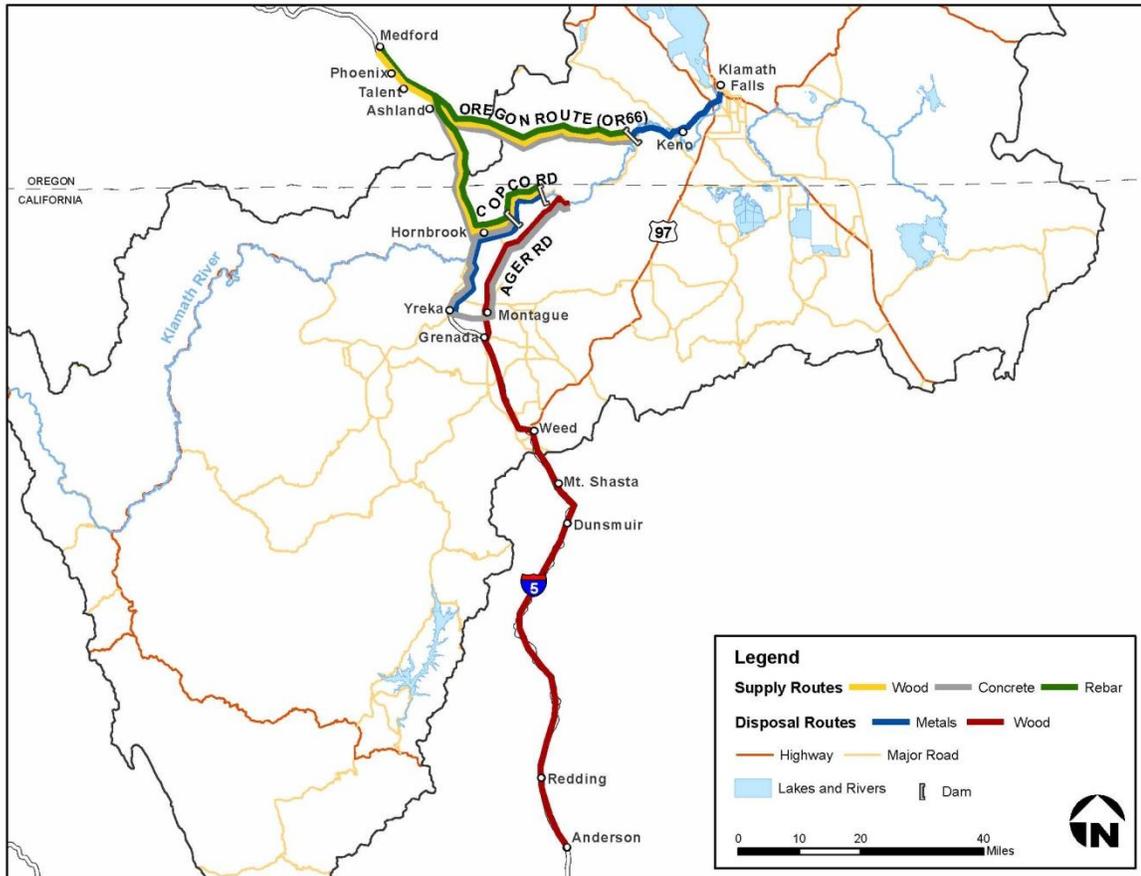


Figure 3.23-1. Primary Haul Routes From Dam Sites

Table 3.23-1. Maximum Allowable Noise Levels from Construction Equipment in Siskiyou County, CA

Equipment Type	Peak Noise Level (dBA at 50 feet) <sup>1</sup>
Compressors	81
Concrete Mixers	81
Concrete Pumps	81
Cranes	81
Dozers	81
Front Loaders	81
Generators	81
Pneumatic Tools	86
Pumps	81
Tractors	81
Trucks	81

Source: Siskiyou County 1978.

Notes:

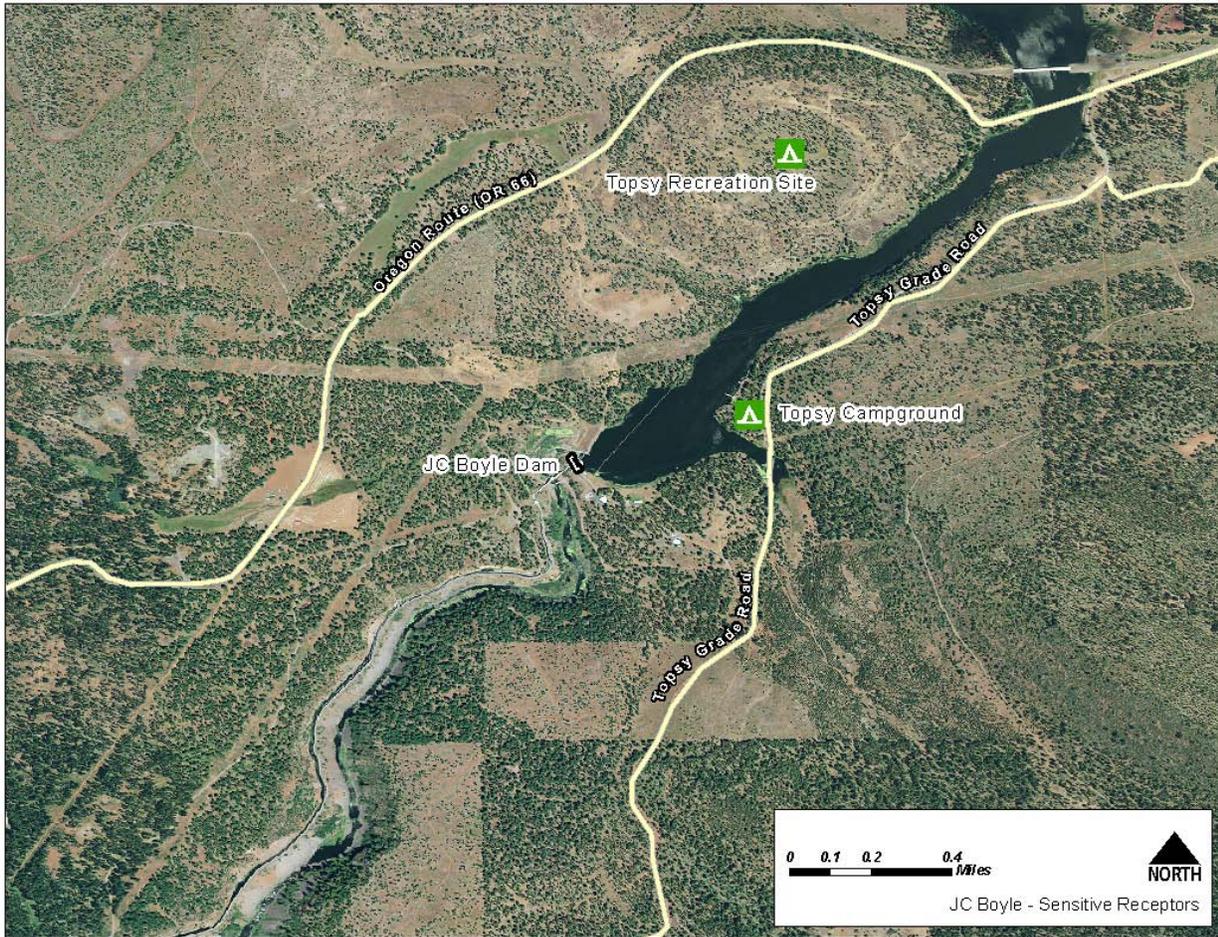
<sup>1</sup>Maximum allowable noise levels from construction equipment at 100 ft from Siskiyou County's General Plan converted to noise levels at 50 ft.

### **3.23.3 Existing Conditions/Affected Environment**

The Lead Agencies identified noise-sensitive human receptor locations (i.e. residences) based on a review of current topographic, aerial, and land use maps. Existing outdoor ambient noise levels at affected sensitive receptor locations were estimated using published average ambient noise levels for various land uses. Siskiyou County presents average noise levels for various land use categories in the Noise Element of their General Plan (Siskiyou County 1978). However these median ambient noise levels for different land use categories were developed based on a one-time field survey in the 1970s and none of the measurements were taken in the project area. Therefore, the Lead Agencies used average daytime  $L_{eq}$  and nighttime outdoor  $L_{eq}$  noise levels from U.S. Environmental Protection Agency's (USEPA's) *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (1974) to estimate ambient noise levels at selected receptor locations. Noise levels for rural residential areas in the USEPA document are lower than the levels presented in the Siskiyou County General Plan; it is more conservative to analyze the impacts using the USEPA levels. Because noise and vibration impacts would not occur without a receptor, the Affected Environment includes the rural residential areas and wildlife nesting areas closest to the proposed construction sites. The following paragraphs describe the sensitive receptors in the Affected Environment.

#### **3.23.3.1 Existing Noise Levels near Construction Sites**

The land surrounding the J.C. Boyle Dam is primarily undeveloped, and land use is primarily recreational. Recreational sites would be closed to visitors during construction and demolition activities; therefore, no impact analysis was conducted for campgrounds. No residential areas are within a mile of the dam. Because of this, noise and vibration impacts to humans would not occur from construction and deconstruction activities at the J.C. Boyle Dam. Trucks from J.C. Boyle Dam would most likely travel on Oregon Route 66 (OR66), approximately 2,500 feet west of the dam, reached via Topsy Grade Road to access Interstate 5 (I-5) or U.S. Route 97 (US97). Figure 3.23-2 shows the locations of J.C. Boyle Dam, Topsy Campground, Topsy Recreation Site, and Topsy Grade Road.



**Figure 3.23-2. J.C. Boyle Noise Receptors (Closest Receptors to J.C. Boyle Dam)**

Copco 1 Dam and Powerhouse are approximately 2,200 feet west of a rural residential area (see Figure 3.23-3). Residences on Janice Avenue are the closest sensitive receptors, and the estimated existing daytime and nighttime outdoor Leq, based on the USEPA information as noted above are 40 and 30 dBA, respectively. The 2,200-foot distance between the dam and the receptor would provide 34 decibels (dB) of noise reduction, based on basic noise propagation calculation as described in Appendix U. The line of sight from the dam to the Janice Avenue receptor is blocked by a hill, the top of which is about 60 feet higher in elevation than the top of Copco 1 Dam at the hill's highest point along the line of sight between the dam and the receptor. The terrain may provide up to 5 dB of additional noise attenuation from the construction site to the Janice Avenue receptors. Copco Road and Ager-Beswick Road are the main off-site haul routes from this construction site. The Lead Agencies estimated traffic noise for trucks transporting materials in and out of the Copco 1 Dam and Powerhouse site via Copco Road and Ager-Beswick Road.

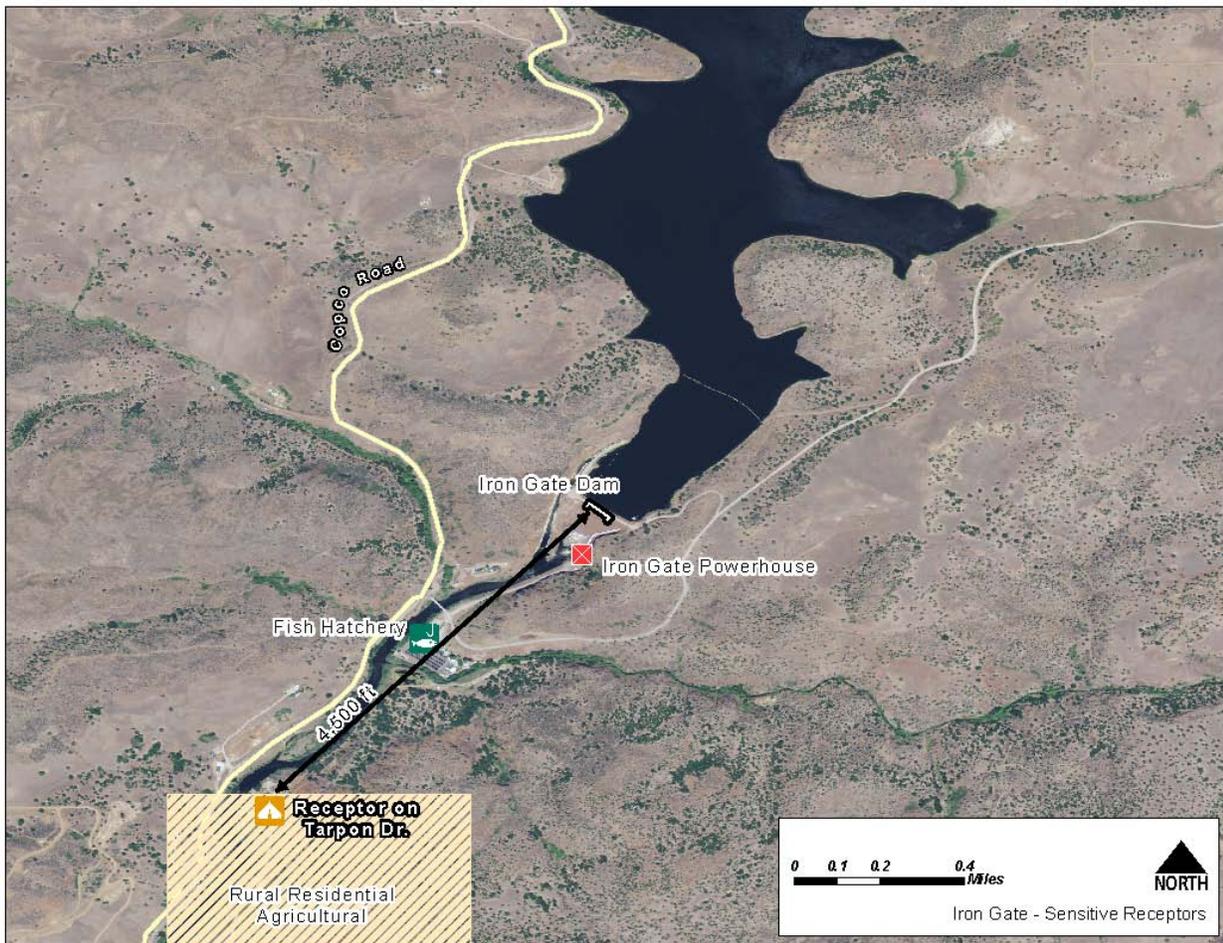


**Figure 3.23-3. Copco 1 & 2 Noise Receptor (Closest Receptor to Copco 1 and Copco 2 Dams)**

The closest sensitive receptor to Copco 2 Dam is the residential area on Janice Avenue described above for Copco 1 Dam. From Copco 2 Dam, the receptor is approximately 3,700 feet to the east. The line of sight from the dam to the receptor is blocked by two hills that have elevations approximately 180 feet higher than the top of the dam. Because of this natural topography surrounding the dam and distance between the dam and the receptor, noise from onsite construction activities at Copco 2 Dam would be reduced by 44 dB. No further analysis was conducted on noise from construction equipment and on-site hauling at Copco 2 Dam. The Lead Agencies estimated traffic noise for trucks transporting materials in and out of Copco 2 Dam via Copco Road and Ager-Beswick Road. Figure 3.23-3 shows the Copco 1 Dam, Copco 1 Powerhouse, and Copco 2 Dam locations as well as the closest sensitive receptor on Janice Avenue.

The Iron Gate Dam area is approximately 1,100 feet east of Copco Road, its main haul route. The closest sensitive receptor to Iron Gate Dam is on Tarpon Drive, approximately 4,500 feet southwest of the dam, as shown on Figure 3.23-4. Based upon the rural residential land use category, the existing daytime outdoor  $L_{eq}$  on Tarpon Drive is likely

40 dBA. The existing nighttime outdoor  $L_{eq}$  at this receptor is approximately 30 dBA. At its highest point along the line of sight between the receptor and the dam, the hill on river left just upstream of the Fish Hatchery is approximately 20 feet lower in elevation than the top of Iron Gate Dam. At the receptor, the hill would provide up to 3 dBA of noise reduction, in addition to the 43 dBA reduction due to distance from the construction site, for a total reduction of 46 dBA. Although this reduction is greater than that for Copco 2 Dam, there would be nighttime construction activities at Iron Gate Dam which may result in significant impact; the Lead Agencies estimated onsite construction and hauling noise levels.



**Figure 3.23-4. Iron Gate Noise Receptors (Closest Receptor to Iron Gate Dam)**

Section 3.5, Terrestrial Resources, shows the presence of special-status bird and other animal species near each of the dam sites and describes potential impacts and possible mitigation measures related to noise.

Table 3.23-2 summarizes the existing noise levels for the residential receptors selected to assess the noise and vibration impacts from each construction site. Daytime is defined as hours between 7:00 a.m. and 10:00 p.m., and nighttime is defined as 10:00 p.m. to 7:00 a.m. PacifiCorp’s residential properties were assumed to be unoccupied during the transfer of ownership to Reclamation and were not considered in this analysis.

**Table 3.23-2. Existing Noise Levels at Residential Receptors Near Construction Sites**

Construction Site <sup>1</sup>	Receptor Description	Distance from Construction Site (feet)	Estimated Existing Daytime L <sub>eq</sub> (dBA)	Estimated Existing Nighttime L <sub>eq</sub> (dBA)
Copco 1 Dam	Residential Area on Janice Ave, East of Copco 1 Dam.	2,200	40	30
Copco 2 Dam <sup>2</sup>	Residential Area on Janice Ave, East of Copco 1 Dam.	3,700	N/A	N/A
Iron Gate Dam	Residential Area on Tarpon Dr, SW of Iron Gate Dam.	4,500	40	30

Sources: Google Earth; USEPA 1974.

Notes:

<sup>1</sup> There are no applicable receptors at the J.C. Boyle Dam.

<sup>2</sup> Copco 2 Dam was not analyzed for noise impacts because the reduction in noise level due to distance and terrain between the receptor and the construction site would result in less than significant noise increase at the receptor.

Key:

dBA = A-weighted decibels

L<sub>eq</sub> = 1-hour equivalent noise level

N/A = not applicable

### 3.23.3.2 Existing Noise Levels along the Haul Routes

The Lead Agencies used the FHWA Traffic Noise Model, Version 2.5 (TNM2.5) to estimate the existing daytime peak hour L<sub>eqs</sub> along proposed haul routes. Peak-hour traffic was estimated by multiplying the average daily traffic by 10 percent based on a review of Caltrans and ODOT 2009 average daily and peak hourly traffic data (Caltrans 2010; ODOT 2010). Average daily traffic values published by ODOT (2010) and Caltrans (2010) were used to estimate the existing noise levels on OR66, US97, and I-5. Traffic volumes for I-5 between Yreka and Anderson, California are higher than those for north of Yreka; therefore, for conservative analysis, the lower volumes in the northern portion were used for the baseline. Field observations conducted for the preparation of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR) provided the basis for estimating existing 1-hr L<sub>eq</sub> along Topsy Grade Road, Copco Road, and Ager-Beswick Road.

This analysis uses peak-hour noise level results from TNM2.5 for generic receptors 50 and 500 feet from the edge of the road. Fifty feet represents the minimum distance for a receptor along any roadway and 500 feet is the maximum recommended receptor distance for traffic noise models (Caltrans 2006). Table 3.23-3 summarizes the existing peak hour L<sub>eq</sub> for project haul routes at 50 feet and 500 feet from the edge of the roadway.

**Table 3.23-3. Existing Peak Hour  $L_{eq}$  Along Proposed Haul and Commute Routes**

Haul Route/Commute Segment	Existing Daytime Peak hour $L_{eq}$ (dBA) <sup>1</sup>	
	50 feet	500 feet
Topsy Grade County Road / Ager-Beswick Road	53	42
US97	75	64
OR66	60	49
Copco Road	58	46
I-5: Between Medford, OR and OR66	77	66
I-5: Between OR66 and Yreka, CA	76	66

Source: Caltrans 2010. ODOT 2010. USEPA 1974.

Notes:

<sup>1</sup> Daytime 1-hour  $L_{eq}$  estimated by modeling traffic counts using TNM2.5.

Key:

dBA = A-weighted decibels

$L_{eq}$  = 1-hour equivalent noise level

### 3.23.4 Environmental Consequences

Potential sources of noise from implementation of the Klamath Hydroelectric Settlement Agreement include construction equipment and construction-related traffic noise. Impact determination methods, criteria, and effects determination are presented below.

#### 3.23.4.1 Environmental Effects Determination Methods

This analysis compared the impacts of the Proposed Action and alternatives to the baseline existing conditions. This analysis assumes that no considerable changes in land use would occur in the next 10 years and therefore, existing conditions and the No Action/No Project ambient noise levels would be the same. The Lead Agencies determined noise and vibration levels from construction equipment in the project area and construction-related traffic for each action alternative using the methods described below. A more detailed method description, analysis results, and data supporting the analysis are included in Appendix U.

#### On-site Construction Noise

The construction impact analysis focused on outdoor receptors in residential areas near the construction sites. Anticipated sources of construction noise include cranes, excavators, loaders, dozers, concrete trucks, water tankers, pick-up trucks, generators, air compressors, and pavement breakers.

Principles and methods described in FHWA's Roadway Construction Noise Model User's Guide (2006) were the basis for predicting noise impacts associated with construction equipment for the action alternatives. Table 3.23-4 presents noise levels of common construction equipment operating at full power ( $L_{max}$ ) measured 50 feet from the source, the percentage of time the equipment would be operated at full power (usage factor), and the  $L_{eq}$  over a single shift (FHWA 2006). For equipment whose  $L_{max}$  in the Roadway Construction Noise Model exceeds the maximum allowable noise levels from

construction equipment in the Siskiyou County General Plan Noise Element (1978), the upper limits from Siskiyou County were used.

**Table 3.23-4. Construction Operations, Equipment Types, and Their Noise Levels**

Equipment Types	Usage Factor	L <sub>max</sub> at 50 feet (dBA)	L <sub>eq</sub> at 50 feet (dBA)
Air Compressor	40%	78	74
Backhoe	40%	78	74
Blasting	1%	94	74
Compactor	20%	83	76
Concrete Mixer Truck	40%	79	75
Concrete Pump Truck <sup>1</sup>	20%	81	74
Crane	16%	81	73
Dozers <sup>1</sup>	40%	81	77
Dump Truck	40%	77	73
Excavator	40%	81	77
Front End Loader	40%	79	75
Generator	50%	81	78
Grader	40%	85	81
Jackhammer <sup>1</sup>	20%	81	74
Mounted Impact Hammer (hoe ram)	20%	90	83
Pickup Truck	40%	75	71
Pumps	50%	81	78
Scraper	40%	84	80
Tractor <sup>1</sup>	40%	81	77

Source: FHWA 2006. Siskiyou County 1978.

Notes:

<sup>1</sup>Maximum allowable noise levels from construction equipment at 100 ft from Siskiyou County's General Plan converted to noise levels at 50 ft.

Key:

dBA = A-weighted decibels

L<sub>eq</sub> = 1-hour equivalent noise level

L<sub>max</sub> = noise levels of equipment operating at full power

Detailed equipment lists for each phase of construction were not available at the time of this analysis. Therefore, the analysis conservatively assumed that the dam removal phase would involve the greatest amount of construction equipment. Attenuation due to sound travel from the source to the receptor was applied to the combined L<sub>eq</sub> at 50 feet from all equipment, and the approximate noise level from construction at the receptor was added to existing outdoor ambient levels. Noise levels for each dam were analyzed separately because the facilities are spread out. Other phases, such as road and/or bridge improvement, Yreka pipeline construction, implementation of the interim measures, cofferdam construction, drawdown, and removal of recreational facilities, would cause less noise and vibration impacts than on the peak day.

### Vibration from Construction Sites

In addition to producing noise, construction activities have the potential to produce vibration that is annoying to humans and may cause damage to structures. Blasting, drilling, and demolition cause the highest levels of vibration from construction projects. Table 3.23-5 presents the peak particle velocity (PPV) in inches per second (in/sec) and vibration velocity level ( $L_v$ ) in vibration decibels (VdB) for typical construction equipment (Federal Transit Administration [FTA] 2006). The Lead Agencies applied these levels to each construction site as appropriate and calculated the equivalent PPV and  $L_v$  at the receptor. As was done for noise, the PPV and  $L_v$  are based on all construction equipment operating simultaneously on peak construction days.

**Table 3.23-5 Vibration Levels for Construction Equipment**

Equipment Types	PPV at 25 feet (in/sec)	$L_v$ at 25 feet (VdB)
Clam Shovel Drop	0.202	94
Vibratory Roller	0.210	94
Large Bulldozer / Hoe Ram	0.089	87
Caisson Drilling	0.089	87
Loaded Trucks	0.076	86
Jackhammer	0.035	79

Source: FTA 2006.

Key:

in/sec = inches per second

$L_v$  = vibration velocity level

PPV = peak particle velocity

VdB = vibration decibels

### Construction-Related Traffic Noise

Transportation noise impacts include noise generated from an increase in local vehicle traffic due to construction workers commuting and trucks hauling waste and construction materials. Details regarding the roadways affected by this Proposed Action are presented in Section 3.22, Traffic and Transportation. Trucks for onsite waste disposal were included in the construction equipment analysis.

Under the Proposed Action, trucks would haul recyclable metal waste to Yreka, California for waste originating in California and to Klamath Falls, Oregon for waste originating in Oregon. Wood waste from Copco 2 Dam would likely be hauled to a hazardous waste landfill in Anderson, California. For construction of fish passages, rebar and wood would be supplied from Medford, Oregon, and concrete would be transported from Yreka, California. The haul routes would likely be I-5, US97, OR66, Copco Road, Ager-Beswick/Ager Road, and Topsy Grade Road. Communities potentially affected by project-related traffic include unincorporated areas of Siskiyou (California) and Klamath (Oregon) Counties and the following cities: Yreka, Montague, Grenada, Weed, Dunsmuir, Mt. Shasta, Redding, and Anderson in California and Klamath Falls, Ashland, Talent, Phoenix, and Medford in Oregon. Figure 3.23-1 shows, for each supplied or removed material type, the haul route and the communities along the haul routes.

Like the trucks, construction workers would commute to the sites using the major highways and roads (I-5, OR66, US97, Copco Road, and Topsy Grade Road). Based on the impact analysis in Section 3.17, Population and Housing, the analysis assumed that workers at facilities in California (Copco 1, Copco 2, and Iron Gate) would commute from Medford, Oregon or Yreka, California and workers at J.C. Boyle Dam would commute from Keno, Oregon and Klamath Falls, Oregon.

This analysis bases the off-site traffic noise impact assessment on the sum of likely existing noise levels near the haul routes, as described in the Affected Environment/Environmental Setting section, and additional traffic noise from the project. Results from TNM2.5 were used for predicting noise levels 50 feet and 500 feet from roadways. This analysis assumes that off-site hauling to suppliers and landfills would only occur during the daytime. Although the worker commute may not overlap with off-site hauling, the number of cars and trucks from worker commute and hauling were added to the baseline traffic counts for a conservative analysis. Nighttime construction at Copco 1 and Iron Gate would have less impact (i.e., only worker commute) than daytime commute and offsite hauling.

#### **3.23.4.2 Significance Criteria**

For the purpose of this analysis, a project action would be significant if it resulted in any the following:

- A greater than 10 dBA increase in the daytime or nighttime outdoor 1-hour  $L_{eq}$  at the receptor from on-site construction operations
- A PPV greater than 0.3 in/sec at the receptor
- An  $L_v$  greater than 72 VdB at the receptor
- A greater than 12 dBA (in California) or 10 dBA (in Oregon) increase above existing 1-hour  $L_{eq}$  for traffic-related noise

The criteria above were based on the characteristics of noise, published studies on vibration effects, and established regulations. Although Siskiyou County does not have local significance criteria for noise and vibration levels, the significance criteria itemized above is expected to provide a conservative analysis of noise and vibration levels. Daytime is defined as the hours between 7:00 am and 10:00 pm, and nighttime is defined as the hours between 10:00 pm to 7:00 am. A 10 dBA increase in noise level is perceived as a doubling of noise (FHWA 2011). A PPV of 0.3 in/sec or greater can damage old residential structures from continuous or frequent vibration sources (Caltrans 2004). The annoyance level for vibration is 72 VdB in residential areas (FTA 2006). Caltrans (2006) and ODOT (2009) define a substantial increase in noise levels from traffic as an increase of 12 dBA or 10 dBA, in California and Oregon, respectively, above existing 1-hour  $L_{eq}$ .

### **3.23.4.3 Effects Determinations**

The following sections describe the noise and vibration impacts for each alternative.

#### **Alternative 1: No Action/No Project**

*The Four Facilities would not be removed and fish passages would not be constructed.*

This analysis assumes that ambient noise levels under the No Action/No Project Alternative would be the same as existing conditions. **Therefore, implementation of the No Action/No Project Alternative would cause no change from existing conditions from construction noise impacts.**

*Several ongoing resource management actions could cause noise and vibration impacts.*

There may be some noise and vibration effects due to the use of construction equipment throughout the basin associated with ongoing resource management actions, including the Fish Habitat Restoration Program. These activities may include mechanical thinning of vegetation, gravel augmentation, and breaching levees. Although sufficient information is currently not available to estimate noise and vibration impacts, the quantity of equipment required to complete these restoration activities are expected to be less than the required equipment for dam removal and fish ladder construction activities. **Noise and vibration impacts from ongoing resource management actions are therefore assumed to be less than significant.**

#### **Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

This section summarizes the noise and vibration effects that would be caused by removing the dams, powerhouses, and other associated structures. J.C. Boyle Dam was not analyzed relative to impacts to human receptors because there are no applicable human sensitive receptors within a 1-mile radius. Copco 2 Dam was also not analyzed for human receptor noise impacts because the line of sight between the dam and the receptor is completely blocked by the terrain, and the nearest sensitive receptor is 3,700 feet from the dam. Impacts to special-status bird species identified near J.C. Boyle Dam and Copco 2 Dam are discussed in further detail below, as well as in Section 3.5, Terrestrial Resources. The Proposed Action impacts are expected to occur between January and September 2020 for approximately four to six months during the scheduled peak dam removal at each site. There are no long-term noise and vibration impacts due to the Proposed Action.

#### **Construction Equipment Noise and Vibration**

Two shifts of construction workers are expected to carry out deconstruction of Copco 1 and Iron Gate Dams. Both work shifts overlap with daytime (7:00 a.m. to 10:00 p.m.) and nighttime (10:00 p.m. to 7:00 a.m.) existing levels defined in the previous section. The shifts are described further below. Table 3.23-6 lists the predicted average 1-hour  $L_{eq}$  at each construction site and receptor, the increase in noise level at the receptor that would occur as a result of the Proposed Action, and the times of day when the significant impact is expected to occur.

**Table 3.23-6. Summary of Noise Levels from Deconstruction Activities for the Proposed Action**

Location <sup>1</sup>	L <sub>eq</sub> (dBA)		
	At Construction Site (50 feet)	At Receptor with Proposed Action	Increase in L <sub>eq</sub> Caused by Proposed Action
Copco 1 Dam Daytime <sup>2</sup> Nighttime <sup>3</sup>	88-91 88-91	50-52 49-52	10-12 10-22
Iron Gate Dam Daytime <sup>2</sup> Nighttime <sup>3</sup>	91 91	46 44-46	6 6-14

Source: FHWA 2006.

Notes:

- <sup>1</sup> J.C. Boyle Dam removal was not analyzed because there are no receptors within 1 mile. Copco 2 Dam removal was not analyzed because the line of sight to the closest receptor is completely blocked.
- <sup>2</sup> Daytime is defined as between the hours of 7:00 a.m. to 10:00 p.m.
- <sup>3</sup> Nighttime is defined as between the hours of 10:00 p.m. to 7:00 a.m.

Key:

dBA = A-weighted decibels

L<sub>eq</sub> = 1-hour equivalent noise level

*Deconstruction activities at the Four Facilities could cause a temporary increase in noise levels at Copco 1 Dam that could affect residents in the area.* The predicted shift-period L<sub>eq</sub> from all construction equipment on a peak construction day at Copco 1 is 91 dBA at 50 feet during the first shift (6:00 a.m. to 3:00 p.m.) and 88 dBA during the second shift (3:00 p.m. to midnight). Attenuation due to distance, topography, and the atmosphere would reduce these construction site L<sub>eq</sub> by approximately 39 dBA at the nearest receptor. Compared to the daytime (7:00 a.m. to 10:00 p.m.) and nighttime (10:00 p.m. to 7:00 a.m.) existing outdoor noise levels of 40 and 30 dBA, the resulting increases range from less than 10 to 22 dBA, depending on the time of day. The first shift exceeds the significance criteria at all times because of the high source noise level. The second shift only exceeds the significance criteria after 10:00 p.m. when the background noise levels are expected to be very low. **This increase in outdoor noise levels would have a temporary significant noise impact on the residential area near Copco 1 Dam. Mitigation Measure NV-1 would be implemented but would not reduce outdoor noise impacts to less than significant levels at sensitive receptors; therefore noise impacts would remain significant and unavoidable for outdoor receptors during Copco 1 Dam deconstruction.**

*Deconstruction activities at the Four Facilities could cause a temporary increase in nighttime noise levels at Iron Gate Dam.* The predicted shift-period L<sub>eq</sub> from the Iron Gate facilities removal is 91 dBA at 50 feet during both shifts (7:00 a.m. to 4:00 p.m. and 4:00 p.m. to 11:00 p.m.). The combination of existing noise, distance divergence, topographic attenuation, and atmospheric attenuation would result in a shift-period L<sub>eq</sub> of 46 dBA during the daytime (7:00 a.m. to 10:00 p.m.) and 44 dBA during the nighttime (10:00 p.m. to 11:00 p.m.) at the nearest receptor. The estimated noise level at the receptor exceeds the significance criterion for nighttime noise. **Deconstruction noise**

**would cause a temporary significant noise impact on the residential area near Iron Gate Dam at night. Mitigation Measure NV-1 would be implemented but would not reduce nighttime outdoor noise impacts to less than significant levels at sensitive receptors. Nighttime noise impacts would remain significant and unavoidable for outdoor receptors during Iron Gate nighttime deconstruction.**

*Reservoir restoration activities could result in short-term increases in noise levels in the project vicinity.* Additional equipment, including hydroseeding barges, trucks, and helicopters, would be used for reservoir restoration at the same time as dam deconstruction. This reservoir restoration activity would add to the noise levels generated by dam deconstruction activities in and around the dam sites described above.

Additionally residential areas along Copco Lake and Iron Gate Reservoir away from the dam deconstruction sites may experience temporary increased noise levels due to passing hydroseeding vessel, vehicle, or aircraft along the embankment. Aerial hydroseeding is scheduled to begin on March 15 and last for 10 days at Iron Gate and 20 days at Copco. The helicopter would make 30 trips per day between the hours of 7:30 a.m. and 7:00 p.m. All other hydroseeding would be accomplished by barges and trucks. **Helicopters and other equipment noise from embankment restoration would cause a temporary significant noise impact on the residential areas near Copco Lake and Iron Gate Reservoir and increase the significant noise levels generated by dam deconstruction in and around the dam sites. Mitigation Measure NV-1 would be implemented but would not reduce outdoor noise impacts to less than significant levels at these sensitive receptors.**

*Blasting activities at Copco 1 Dam could increase vibration levels.* Table 3.23-7 summarizes the Proposed Action's vibration levels at sensitive receptors. Because of blasting, during the first shift at Copco 1 Dam, the PPV and  $L_v$  at the nearest receptor are 0.065 in/sec and 84 VdB, respectively. For reference, vibration levels without blasting are shown in Table 3.23-7. The first shift at Copco 1 Dam would therefore exceed the significance criteria for  $L_v$  and this is because of the substantial amount of blasting required. During the second shift, the maximum PPV for this alternative would be 0.001 in/sec at the receptors and the  $L_v$  at the receptors would be approximately 48 VdB. The vibration levels from Iron Gate Dam and Copco 2 Dam or during the second shift from Copco 1 Dam would not exceed the significance criteria of 0.3 in/sec and 72 VdB.

**Deconstruction activities would result in significant human annoyance levels for vibration impacts at receptors near Copco 1 Dam during blasting operations in the first shift. Mitigation Measure NV-1 would be implemented but would not reduce vibration impacts to less than significant levels; therefore, vibration impacts to humans would remain significant and unavoidable during blasting at Copco 1.**

**Table 3.23-7. Summary of Vibration from Construction Activities for the Proposed Action**

Source <sup>1</sup>	PPV at Receptor (in/sec)	L <sub>v</sub> at Receptor (VdB)
Copco 1 Dam Shift 1	0.065 (0.002 without blasting) 0.001	<b>84</b> (53 without blasting) 47
Shift 2		
Copco 2 Dam	0.001	48
Iron Gate Dam Shift 1	0.001 0.001	48 48
Shift 2		

Source: FTA 2006.

Notes:

<sup>1</sup> J.C. Boyle was not analyzed because there are no receptors within 1 mile.

Key:

L<sub>v</sub> = vibration velocity level

PPV = peak particle velocity

VdB = vibration decibels

in/sec = inches per second

### Deconstruction-Related Traffic Noise

*Transporting waste to off-site landfills and construction worker commutes could cause increases in noise along haul routes.* Noise effects from transporting waste and construction worker commute were evaluated for receptors at 50 feet and 500 feet from the road. Table 3.23-8 shows the results of the TNM2.5 modeling for this potential impact. The TNM2.5 results showed only minor increases in existing L<sub>eq</sub> for receptors 50 feet or more from all haul routes analyzed. Increases in traffic from construction worker commutes for the second shift at Copco 1 and Iron Gate would result in less noise impact than that presented in Table 3.23-8. **Transporting waste off-site and construction worker commutes would result in less than significant noise impacts for receptors 50 feet or more from all local roadways.**

**Table 3.23-8. Summary of Construction-Related Traffic Noise from Off-site Hauling and Construction Worker Commute for the Proposed Action**

Haul Route/Commute Segment	Peak 1-hour L <sub>eq</sub> (dBA)		Increase in L <sub>eq</sub> Caused by Proposed Action (dBA) <sup>1</sup>	
	50 ft	500 ft	50 ft	500 ft
Topsy Grade County Road	56	45	3	3
OR66	62	51	2	2
US97	76	64	0	0
I-5: Between OR66 and Medford, OR	77	66	0	0
Ager-Beswick Road	54	43	1	1
Copco Road	63	51	5	5
I-5: Between OR66 and Yreka, CA	77	66	0	0

Notes:

<sup>1</sup> The increase in L<sub>eq</sub> may appear different when subtracting the existing 1-hour L<sub>eq</sub> from peak 1-hour L<sub>eq</sub> values due to rounding.

Key:

dBA = A-weighted decibels

L<sub>eq</sub> = 1-hour equivalent noise level

ft = feet

### **Keno Transfer**

*The transfer of Keno dam to the United States Department of the Interior (DOI) could have adverse effects on noise and vibration.* The Keno Transfer is a transfer of title for the Keno Facility from PacifiCorp to the DOI. This transfer would not result in the generation of new impacts on noise and vibration compared with existing facility operations. Following transfer of title, DOI would operate Keno in compliance with applicable law and would provide water levels upstream of Keno Dam for diversion and canal maintenance with agreements and historic practice (KHSA Section 7.5.4).

**Therefore, the Keno Transfer would have no change from existing conditions for noise and vibration.**

### **East and West Side Facility Decommissioning**

*The decommissioning of the East and West Side Facilities could have adverse effects on Noise and Vibration.* Decommissioning of the East and West Side canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will redirect water flows currently diverted at Link River Dam in to the two canals, back into the Link River. The decommissioning and deconstruction activities could create noise and vibration in excess of applicable standards depending on the location of nearby sensitive receptors. Surveys of receptors and specific decommissioning activities will need to be completed prior to the decommissioning in order to prevent adverse impacts to sensitive receptors.

**Therefore, the decommissioning of the East and West Side Facilities would have less than significant effects on noise and vibration.**

### **KBRA**

The KBRA has several programs that could cause temporary increases in noise and vibration level. The following KBRA programs may cause some noise and vibration impacts from the use of heavy equipment:

- Phases I and II Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction

*Construction activities associated with the KBRA could cause temporary increases in noise and vibration levels.* Construction activities associated with the above KBRA programs include channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. While the exact geographic location and timing of these programs is not known, it is assumed that some could occur at the same time and in the same area as the hydroelectric facility removal actions analyzed above and could contribute to the effects of facility removal on noise and vibration. **Due to the potentially large amount of construction activities that would occur for the various KBRA programs, it is**

**anticipated that the effects from noise and vibration could be potentially significant on sensitive receptors. Mitigation Measure NV-1 would be expected to reduce noise and vibration impacts to less than significant levels; therefore, noise vibration impacts to humans would be expected to be reduced to a less than significant impact. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in noise and vibration levels from vehicles associated with trap-and-haul activities.* Haul trucks relocating anadromous fish species around Keno Impoundment and Link River could produce noise and vibration. Seasonal trap and haul operations would occur at Keno Dam and Link River Dam during periods of poor water quality. Hauling activities would occur after the peak noise-generating period of facility removal because fish cannot access Keno Dam until after removal of the Four Facilities; however, some noise and vibration associated with completing removal activities and reservoir restoration may occur at the same time as hauling operations. Construction noise and vibration related to dam removal and hauling operations, taken together, could increase the severity of the effects, but the combined noise and vibration would likely still be less than the peak levels during dam deconstruction. The timing of these trap and haul operations from the hydroelectric facility removal actions analyzed above reduce the potential for any negative noise and vibration effects generated by these trap and haul actions from contributing to the effects of facility removal actions.

**Although the exact extent and timing of these hauling activities is not known, it is anticipated that the effects from noise and vibration could be potentially significant on sensitive receptors. Mitigation Measure NV-1 would be expected to reduce noise and vibration impacts to less than significant levels; therefore, noise vibration impacts to humans would be expected to be reduced to a less than significant impact. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

### **Alternative 3: Partial Facilities Removal of Four Dams**

Under this alternative, short-term demolition activities and drawdown of reservoirs would still occur; however, only in-stream facilities and select ancillary facilities would be demolished. Although there would be less total construction work and material hauling, peak day operations would be similar to those of the Proposed Action.

*Deconstruction activities at the Four Facilities could increase noise and vibration levels.* Noise and vibration impacts would be the same as for the Proposed Action and would be significant for construction noise and vibration impacts. **Mitigation Measure NV-1 would be implemented but would not reduce outdoor noise impacts to less than significant levels at sensitive receptors. Noise impacts would remain significant and unavoidable for outdoor receptors near Copco 1 and Iron Gate. Aircraft and other equipment noise from embankment restoration would cause a temporary significant noise impact on the residential areas near Copco Lake and Iron Gate Reservoir. Vibration impacts to humans would remain significant and unavoidable during blasting at Copco 1. Transporting waste to off-site landfills and construction**

**worker commutes would result in a less than significant noise impact for receptors 50 feet or more from all local roadways.**

**Keno Transfer**

The effects of the Keno Transfer would be the same as those for the Proposed Action.

**East and West Side Facility Decommissioning**

The effects of the East and West Side Facilities removal would be the same as those described for the Proposed Action.

**KBRA**

The Partial Facilities Removal Alternative would include full implementation of the KBRA. Therefore, impacts related to KBRA actions would be the same as under the Proposed Action, discussed above.

**Alternative 4: Fish Passage at Four Dams**

This section summarizes the potential noise and vibration impacts from constructing a fish passage at the Four Facilities. J.C. Boyle Dam was not analyzed for this alternative because there are no applicable sensitive receptors within a 1-mile radius. Copco 2 Dam was also not analyzed because the line of sight between the dam and the receptor is completely blocked by hills.

**Construction Equipment Noise and Vibration**

*Construction activities at the Four Facilities could cause a temporary increase in noise levels at Copco 1 and Iron Gate receptor sites.* Table 3.23-9 summarizes the predicted average 1-hour  $L_{eq}$  at each construction site and receptor, and the temporary increase in noise level at the receptor that would occur as a result of the Fish Passage at Four Dams Alternative. There are no long-term noise and vibration impacts due to this alternative.

**Table 3.23-9. Summary of Noise Levels from Construction Activities for the Fish Passage at Four Dams Alternative**

Location <sup>1</sup>	1-Hour $L_{eq}$ (dBA)		
	At Construction Site (50 feet)	At Receptor with Fish Passage Construction	Increase in Existing $L_{eq}$ Caused by Fish Passage Construction
Copco 1 Dam	90	52	12
Iron Gate Dam	90	45	5

Source: FHWA 2006.

Notes:

<sup>1</sup> J.C. Boyle was not analyzed because there are no receptors within 1 mile. Copco 2 Dam was not analyzed because the line of sight to the closest receptor is completely blocked.

Key:

dBA = A-weighted decibels

$L_{eq}$  = 1-hour equivalent noise level

*Fish passage construction activities could cause a temporary increase in noise levels at Copco 1 Dam.* The predicted shift-period  $L_{eq}$  from construction activities at Copco 1 Dam is 90 dBA at 50 feet. Attenuation offered by distance, topography, and the

atmosphere would reduce this  $L_{eq}$  to approximately 52 dBA at the nearest receptor. The resulting increase in ambient noise levels at the receptor would be 12 dBA. **This increase in ambient noise levels would represent a significant noise impact on the residential area near Copco 1 Dam. Mitigation Measure NV-1 would be implemented but would not reduce outdoor noise impacts to less than significant levels at sensitive receptors. Noise impacts would remain significant and unavoidable for outdoor receptors during construction.**

*Fish passage construction activities could cause a temporary increase in noise levels at Iron Gate Dam.* The predicted shift period  $L_{eq}$  from construction activities at Iron Gate Dam is 90 dBA at 50 feet. Attenuation offered by distance, topography, and the atmosphere would reduce this 1-hour  $L_{eq}$  to approximately 45 dBA at the nearest receptor. The resulting increase in ambient noise levels at the receptor would be 5 dBA. **This increase in ambient noise levels would result in a less than significant noise impact on the residents near Iron Gate Dam.**

*Construction activities could increase vibration levels.* Table 3.23-10 summarizes vibration levels at the receptors for the Fish Passage at Four Dams Alternative. The maximum PPV for this alternative would be 0.003 in/sec at the receptor near Copco 1 Dam. The  $L_v$  at the receptors would range from 46 to 57 VdB for different vibration source locations; these vibration levels would not exceed the 0.3 in/sec and 72 VdB significance criteria. **Construction activities would result in less than significant vibration impacts.**

**Table 3.23-10. Summary of Vibration Levels at Receptors from Construction Activities for the Fish Passage at Four Dams Alternative**

Location <sup>1</sup>	Peak Particle Velocity (in/sec)	Vibration Velocity Level (VdB)
Copco 1 Dam	0.003	57
Copco 2 Dam	0.001	48
Iron Gate Dam	0.001	46

Source: FTA 2006.

Notes:

<sup>1</sup> J.C. Boyle was not analyzed because there are no receptors within 1 mile.

Key:

VdB = vibration decibels

in/sec = inches per second

### **Construction-Related Traffic**

*Transporting construction materials from off-site suppliers and construction worker commute could cause increases in noise along haul routes.* The Lead Agencies evaluated the noise effects of transporting materials to the construction sites for receptors at 50 feet and 500 feet from the road. Table 3.23-11 shows the results of the TNM2.5 modeling for this potential impact. The TNM2.5 results showed only minor increases in existing  $L_{eq}$  for receptors 50 feet or more from all haul routes analyzed. **Transporting construction**

**materials from off-site suppliers and construction worker commute would have a less than significant impact on receptors 50 feet or more from all local roadways.**

**Table 3.23-11. Summary of Construction-Related Traffic Noise from Off-site Hauling for the Fish Passage at Four Dams Alternative**

Haul Route/Commute Segment	Peak 1-hour L <sub>eq</sub> (dBA)		Increase in Existing L <sub>eq</sub> Caused by Fish Passage Construction (dBA) <sup>1</sup>	
	50 ft	500 ft	50 ft	500 ft
Topsy Grade County Road	56	44	3	3
OR66	62	50	1	1
US97	76	64	0	0
I-5: Between Medford, OR and OR66	77	66	0	0
Ager-Beswick Road	54	43	3	3
Copco Road	60	49	2	2
I-5: Between OR66 and Yreka, CA	77	66	0	0

Notes:

<sup>1</sup> The increase in L<sub>eq</sub> may appear different when subtracting the existing 1-hour L<sub>eq</sub> from peak 1-hour L<sub>eq</sub> values due to rounding.

Key:

dBA = A-weighted decibels

L<sub>eq</sub> = existing 1-hour equivalent noise level

ft = feet

### **Trap and Haul – Programmatic Measure**

*Trap and Haul operations could result in temporary increases in noise and vibration levels from vehicles used to relocate fish.* Haul trucks relocating anadromous fish species around Keno Impoundment and Link River could produce noise and vibration. Seasonal trap and haul operations would occur at Keno Dam and Link River Dam during periods of poor water quality. Although the exact extent and timing of these hauling activities is not known, it is anticipated that the **effects from noise and vibration could be potentially significant on sensitive receptors. Mitigation Measure NV-1 would be expected to reduce noise and vibration impacts to less than significant levels; therefore, noise vibration impacts to humans would be expected to be reduced to a less than significant impact. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

### **Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Dams**

This section summarizes the noise and vibration impacts that would be caused by constructing a fish passage at J.C. Boyle and Copco 2 Dams and removing the facilities at the Copco 1 and Iron Gate Dams. The analysis for this alternative does not predict construction impacts at J.C. Boyle Dam because there are no applicable receptors. Copco 2 Dam was also not analyzed for noise impacts because the line of sight between the dam and the receptor is completely blocked by hills.

### **Construction Equipment Noise and Vibration**

*Construction and deconstruction activities could cause a temporary increase in noise and vibration levels at receptor sites.* Noise and vibration impacts at Copco 1 and Iron Gate Dams would be the same as for the Proposed Action. Vibration impacts near Copco 2 would be the same as for the Fish Passage at Four Dams Alternative. Increased noise and vibration levels would occur only during the construction/deconstruction period; no long-term noise and vibration impacts would occur. **Deconstruction at Copco 1 and Iron Gate Dams would have a temporary significant noise impact on outdoor receptors near the dam. Vibration impact to humans would be significant near Copco 1 Dam during blasting. Vibration impacts would be less than significant at receptors near Iron Gate and Copco 2 Dams. Aircraft and other equipment noise from embankment restoration would have a temporary significant noise impact on the residential areas near Copco and Iron Gate Reservoirs. Mitigation Measure NV-1 would be implemented but would not reduce outdoor noise and/or vibration impacts to less than significant levels at sensitive receptors near Copco 1 and Iron Gate Dams. Noise impacts would remain significant and unavoidable for outdoor receptors. Vibration impacts would also remain significant and unavoidable to humans near Copco 1.**

### **Construction-Related Traffic**

*Transporting waste to off-site landfills, hauling construction materials from off-site suppliers, and construction worker commute could cause increases in noise along haul routes.* Noise impacts from haul trucks and worker commute were evaluated for receptors at 50 feet and 500 feet from the road. Table 3.23-12 shows the results of the TNM2.5 modeling for this alternative. The TNM2.5 results showed only minor increases in existing  $L_{eq}$  for receptors 50 feet or more from all haul routes analyzed. The second shift at Copco 1 and Iron Gate would not impact the roads in Oregon and would cause less impact on the California roads than what is presented in Table 3.23-12.

**Transporting waste and construction materials and construction worker commute would have a less than significant impact on receptors 50 feet or more from all local roadways.**

### **Trap and Haul – Programmatic Measure**

*Trap and Haul operations could result in temporary increases in noise and vibration levels from vehicles used to relocate fish.* The trap and haul measures around Keno Impoundment and Link River would have the same impacts under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative as the Fish Passage at Four Dams Alternative. Although the exact extent and timing of these hauling activities is not known, it is anticipated that the **effects from noise and vibration could be potentially significant on sensitive receptors. Mitigation Measure NV-1 would be expected to reduce noise and vibration impacts to less than significant levels; therefore, noise vibration impacts to humans would be expected to be reduced to a less than significant impact. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

**Table 3.23-12. Summary of Construction-Related Traffic Noise from Off-site Hauling for the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative**

Haul Route/Commute Segment	Peak 1-hour L <sub>eq</sub> (dBA)		Increase in Existing L <sub>eq</sub> Caused by Fish Passage Construction or Facilities Removal (dBA) <sup>1</sup>	
	50 ft	500 ft	50 ft	500 ft
Topsy Grade County Road	56	44	3	3
OR66	62	50	1	1
US97	76	64	0	0
I-5: Between Medford, OR and OR66	77	66	0	0
Ager-Beswick Road	53	42	0	0
Copco Road	62	51	4	4
I-5: Between OR66 and Yreka, CA	77	66	0	0

Notes:

<sup>1</sup> The increase in L<sub>eq</sub> may appear different when subtracting the existing 1-hour L<sub>eq</sub> from peak 1-hour L<sub>eq</sub> values due to rounding.

Key:

ft = feet

dBA = A-weighted decibels

### 3.23.5 Mitigation Measures

The following sections describe the recommended noise and vibration mitigation measures for each alternative.

#### **Mitigation Measure by Consequences Summary**

*Mitigation Measure NV-1* – The Dam Removal Entity will develop a Noise and Vibration Control Plan (NVCP) to address increased day and night time noise levels as a result of the proposed project. The NVCP will identify the procedures for predicting construction noise levels at sensitive receptors prior to performing construction activities and will describe the reduction measures required to meet the target noise level. The NVCP will be based on planned construction activities. Noise and vibration mitigation measures will include, but will not be limited to the following:

- The Dam Removal Entity will ensure that the Construction Contractor is maintaining equipment to comply with noise standards (e.g., exhaust mufflers, acoustically attenuating shields, shrouds, or enclosures).
- For nighttime or after-hour construction, the Dam Removal Entity will coordinate with the local jurisdictions to minimize noise. Nearby residents will be notified of hours and duration of construction activities.
- Schedule truck loading, unloading, and hauling operations so as to reduce daytime and nighttime noise impacts to less than noticeable levels.
- The blasting schedule will be coordinated with local jurisdictions to minimize noise. Nearby residents will be notified of blasting schedules.

- Appropriate blasting techniques will be employed to minimize noise and vibration.
- Noise and vibration complaints will be addressed promptly and high impact activities rescheduled or alternate means of demolition and construction implemented, when feasible.

#### **Effectiveness of Mitigation in Reducing Consequences**

Implementation of mitigation measure NV-1 would manage noise and vibration impacts but would not reduce to less than significant levels. Because of the large construction areas and the long distances between the construction site and the receptors, conventional methods to reduce noise source, such as constructing barriers, would not provide a substantial reduction in noise levels and would not reduce noise and vibration to less than significant levels.

#### **Agency Responsible for Mitigation Implementation**

The Dam Removal Entity will be responsible for implementing mitigation measure NV-1.

#### **Remaining Significant Impacts**

Mitigation measures presented in Section 3.23.5 would not reduce noise impacts to less-than-significant levels for outdoor receptors. This is because of the very low existing noise levels at the receptor compared to the high noise levels at the construction site. However, actual existing daytime and nighttime ambient noise levels may be higher than those used in this analysis and construction noise levels may be lower and therefore the impact may be less. This analysis calculated outdoor noise levels at residential properties. A review of the parcel lots near each dam site indicated that the following parcels are located within a one-mile radius of each dam site, as shown in Figures 3.23-5 and 3.23-6, and may be affected by noise:

- Iron Gate: 40 parcels, excluding federal, county, and Pacific Power and Light Properties
- Copco 1 and 2: 135 parcels, excluding federal, county, and Pacific Power and Light Properties

It is not known at this time how many parcels would be occupied during construction and demolition activities; therefore it is assumed all parcels would contain residents and would be affected. The majority of parcels, however, are located farther from the construction sites than the peak sensitive receptor, so any potential impacts would be less than what was estimated for the peak receptor.

As described earlier, all calculated noise levels are for outdoor human receptors. Buildings with an open window would reduce the noise levels indoors by 10 dB. A light frame building with a closed ordinary sash would reduce the outdoor noise level by 20 dB. Depending on the building and window types, up to 35 dB reduction in indoor levels may be achieved (FHWA 2011), substantially reducing impacts for indoor receptors.

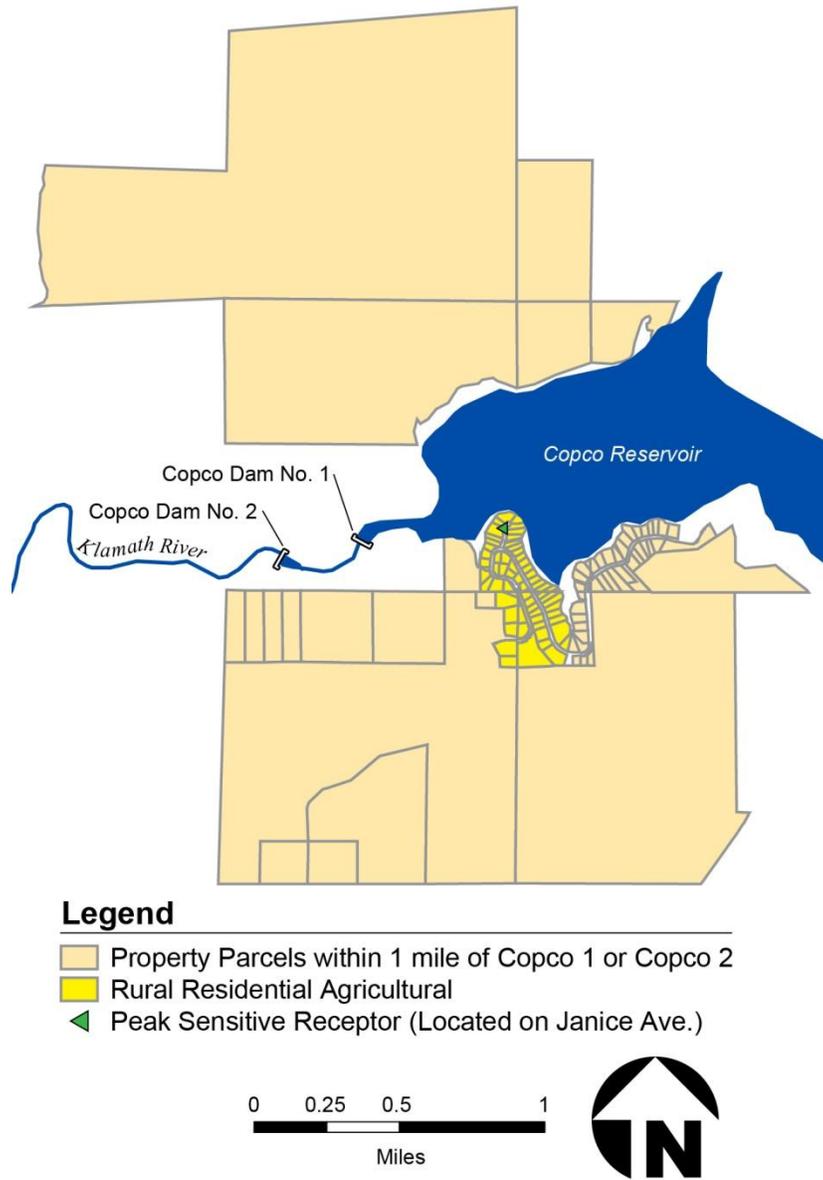


Figure 3.23-5. Parcel Lots within One-Mile of Iron Gate Dam

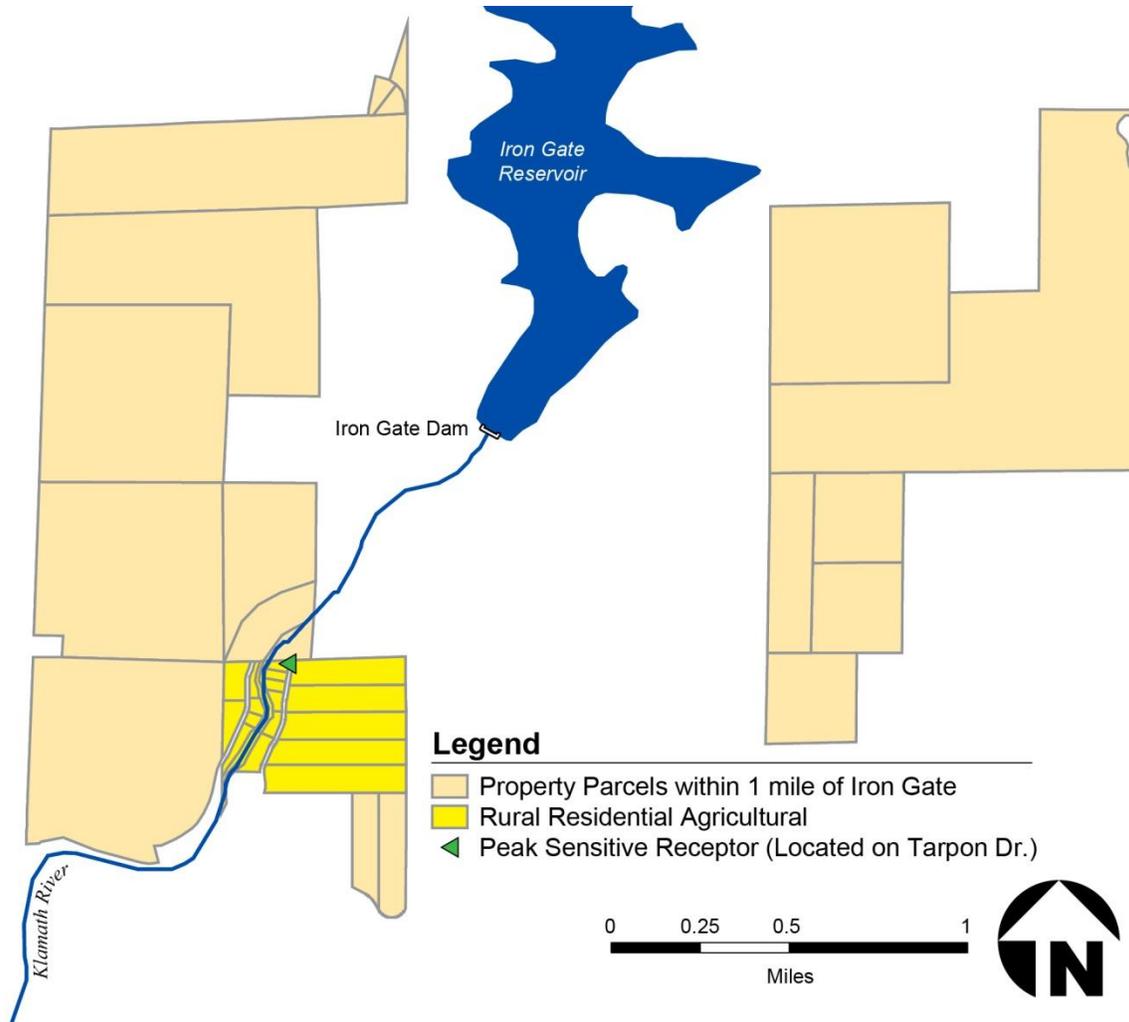


Figure 3.23-6. Parcel Lots within One-Mile of Copco 1 and 2 Dams

#### **Mitigation Measures Associated with Other Resource Areas**

*Transporting fish and mollusks under Mitigation Measures AR-1, 2, 5-7 could cause temporary increases in traffic noise.* These mitigation measures involve trap and haul of fish and mollusks to protect them from the reservoir drawdown and dam deconstruction activities. It is anticipated that as many as 150 truck trips may be required to transport juveniles from areas downstream of Iron Gate Dam to the confluence of Klamath and Trinity Rivers between February and April of 2020. On average, the traffic volume during peak construction times would increase by two trucks due this mitigation measure. As a rule of thumb, for traffic noise levels to increase significantly, hourly traffic volume must multiply by approximately a factor of 10. **The noise and vibration impacts of these measures would be less than significant.**

*Construction activities under Mitigation Measure TR-1 could cause a temporary increase in noise and vibration levels.* Relocation of Jenny Creek Bridge and culverts near Iron Gate Reservoir would occur before the other construction phases of dam removal. In comparison to the dam removal, equipment and time required for this construction would be minimal. No sensitive receptors were identified near the bridge and therefore, noise and vibration from construction would not impact human receptors. **Construction noise and vibration due to TR-1 would be less than significant.**

*Construction activities under Mitigation Measure REC-1 could cause a temporary increase in noise and vibration levels.* Mitigation REC-1 would create a plan to develop recreational facilities and access points along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. Recreation facilities, such as campgrounds and boat ramps, currently located on the edge of the reservoir would need to be replaced in appropriate areas near the new river channel once the reservoir is removed. In comparison to the dam removal, equipment and time required for this construction would be minimal. Recreation facility replacement would occur following dam removal and would not generate noise levels that exceeds levels anticipated for the peak day. **Construction noise and vibration due to REC-1 would be less than significant.**

Several other mitigation measures may require construction, including mitigation measures H-2 (move or elevate structures with flood risk), GW-1 (deepen or replace wells), and WRWS-1 (modify water intakes). These measures could produce noise and vibration associated with construction activities. These activities would take place before or after the primary construction and deconstruction activities associated with the Proposed Action and action alternatives; therefore, they would not add to these noise and vibration impacts. The construction activities are generally smaller efforts that would not cause a substantial increase in noise to sensitive receptors. **Construction-related mitigation measures would cause a less than significant noise and vibration impact to sensitive receptors.**

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# Chapter 4

## Cumulative Effects

This chapter describes the cumulative effects of the Proposed Action and alternatives. Included here are descriptions of the regulatory requirements, methods, and past, present, and reasonably foreseeable future actions considered as part of the analysis.

### 4.1 Cumulative Effects Overview

Cumulative effects are those environmental effects that, on their own, may not be “significant” (National Environmental Policy Act [NEPA]) or “considerable” (California Environmental Quality Act [CEQA]), but when combined with similar effects over time, result in “significant” (NEPA) or “considerable” (CEQA) effects. Cumulative effects are an important part of the environmental analysis because they allow decision makers to look not only at the impacts of an individual proposed project, but the overall impacts on a specific resource, ecosystem, or human community over time from several different projects.

#### 4.1.1 Regulatory Requirements

Both the NEPA and the CEQA require consideration of cumulative effects in an Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The National Historic Preservation Act (NHPA) requires consideration of cumulative effects to historic properties.

##### 4.1.1.1 *National Environmental Policy Act*

Cumulative effects are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions (40 CFR Section 1508.7).”

NEPA regulations require an analysis of direct, indirect, and cumulative effects and define “effects” as “ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative (40 CFR Section 1508.8).” In addition, the NEPA regulations state that when determining the scope of an EIS, both connected and cumulative actions must be discussed in the same document as the Proposed Action (40 CFR Section 1508.25(a)(1) and (2)).

#### **4.1.1.2 National Historic Preservation Act**

The regulations for Section 106 of the NHPA define “adverse effect” as an undertaking that “may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association.” (36 CFR Section 800.5(a)(1)). “Adverse effects” explicitly include “reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.” (36 CFR Section 800.5(a)(1)). Cumulative effect under Section 106 of the NHPA applies only to those resources that are listed in or eligible for the National Register. Much of the analysis regarding potential cumulative adverse effects to historic properties, including proposed mitigation measures, is discussed in Chapter 3.13 - Cultural Resources.

#### **4.1.1.3 California Environmental Quality Act**

Cumulative effects are defined in the CEQA Guidelines as:

“Two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.

- (a) The individual effects may be changes resulting from a single project or a number of separate projects.
- (b) The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time (CEQA Guidelines Section 15355).”

According to the CEQA Guidelines, a lead agency must discuss the cumulative impacts of a project when the cumulative effect is significant and the project's incremental contribution to the cumulative effect would be “cumulatively considerable,” that is, when the incremental effects of a project would be significant when viewed in connection with the effects of past, present, and probable future projects (CEQA Guidelines Section 15065(a)(3); Section 15130(a)).

If the combined cumulative impact associated with the project's incremental effect and the effects of other projects would not be significant, an EIR should briefly indicate why the cumulative impact is not significant (CEQA Guidelines Section 15130(a)(2)).

Additionally, an EIR can determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and therefore not significant. A project's contribution can also be less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency must identify facts supporting this conclusion (CEQA Guidelines Section 15130(a)(3)).

## 4.2 Cumulative Effects Methods

The Lead Agencies began analyzing cumulative effects in the Klamath Facilities Removal EIS/EIR by reviewing the impacts of the Proposed Action and alternatives on the specific environmental resources presented in Chapter 3. The Lead Agencies then identified past, present, and reasonably foreseeable future actions that could contribute to cumulative effects on each resource, and defined an area of analysis and timeframe for the potential cumulative effects for each resource. The Lead Agencies determined the significance of identified cumulative effects in accordance with CEQA requirements. As noted above, NEPA and CEQA have differing definitions of significance for cumulative effects; in most cases NEPA does not require a specific determination of significance, while CEQA does. If the Lead Agencies determined that a cumulative effect would be significant, feasible mitigation measures are proposed in this chapter. If no feasible mitigation would be possible (i.e., the technology does not exist), the cumulative effect is considered significant and unavoidable.

### 4.2.1 Identifying Past, Present, and Future Actions Contributing to Cumulative Effects

CEQA Section 15130(b)(1) identifies two methods that may be used to analyze cumulative impacts:

1. “A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency,” and/or
2. “A summary of projections contained in an adopted local, regional, or statewide plan or related planning document, that describes or evaluates conditions contributing to the cumulative effect. Such plans may include: a general plan, regional transportation plan, or plans for the reduction of greenhouse gas emissions. A summary of projections may also be contained in an adopted or certified prior environmental document for such a plan. Such projections may be supplemented with additional information such as a regional modeling program. Any such document shall be referenced and made available to the public at a location specified by the lead agency.”

The Lead Agencies analyzed cumulative impacts using both CEQA methods identified above. Some resources use a combination of both methods, when applicable. Table 4-1 lists the method used to evaluate the cumulative impacts for each resource, either the project method (#1) above, the projection method (#2) above, or a combination of both.

**Table 4-1. Method for Developing the Cumulative Condition**

<b>Resource</b>	<b>Method for Developing the Cumulative Condition</b>
Water Quality	(1) Project Method
Aquatic Resources	(1) Project Method, and (2) Projection Method
Algae	(1) Project Method, and (2) Projection Method
Terrestrial Resources	(1) Project Method
Flood Hydrology	(1) Project Method, and (2) Projection Method
Groundwater	(1) Project Method, and (2) Projection Method
Water Supply/Water Rights	(1) Project Method
Air Quality	(1) Project Method, and (2) Projection Method
Greenhouse Gases/Global Climate Change	(2) Projection Method
Geology, Soils and Geologic Hazards	(1) Project Method
Tribal Trust	(1) Project Method
Cultural and Historic Resources	(1) Project Method
Land Use, Agricultural and Forest Resources	(1) Project Method
Socioeconomics	(1) Project Method, and (2) Projection Method
Environmental Justice	1) Project Method
Population and Housing	(2) Projection Method
Public Health and Safety, Utilities and Public Services, Solid Waste, Power	(1) Project Method, and (2) Projection Method
Scenic Quality	(2) Projection Method
Recreation	(1) Project Method
Toxic/Hazardous Materials	(1) Project Method
Traffic and Transportation	(1) Project Method
Noise and Vibration	(1) Project Method, and (2) Projection Method

The methods described above for CEQA are considered to be sufficient to identify past, present, and future actions for the NEPA cumulative analysis.

The Lead Agencies used a variety of federal, tribal, state, county, and local government sources to identify and collect information on past, present, and reasonably foreseeable actions in the project area that could contribute to cumulative effects (see Table 4-2).

These include:

- City and County General Plans
- Biological Management Plans
- Population, housing, traffic, and other projections found in existing city and county general plans
- Scoping comments
- Consultation with federal and state agencies
- Published reports, documents, and plans
- Existing environmental documents

In addition to the documents reviewed above, the Lead Agencies mailed a formal request to the following transportation, city, and county planning departments on January 21, 2010, requesting information on past, present, and future actions in the area of analysis:

- Siskiyou County, California
- Klamath County, Oregon
- City of Yreka
- City of Chiloquin
- California Department of Transportation (Caltrans), District 2
- Oregon Department of Transportation, Region 4

Relevant information collected as part of this effort is presented Section 4.3 and was considered in this cumulative analysis.

#### **4.2.2 Cumulative Effects Area of Analysis**

Both NEPA and CEQA require a defined geographic scope for a cumulative effects analysis (Council of Environmental Quality [CEQ] 1997; CEQA Guidelines 15130(b)(3)). For NHPA, the Area of Potential Effects for the cumulative analysis is the same as the one defined in Section 3.13, Cultural and Historical Resources. The cumulative area of analysis for each resource in this EIS/EIR varies depending on the type of impacts that could occur and the nature of those impacts. The areas of analysis for some resource areas have clearly defined cumulative boundaries while others are more general in nature. Table 4-2 lists the area of analysis for each resource area's cumulative impacts related to the Klamath Hydroelectric Settlement Agreement (KHSAs). The general cumulative effects area of analysis for the KBRA includes the Klamath Basin and its tributaries. Generally, fisheries programs proposed in the KBRA apply to the entire basin, while programs related to water use apply mostly to the Upper Klamath Basin upstream of J.C. Boyle Dam. County and tribal programs apply to the relevant jurisdictions throughout the entire basin.

**Table 4-2. Cumulative Effects Area of Analysis by Resource**

<b>Resource</b>	<b>Area of Analysis</b>	<b>Justification</b>
Water Quality	Rivers, streams and reservoirs within the upper and lower Klamath Basins including Wood, Williamson and Sprague Rivers; Upper Klamath Lake; the Klamath River to the Klamath River Estuary; and the Klamath River watershed	This is the extent of physical and operational changes affecting water quality
Aquatic Resources	Surface waters within the Klamath Basin affected by dam removal activities excluding the Lost River watershed, Tule Lake basin, and Trinity River. The Klamath River to the Pacific Ocean	This is the extent of physical changes affecting water quality, habitat, and flows
Algae	Surface waters within the Klamath Basin affected by dam removal activities excluding the Lost River watershed, Tule Lake basin, and Trinity River. The Klamath River to the Pacific Ocean	This is the extent of physical changes affecting water quality, habitat, and flows
Terrestrial Resources	Klamath River channel and riparian habitat adjacent to the channel from Keno Dam downstream to the Pacific Ocean; the dam sites and construction areas, including equipment staging and access areas	This is the extent of physical changes affecting habitat
Flood Hydrology	The Klamath River watershed starting at J.C. Boyle reservoir and continuing downstream from the deconstruction area of the four dams to the Pacific Ocean	This is the extent of potential changes in surface water elevation
Groundwater	Groundwater supply wells adjacent to J.C. Boyle, Copco1, Copco 2, and Iron Gate reservoirs	This is the extent of physical changes affecting groundwater
Water Supply/Water Rights	An area surrounding the Klamath River main stem between Upper Klamath Lake and Seiad Valley.	This is the extent of physical and operation changes affecting water supply and water rights
Air Quality	Klamath and Jackson Counties in Oregon and Siskiyou and Shasta Counties in California	Air quality impacts would occur within Siskiyou County, California and Klamath County, Oregon for dam removal activities, while additional impacts could occur in Jackson County, Oregon and Shasta County, California from truck or construction worker travel
Greenhouse Gases/Global Climate Change	Greenhouse Gases geographic scope includes the entire State of California	Total greenhouse gas emissions are available for the State of California; therefore this analysis examines cumulative greenhouse gas emission targets for the entire State
Geology, Soils and Geologic Hazards	The reservoir bed and banks at the sites of the reservoirs impounded by J.C. Boyle Dam, Copco 1, Copco 2, and Iron Gate Dams, as well as the riverbed and adjacent banks along the Klamath River downstream of Iron Gate dam to its mouth at the Pacific Ocean	This is the extent of physical changes affecting geology, soils and geologic hazards
Tribal Trust	The area of analysis includes the entire 263 miles of the Klamath River and the Klamath Basin. The federally recognized tribes within this area of analysis include the Klamath Tribes, Quartz Valley Indian Community, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe, and Resighini Rancheria	This is the geographic extent of the tribal trusts that could be affected by the project are located
Cultural and Historic Resources	Known and unknown cultural and historic resources in the vicinity of the Four Facilities and the Klamath Basin where construction or land disturbance could occur	This is the extent of where cultural and historic resources could be affected

**Table 4-2. Cumulative Effects Area of Analysis by Resource**

<b>Resource</b>	<b>Area of Analysis</b>	<b>Justification</b>
Land Use, Agricultural and Forest Resources	All lands directly adjacent to the Four Facilities	This is the extent of physical and operational changes affecting land use
Socioeconomics	Regional economies with Siskiyou, Humboldt, Del Norte, Modoc and Mendocino counties in California and Klamath, Jackson and Curry counties in Oregon	This is the extent of the counties that could experience socioeconomic effects.
Environmental Justice	Siskiyou, Humboldt, Del Norte, Shasta, Modoc and Mendocino counties in California and Klamath, Jackson and Curry counties in Oregon	These are the counties that contain environmental justice populations that could be affected by the project
Population and Housing	The area of analysis includes a combination of urban and rural communities: Hornbrook and Yreka in California and Klamath Falls and Medford in Oregon. The area of analysis also includes the residential rural areas immediately near the Copco 1 and 2 Dams and just upstream of the J. C. Boyle Dam	These are the communities with the potential to house temporary construction workers
Utilities and Public Services, Solid Waste, Public Health and Safety, Power	Utilities and Public Services : Existing utilities and public services supplying Siskiyou and Klamath Counties	These are the two counties that could experience utility and service effects from construction
	Solid Waste : Existing landfills in Siskiyou and Klamath Counties	Waste generated by the project would be sent to waste facilities in these two counties
	Public Health and Safety : The proposed dam deconstruction areas surrounding the Four Facilities (for deconstruction related safety issues), downstream of the dams (for flooding impacts), and the associated reservoirs (for impacts related to wildfires and public health issues)	This is the extent of construction activities that could affect public health and safety
	Power : Existing generator facilities, employees and local customer base in Siskiyou and Klamath Counties and other potential power supply sources used to service the existing customer base	This is the extent of hydroelectric power service that would be affected by the Proposed Action. Other sources of power will be needed to replace lost service
Scenic Quality	All areas surrounding the Four Facilities that would have views of the four reservoirs or the Klamath River from J.C. Boyle to Iron Gate Dam	This is the extent of physical changes affecting aesthetics and visual resources
Recreation	Recreation areas at the lakes/reservoirs, the Klamath River and applicable tributaries within the Klamath Basin. Wildlife refuges and other regional recreation areas affected by changes at some reservoirs are included	This is the extent of physical and operational changes that could affect recreation
Toxic/Hazardous Materials	The proposed deconstruction areas surrounding the Four Facilities, transportation routes and disposal points for toxic hazardous materials	This is the area where exposure to toxic or hazardous materials could occur during deconstruction, transport and/or disposal activities
Traffic and Transportation	Roadways within Klamath and Jackson Counties in Oregon and within Siskiyou County in California	These are the roadways that would be used by construction vehicles and workers
Noise and Vibration	The region surrounding the Four Facilities and the haul routes in Klamath and Jackson Counties, Oregon and Siskiyou and Shasta Counties, California	This is the extent of where deconstruction and restoration activities would produce noise and vibration

### **4.2.3 Timeframe**

Cumulative effects consider the timeframe for the project-specific analysis as well as how long the effects of the project are expected to last. There may be instances when the timeframe for cumulative effects must be expanded to encompass cumulative effects occurring further into the future (Council on Environmental Quality 1997). The Proposed Action and alternatives would not be implemented until 2020; however this cumulative analysis must rely on information available at the time of this document.

The timeframe for this cumulative effects analysis varies by environmental resource and is described for each resource area in this chapter. For several resources, impacts would occur only for the duration of deconstruction; for these resources, the cumulative effects analysis timeframe includes only the duration of deconstruction (May 2019 through December 2021). For other resources, long-term effects could occur even after deconstruction, so the Lead Agencies examined a longer timeframe. The timeframe for cumulative effects analysis also depends on the type of information available. Many general plans or other documents that are used to obtain relevant projections only have forecasts for 10 or 20 years from the date of the document. The timelines identified for long-term cumulative effects are based on the best available existing information. The cumulative effects analysis also accounts for past and present projects to the extent feasible.

### **4.2.4 Mitigation**

#### ***4.2.4.1 National Environmental Policy Act***

According to NEPA, a discussion on mitigation for adverse environmental effects is required in an EIS (40 Section Part 1502.16(h), 40 CFR Section 1502.14(f)); however, a final set of mitigation measures that are selected for implementation are adopted in a Record of Decision (ROD). If mitigation measures presented in the EIS are not adopted, the reasons why must be explained in the ROD (40 CFR Section 1505.2(c)). This cumulative effects analysis will identify potential mitigation for significant cumulative effects; the ROD will present the final mitigation measures adopted as part of the project that will be completed with the respective alternative selected for implementation.

#### ***4.2.4.2 National Historic Preservation Act***

The United States Department of the Interior (DOI) is required to develop appropriate measures to avoid, minimize, or mitigate adverse effects to historic properties under Section 106 of the NHPA (36 CFR Sections 800.6, 800.8(c)(1)(v)). Such measures were identified and described in Chapter 3.13. These measures will be incorporated into the ROD and will become binding terms for addressing potential adverse effects to historic properties, including such effects identified as cumulative.

#### ***4.2.4.3 California Environmental Quality Act***

Mitigation requirements of CEQA differ from those of NEPA. An EIR must examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects (CEQA Guidelines Section 15130). In addition, no public agency can approve or carry out a project with an EIR that identifies significant impacts

unless feasible changes or alterations have been incorporated into the project to avoid or substantially lessen the significant environmental impacts identified in the Final EIR (CEQA Guidelines Section 15091). Therefore, CEQA requires each public agency to mitigate or avoid the significant effects of projects that it carries out or approves whenever it is feasible to do so. (Pub. Res. Code § 21002.1(b)). This cumulative effects analysis will identify all feasible mitigation measures for effects of the project determined to be “cumulatively considerable.” The approval of the EIR and subsequent CEQA findings will contain the feasible mitigation measures adopted as part of the project.

### **4.3 Actions and Projects Considered in Cumulative Effects Analysis**

This section outlines all the past, present, and reasonably foreseeable actions or projects that could contribute to cumulative effects and that were considered in the analysis.

#### **4.3.1 Documents Reviewed**

The Lead Agencies consulted many documents as part of this cumulative effects analysis to identify projects, plans, programs, and projections. Table 4-3 lists the documents considered in this analysis.

**Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis**

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
<b>Federal</b>					
Reclamation, U.S. Fish and Wildlife Service, Hoopa Valley Tribe, and Trinity County	Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement and Record of Decision	Trinity River	Aquatic Resources	2000	Undefined
National Oceanic and Atmospheric Administration Fisheries Service Southwest Region	Biological Opinion for Klamath River Project - Operation of the Klamath Project between 2010 and 2018 and its Effects on South Oregon/Northern California Coast Coho Salmon	Klamath Project Area - Klamath County, Oregon, Siskiyou and Modoc Counties, California	Aquatic Resources	2010	2010 to 2018
National Oceanic and Atmospheric Administration Fisheries Service	Draft Central California Coast Coho Salmon Recovery Plan	West Coast from British Columbia to California	Aquatic Resources	2010	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	Critical Habitat for the Southern Distinct Population Segment of Eulachon	California	Aquatic Resources	2010	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	2007 Federal Recovery Outline Southern Oregon/Northern California Coast Coho Salmon	California and Oregon	Aquatic Resources	2007	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	Biological Opinion for the Klamath Hydroelectric Project License <sup>1</sup>	Klamath River, Klamath County, Oregon and Siskiyou County, California	Aquatic Resources	2007	50 Years
U.S. Fish and Wildlife Service	Klamath Marsh National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment	Klamath Marsh National Wildlife Refuge	Terrestrial Resources, Water Quality	2010	2025 and beyond

<sup>1</sup> If a new license is issued by the Federal Energy Regulatory Commission for the Klamath Hydroelectric Project, the Project would need to comply with the recommendations set forth in this Biological Opinion. Because the existing license expired in 2006, the Klamath Hydroelectric Project is currently operating under an annual license with the same terms and conditions of the existing license.

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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
U.S. Fish and Wildlife Service	Biological/Conference Opinion Regarding the Effects of the U.S. Bureau of Reclamation's Proposed 10-Year Operation Plan (April 1, 2008 – March 31, 2018) for the Klamath Project and its Effects on the Endangered Lost River and Shortnose Suckers	Klamath Project (Project) in Klamath County, Oregon and Modoc and Siskiyou Counties	Aquatic Resources	2008	2008 to 2018
U.S. Fish and Wildlife Service	Biological Opinion on the Proposed Relicensing of the Klamath Hydroelectric Project <sup>2</sup>	Klamath River, Klamath County, Oregon and Siskiyou County, California	Aquatic Resources	2007	50 Years
National Oceanic and Atmospheric Administration Fisheries Service	Pacific Coast Management Plan Amendment 14 Appendix A: Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon	Washington, Oregon, California	Aquatic Resources	1999	Undefined
U.S. Fish and Wildlife Service	Recovery Plan for Bull Trout	Columbia River/Klamath	Aquatic Resources	2002	Undefined
Redwood National and State Parks	General Management Plan/General Plans	Redwood National and State Parks	Land Use, Agriculture and Forest Resources/Soils/Water Quality/Aquatic Resources	2000	2020
Reclamation	Cascade-Siskiyou National Monument Record of Decision and Resource Management Plan	Cascade-Siskiyou National Monument	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	2008	2008-2023
National Park Service	Lava Beds National Monument Draft General Management Plan and Environmental Assessment	Lava Beds National Monument	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	2010	2010-2025

<sup>2</sup> If a new license is issued by the Federal Energy Regulatory Commission for the Klamath Hydroelectric Project, the Project would need to comply with the recommendations set forth in this Biological Opinion. Because the existing license expired in 2006, the Klamath Hydroelectric Project is currently operating under an annual license with the same terms and conditions of the existing license.

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U.S. Forest Service Pacific Northwest Region	Land and Resource Management Plan, Fremont National Forest and Amendments (and associated Planning Documents)	Fremont National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1989 for the original plan and 36 Amendments to the Plan are also listed starting in year 1992 and ending in July of 2010	1989-2004
U.S. Forest Service Pacific Northwest Region	Land and Resource Management Plan, Wineman National Forest and Amendments (and associated Planning Documents)	Wineman National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1990 with Amendments up to 2010	1990-2005
U.S. Forest Service Pacific Southwest Region	Shasta-Trinity National Forest, Land and Resource Management Plan	Shasta-Trinity National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995	Management Actions 1995-2010  Planning horizon 1995-2045
U.S. Forest Service Pacific Southwest Region	Six Rivers National Forest, Land and Resource Management Plan and Amendment	Six Rivers National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995 with Amendment in 2008	1995-2010
U.S. Forest Service Pacific Southwest Region	Klamath National Forest, Land and Resource Management Plan and Amendments (and associated Planning Documents)	Klamath National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995 with Amendments up to 2001	Management Direction Planning Period 1995-2010  Long Range Planning 1995-2045
U.S. Forest Service Pacific Southwest Region	Modoc National Forest, Land and Resource Management Plan and Amendments (and associated Planning Documents)	Modoc National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1991	1991-2006
U.S. Forest Service	Northwest Forest Plan Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl	Federal lands including U.S. Forest Service and Bureau of Land Management (BLM) lands within the range of the northern spotted owl in Oregon, Washington and northern California.	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1994	Undefined

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National Oceanic and Atmospheric Administration Fisheries Service	Draft Central California Coast Coho Salmon Recovery Plan	West Coast from British Columbia to California	Aquatic Resources	2010	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	Critical Habitat for the Southern Distinct Population Segment of Eulachon	California	Aquatic Resources	2010	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	2007 Federal Recovery Outline Southern Oregon/Northern California Coast Coho Salmon	California and Oregon	Aquatic Resources	2007	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	Biological Opinion for the Klamath Hydroelectric Project License <sup>1</sup>	Klamath River, Klamath County, Oregon and Siskiyou County, California	Aquatic Resources	2007	50 Years
U.S. Fish and Wildlife Service	Klamath Marsh National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment	Klamath Marsh National Wildlife Refuge	Terrestrial Resources, Water Quality	2010	2025 and beyond

<sup>1</sup> If a new license is issued by the Federal Energy Regulatory Commission for the Klamath Hydroelectric Project, the Project would need to comply with the recommendations set forth in this Biological Opinion. Because the existing license expired in 2006, the Klamath Hydroelectric Project is currently operating under an annual license with the same terms and conditions of the existing license.

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U.S. Fish and Wildlife Service	Recovery Plan for Bull Trout	Columbia River/Klamath	Aquatic Resources	2002	Undefined
Redwood National and State Parks	General Management Plan/General Plans	Redwood National and State Parks	Land Use, Agriculture and Forest Resources/Soils/Water Quality/Aquatic Resources	2000	2020
Reclamation	Cascade-Siskiyou National Monument Record of Decision and Resource Management Plan	Cascade-Siskiyou National Monument	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	2008	2008-2023
National Park Service	Lava Beds National Monument Draft General Management Plan and Environmental Assessment	Lava Beds National Monument	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	2010	2010-2025

<sup>2</sup> If a new license is issued by the Federal Energy Regulatory Commission for the Klamath Hydroelectric Project, the Project would need to comply with the recommendations set forth in this Biological Opinion. Because the existing license expired in 2006, the Klamath Hydroelectric Project is currently operating under an annual license with the same terms and conditions of the existing license.

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U.S. Forest Service Pacific Northwest Region	Land and Resource Management Plan, Fremont National Forest and Amendments (and associated Planning Documents)	Fremont National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1989 for the original plan and 36 Amendments to the Plan are also listed starting in year 1992 and ending in July of 2010	1989-2004
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U.S. Forest Service Pacific Southwest Region	Six Rivers National Forest, Land and Resource Management Plan and Amendment	Six Rivers National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995 with Amendment in 2008	1995-2010
U.S. Forest Service Pacific Southwest Region	Klamath National Forest, Land and Resource Management Plan and Amendments (and associated Planning Documents)	Klamath National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995 with Amendments up to 2001	Management Direction Planning Period 1995-2010  Long Range Planning 1995-2045
U.S. Forest Service Pacific Southwest Region	Modoc National Forest, Land and Resource Management Plan and Amendments (and associated Planning Documents)	Modoc National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1991	1991-2006
U.S. Forest Service	Northwest Forest Plan Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl	Federal lands including U.S. Forest Service and Bureau of Land Management (BLM) lands within the range of the northern spotted owl in Oregon, Washington and northern California.	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1994	Undefined

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U.S. Forest Service	Northwest Forest Plan Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl	Federal lands including U.S. Forest Service and BLM lands within the range of the northern spotted owl in Oregon, Washington and northern California.	Land Use, Agriculture and Forest Resources /Tribal Trust/Forest Resources/ Terrestrial Resources/ Water Quality	Undated	Undefined
U.S. Forest Service	Northwest Forest Plan—The First 10 Years (1994–2003): Socioeconomic Monitoring of the Klamath National Forest and Three Local Communities	Scott Valley, Butte Valley, and Mid-Klamath corridor	Land Use, Agriculture and Forest Resources / Socioeconomics	2008	1994-2003
U.S. Forest Service	Sierra Nevada Forest Plan Amendment	Sierra Nevada including Modoc Plateau	Land Use, Agriculture and Forest Resources / Socioeconomics	2003	2004 - 2104
Bureau of Land Management	Record of Decision and Resource Management Plan Klamath Falls Resource Area December 2008	BLM Land within Klamath Falls Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	2008	Undefined
Bureau of Land Management	Klamath Falls Resource Area Upper Klamath Basin and Wood River Wetland Record of Decision and Resource Management Plan	BLM Land within the Upper Klamath Basin and Wood River Wetland Project	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	1996	Undefined
Bureau of Land Management	Redding Resource Management Plan and Record of Decision	BLM Land within the Redding Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	1993	1993-2008
Bureau of Land Management	Record of Decision Alturas Resource Management Plan	BLM Land within the Alturas Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	2008	2008-2023
National Research Council	Hydrology, Ecology, and Fishes of the Klamath Basin	Klamath Basin	Aquatic Resources	2008	2008
Federal Energy Regulatory Commission	Final Environmental Impact Statement for License, Klamath Hydroelectric Project Federal Energy Regulatory Commission Project No. 2082-027	Klamath Hydroelectric Project	Aquatic Resources	2007	30 to 50 years after license issued

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U.S. Forest Service	Northwest Forest Plan—The First 10 Years (1994–2003): Socioeconomic Monitoring of the Klamath National Forest and Three Local Communities	Scott Valley, Butte Valley, and Mid-Klamath corridor	Land Use, Agriculture and Forest Resources / Socioeconomics	2008	1994-2003
U.S. Forest Service	Sierra Nevada Forest Plan Amendment	Sierra Nevada including Modoc Plateau	Land Use, Agriculture and Forest Resources / Socioeconomics	2003	2004 - 2104
Bureau of Land Management	Record of Decision and Resource Management Plan Klamath Falls Resource Area December 2008	BLM Land within Klamath Falls Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	2008	Undefined
Bureau of Land Management	Klamath Falls Resource Area Upper Klamath Basin and Wood River Wetland Record of Decision and Resource Management Plan	BLM Land within the Upper Klamath Basin and Wood River Wetland Project	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	1996	Undefined
Bureau of Land Management	Redding Resource Management Plan and Record of Decision	BLM Land within the Redding Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	1993	1993-2008
Bureau of Land Management	Record of Decision Alturas Resource Management Plan	BLM Land within the Alturas Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	2008	2008-2023
National Research Council	Hydrology, Ecology, and Fishes of the Klamath Basin	Klamath Basin	Aquatic Resources	2008	2008
Federal Energy Regulatory Commission	Final Environmental Impact Statement for License, Klamath Hydroelectric Project Federal Energy Regulatory Commission Project No. 2082-027	Klamath Hydroelectric Project	Aquatic Resources	2007	30 to 50 years after license issued

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<b>Tribal</b>					
Hoop Valley Tribe	Hoop Valley Tribe Environmental Protection Agency Water Quality Control Plan	Hoop Valley Indian Reservation	Water Quality	2008	2008-2018
Yurok Tribe	Water Quality Control Plan	Yurok Lands	Water Quality	2004	Undefined
Karuk Tribe Department of Natural Resources	Draft Eco-Cultural Resources Management Plan	Tribal Trust properties along the Klamath River between Yreka and Orleans, California	Cultural Resources	2010	Undefined
<b>State</b>					
California State Parks	California Recreational Trails Plan	Designated trails in California including Klamath Basin	Recreation	2002	Undefined
California Department of Water Resources	California Water Plan and 2009 Update	California	Water Quality/Water Supply/Water Rights	2009	2050
California Department of Water Resources	Climate Change Characterization and Analysis in California Water Resources Planning Studies	California	Greenhouse Gasses/Global Climate Change	2010	Undefined
California Department of Transportation and California Department of Fish and Game	California Essential Habitat Connectivity Project, A Strategy for Conserving a Connected California	California including the North Coast and Modoc Plateau in area of analysis	Aquatic Resources/Terrestrial Resources	2010	Undefined
California Department of Transportation	California Transportation Plan 2025	California	Traffic and Transportation / Socioeconomics	2006	Through 2025
California Department of Fish and Game	California Wildlife Conservation Challenges, California's Wildlife Action Plan	California including the North Coast and the Modoc Plateau in the area of analysis	Aquatic Resources/Terrestrial Resources	2005	Update conservation actions every 5 to 10 years
California Department of Fish and Game	A Status Review of the Longfin Smelt ( <i>Spirinchus thaleichthys</i> ) in California	California	Aquatic Resources	2009	2009
California Department of Fish and Game	Suction Dredging Permit Program Draft Subsequent Environmental Impact Report	California	Socioeconomics/ Aquatic Resources	2011	Undefined
California Department of Fish and Game	Recovery Strategy for California Coho Salmon	California	Aquatic Resources	2004	Undefined
California State Parks	California Outdoor Recreation Plan 2008	California	Recreation	2009	2009-2014

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California Department of Housing and Community Development	2010-2015 Consolidated Plan and 2010-2011 Annual Plan for Federally-Funded Community Development Programs Operated by the State of California	California	Population and Housing/ Socioeconomics	2010	2010-2015
Governor's Office of Emergency Services	State of California Emergency Plan	California	Public Health and Safety/ Flood Hydrology	2005	Undefined
Riparian Habitat Joint Venture	The Riparian Bird Conservation Plan	California	Terrestrial Resources	2004	Undefined
California, Oregon, Washington	West Coast Governors' Agreement on Ocean Health Action Plan	California, Oregon, Washington	Water Quality/Aquatic Resources/ Socioeconomics	2008	Undefined
North Coast Regional Water Quality Control Board	Action Plan for the Scott River Sediment and Temperature Total Maximum Daily Loads	Scott River	Water Quality/Aquatic Resources	2005	Undefined
North Coast Regional Water Quality Control Board	Salmon River Total Maximum Daily Load for Temperature and Implementation Plan	Salmon River	Water Quality/Aquatic Resources	2005	Undefined
North Coast Regional Water Quality Control Board	Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads	Shasta River	Water Quality/Aquatic Resources	2006	Undefined
North Coast Regional Water Quality Control Board	Water Quality Control Plan for the North Coast Region	The Klamath Basin within California and the North Coastal Basin within all of Del Norte, Humboldt, Trinity, and Mendocino Counties and major portions of Siskiyou and Sonoma Counties and small portions of Glenn, Lake and Marin counties.	Water Quality /Aquatic Resources	2011	Updated every 3 years

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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
North Coast Regional Water Quality Control Board	Action Plan for the Klamath River Total Maximum Daily Loads Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in the Klamath River in California and the Lost River Implementation Plan	Klamath Basin in California	Water Quality /Aquatic Resources	2010	Undefined
North Coast Regional Water Quality Control Board	2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments Requiring Total Maximum Daily Loads	North Coast Region and Klamath Basin in California	Water Quality/Aquatic Resources	2007	2019
State Water Resources Control Board	Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality	Applies to enclosed bays and estuaries only including Klamath estuary.	Water Quality/Aquatic Resources	2009	Not defined
State Water Resources Control Board	Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California	Applies to coastal and interstate waters and enclosed bays and estuaries of California including Klamath estuary	Water Quality/Aquatic Resources	Undated	Undefined
Oregon Department of Environmental Quality	A Plan for Maintaining The National Ambient Air Quality Standards for PM10 in Klamath Falls Urban Growth Boundary, Section 4.56 of the State Implementation Plan	Klamath Falls Urban Growth Boundary	Air Quality	2002	Through 2015
Oregon Department of Environmental Quality	Upper Klamath Lake Drainage Total Maximum Daily Load and Water Quality Management Plan	Upper Klamath Lake Drainage Area	Water Quality /Aquatic Resources	2002	Through 2006
Oregon Department of Environmental Quality	Final Upper Klamath and Lost River Subbasins Total Maximum Daily Load and Water Quality Management Plan	Upper Klamath and Lost River Subbasins	Water Quality /Aquatic Resources	2011	Undefined
Oregon Parks and Recreation Department	The 2008-2012 Oregon Statewide Comprehensive Outdoor Recreation Plan	Oregon	Recreation	2008	2008-2012

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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
<b>County</b>					
Modoc County	Modoc County General Plan	Modoc County, California	Traffic and Transportation/Noise	1988	1988 - 2008
Trinity County	Trinity County General Plan	Trinity County, California	Traffic and Transportation/Noise	Housing 2003 Open Space and Conservation 1973 Safety 2002	20 years
Trinity County	Trinity County Regional Transportation Plan - Draft	Trinity County, California	Traffic and Transportation/Noise /Air Quality/Greenhouse Gasses/Global Climate Change/Socioeconomics	2010	2010-2030
Humboldt County	Humboldt County General Plan Update Planning Commission Hearing Draft	Humboldt County, California	Traffic and Transportation/Noise /Air Quality/Greenhouse Gasses/Global Climate Change/Socioeconomics	2008	2008-2028
Mendocino County	General Plan	Mendocino County, California	Traffic and Transportation/Noise /Air Quality/Greenhouse Gasses/Global Climate Change/Socioeconomics	2009	Undefined
Mendocino County	General Plan Coast Element	Mendocino County Coastal Area, California	Aquatic Resources	Revised 1991	Undefined
Siskiyou County	General Plan	Siskiyou County, California	Traffic and Transportation / Public Utilities and Services/Population and Housing/ Land Use, Agriculture and Forest Resources /Noise/Socioeconomics/ Recreation/ Greenhouse Gasses/Global Climate Change	1970s, Housing Element was updated in 2008	Undefined
Siskiyou County	Siskiyou County Comprehensive Land & Resource Management Plan	Siskiyou County, California	Water Supply and Water Rights/Land Use, Agriculture and Forest Resources/ Socioeconomics/Recreation/ Cultural and Historic Resources/ Traffic and Transportation /Geology, Soils, Geological Hazards	1996	Undefined
Del Norte County	General Plan	Del Norte County, California	Traffic and Transportation/Noise /Air Quality/Greenhouse Gasses/Global Climate Change	2003	2015

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Shasta County Regional Transportation Planning Agency	Final Draft 2010 Regional Transportation Plan	Shasta County, California	Traffic and Transportation/Noise/Air Quality/Greenhouse Gasses/Global Climate Change	2010	2010-2030
Shasta County Regional Transportation Planning Agency	Shasta Forward Final Report	Shasta County, California	Traffic and Transportation /Air Quality/Greenhouse Gasses/Global Climate Change	2010	Long range
Jackson County	Comprehensive Plan	Jackson County, Oregon	Traffic and Transportation /Air Quality/Socioeconomics	2004	Undefined
Jackson County	Transportation System Plan	Jackson County, Oregon	Traffic and Transportation /Air Quality	2005	2005-2025
Curry County	Comprehensive Plan	Curry County, Oregon	Land Use, Agriculture and Forest Resources/Population and Housing/Traffic and Transportation /Socioeconomics	Latest Amendment 2006	2009
Klamath County	Comprehensive Plan	Klamath County, Oregon	Land Use, Agriculture and Forest Resources /Scenic Quality /Cultural Resources /Recreation /Housing/Public Utilities and Services/ Traffic and Transportation/Recreation/ Greenhouse Gasses/Global Climate Change	2010	Undefined
Klamath County	Transportation System Plan	Klamath County, Oregon	Traffic and Transportation /Air Quality/Population and Housing	2010	2010-2030
Klamath County	Economic Opportunities Analysis and Long-Term Urban Land Needs Assessment	Klamath County, Oregon	Land Use, Agriculture and Forest Resources /Population and Housing/Socioeconomics/ Greenhouse Gasses/Global Climate Change	2009	2059
Del Norte, Humboldt, Mendocino, Siskiyou & Trinity Counties	Five Counties Salmonid Conservation Program	Del Norte, Humboldt, Mendocino, Siskiyou & Trinity Counties in California	Aquatic Resources	Undefined	Undefined
<b>City</b>					
City of Eureka	2009-2014 General Plan Housing Element	Eureka, California	Population and Housing	2010	2009-2014
City of Eureka	General Plan	Eureka, California	Land Use, Agriculture and Forest Resources / Housing/ Traffic and Transportation/Recreation	Adopted 1997, Amended 1999	1997-2022

**Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis**

<b>Author</b>	<b>Document Title</b>	<b>Coverage Area</b>	<b>Resource Topic(s) Addressed</b>	<b>Date Published</b>	<b>Timeframe Covered</b>
City of Klamath Falls	Comprehensive Plan	Klamath Falls, Oregon	Cultural Resources/Recreation/ Traffic and Transportation / Land Use, Agriculture and Forest Resources	1981	Undefined
City of Klamath Falls	Economic Opportunities Analysis and Long-Term Urban Land Needs Assessment	Klamath County, Oregon	Land Use, Agriculture and Forest Resources /Population and Housing/Socioeconomics	2009	2059
City of Yreka	General Plan	Yreka, California	Land Use, Agriculture and Forest Resources / Housing/ Traffic and Transportation/Recreation	2002	2002-2022
City of Yreka	2009 Housing Element	Yreka, California	Population and Housing/ Socioeconomic s	2009	2009-2014
City of Arcata	Draft Economic Development Strategic Plan 2010-2014	Arcata, California	Socioeconomics	2010	2010-2014
City of Arcata	Housing Element	Arcata, California	Population and Housing	2009	
City of Arcata	General Plan 2020	Arcata, California	Land Use, Agriculture and Forest Resources / Traffic and Transportation/ Population and Housing /Air Quality/Noise	2000	2000-2020
Crescent City	General Plan	Crescent City, California	Population and Housing	2001	2001-2020
Crescent City	Housing Element	Crescent City, California	Population and Housing	2003	2001-2020
City of Mt. Shasta	2007 General Plan Revision	Mt. Shasta, California	Land Use/ Traffic and Transportation /Public Utilities and Services/Noise	2007	2007-2025
City of Weed	General Plan	Weed, California	Land Use, Agriculture and Forest Resources/ Traffic and Transportation / Population and Housing/Noise	Undefined	Undefined
City of Weed	Draft Housing Element 2009- 2014	Weed, California	Population and Housing/ Socioeconomics	2010	2009-2014
City of Brookings	Comprehensive Plan	Brookings, Oregon	Land Use, Agricultural and Forest Resources / Recreation/ Traffic and Transportation	2009	Undefined
City of Brookings	Public Facilities Plan for urban Growth Expansion Brookings and Harbor Study Areas	Brookings, Oregon and Harbor, Oregon	Public Utilities and Services	1999, Revised 2009	Undefined

**Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis**

<b>Author</b>	<b>Document Title</b>	<b>Coverage Area</b>	<b>Resource Topic(s) Addressed</b>	<b>Date Published</b>	<b>Timeframe Covered</b>
City of Brookings and Oregon Department of Transportation	City of Brookings Transportation System Plan	Brookings, Oregon	Traffic and Transportation	2006	2006-2026
City of Port Orford	Comprehensive Plan	Port Orford, Oregon	Traffic and Transportation	1975	Undefined
City of Ashland	Comprehensive Plan	Ashland, Oregon	Population and Housing / Traffic and Transportation	2005	Undefined
City of Medford	Comprehensive Plan	Medford, Oregon	Population and Housing/ Socioeconomics / Land Use, Agriculture and Forest Resources/ Traffic and Transportation	Undefined	Undefined

### **4.3.2 Cumulative Projects**

The Lead Agencies reviewed past, present, and future projects in the geographically defined area as part of this cumulative effects analysis. Table 4-4 lists the projects considered in this analysis.

**Table 4-4. Projects Considered in Cumulative Effects Analysis**

<b>Implementing Agency</b>	<b>Project/Program Name</b>	<b>Location</b>	<b>Implementation Timeframe</b>	<b>Reference</b>
<b>Tribal</b>				
Hoopa Valley Tribe	Various Watershed Restoration Projects	Hoopa Valley Indian Reservation (Mill Creek, Tish Tang, Supply, and Pine Creek Watersheds)	Undefined (Ongoing)	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan
Hoopa Valley Tribe	Masonite Mill Creek Soil Remediation	Hoopa Valley Indian Reservation (Masonite Mill Creek)	Undefined (Ongoing)	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan
Hoopa Valley Tribe	Supply Creek Landfill Closure	Hoopa Valley Indian Reservation (Supply Creek)	Undefined (Ongoing)	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan
<b>Federal</b>				
Department of the Interior	Klamath Basin Conservation Area Restoration Program	Klamath Basin	1986 to 2006	Long Range Plan for the Klamath Basin Conservation Area Fishery Restoration Program (Klamath River Basin Fisheries Task Force 1991)
<b>State</b>				
California Department of Transportation	Siskiyou I-5/SR89 So Mount Shasta Blvd Interchange	City of Mount Shasta, Siskiyou County	Undefined (Environmental study scheduled for Oct 2011)	District 2 Projects in the Northstate
California Department of Transportation	Various regional transportation projects - Capacity Increasing	Shasta County, CA	Within 20 years	Shasta County Regional 2010 Transportation Plan
<b>County</b>				
Del Norte County	Sewage treatment upgrade	Crescent City, CA	Within 5 yrs.	Del Norte General Plan Policy Document
Del Norte County	Intersection improvements on hwy 101	Between Highway 199 and the Oregon border.	Within 5 yrs.	Del Norte General Plan Policy Document
Shasta County	Various regional transportation projects - Capacity Increase	Shasta County, CA	Within 20 years	Shasta County Regional 2010 Transportation Plan
Siskiyou County Public Works	Ash Creek Bridge Replacement	Intersection of Klamath River Rd and State Route 96	2011	Greg Plucker, Deputy Director of Planning County of Siskiyou

**Table 4-4. Projects Considered in Cumulative Effects Analysis**

<b>Implementing Agency</b>	<b>Project/Program Name</b>	<b>Location</b>	<b>Implementation Timeframe</b>	<b>Reference</b>
Siskiyou County Public Works	Guys Gulch Bridge Replacement	Intersection of Guys Gulch and Old Highway 99	2012	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Schulmeyer Gulch Bridge Replacement	Intersection of Schulmeyer Gulch and Old Highway 99	2012	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Bridge Preventive Maintenance - Replace joint seals, deck rehab	30 Locations at river crossings in the County	2012	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Shasta River Bridge Replacement	Intersection of Louie Road and Shasta River	2017	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	McKinney Creek - Replace culverts with bridge	Intersection of Walker Road and McKinney Creek	2013	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Barr Road Bypass - Construct 1/4 mile of new road	Horse Creek Bridge along the Klamath River	2018	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Ager Road - Overlay/Reconstruct	Ager Road Montague to Klamathon	Unknown Pending Funding	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Copco Road widening - Widen 1/2 mile road	Copco Road	Unknown Pending Funding	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Big Springs Road - Overlay/Reconstruct	Between Highway 97 and A-12	Unknown Pending Funding	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Klamath River Country Estates – 5 Subdivisions of various sizes	South of Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Cascade Shores Subdivision	Northwest of Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Iron Gates Lake Estates – 5 Subdivisions of various sizes	Northeast of Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Seiad Creek Restoration - Proposal to restore about 4,000 lineal feet of stream	Where Seiad Creek intersects with the Klamath River	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou

**Table 4-4. Projects Considered in Cumulative Effects Analysis**

<b>Implementing Agency</b>	<b>Project/Program Name</b>	<b>Location</b>	<b>Implementation Timeframe</b>	<b>Reference</b>
Siskiyou County	Klamath Ranch Quarry Use and Reclamation - 9 acre open pit surface mining operation	Located off Copco Road, 6 miles east from Interstate 5 and 1.25 miles west from Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Triple Duty Mine and Reclamation - 12 acre surface mining operation with the removal of 1.5 million cubic yards of overburden	Bradley/Henley Road, 1000 feet south from Copco Road, in the Community of Hornbrook	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Humboldt, Del Norte, Trinity, Siskiyou and Mendocino Counties	Five Counties Road Maintenance Program	Humboldt, Del Norte, Trinity, Siskiyou and Mendocino Counties	1998 to Present	Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California 19 Watersheds
Jackson County	Various roadway improvements at intersections on Highway 101	Jackson County, OR	Undefined	Jackson County Transportation System Plan
Jackson County	Various pedestrian and bike lane improvements	Jackson County, OR	Undefined	Jackson County Transportation System Plan
Klamath County	Statewide Transportation Improvement Program Projects	Klamath County, OR	Within 20 years	2010-2030 Klamath County Transportation System Plan (Ch. 7)
<b>City</b>				
City of Eureka, CA	Greyhound Hotel Project/Jack Freeman	420 Third Street	As of 2009, the applicant is currently seeking a construction bid proposal	General Plan - Housing Element
City of Eureka, CA	Humboldt County Office of Education (Seventh Street Villa Condominiums)	Between 6th and 7th Street on Myrtle Avenue	July 2009	General Plan - Housing Element
City of Eureka, CA	North Coast Veterans Resource Center Veterans Transitional Housing Facility	Veterans Transitional Housing Facility	Due to the temporary postponement of one of the additional funding sources, the project funds remain frozen until notified of funding availability.	General Plan - Housing Element
City of Eureka, CA	CalHome Grant Program	Unknown	2010	General Plan - Housing Element

**Table 4-4. Projects Considered in Cumulative Effects Analysis**

<b>Implementing Agency</b>	<b>Project/Program Name</b>	<b>Location</b>	<b>Implementation Timeframe</b>	<b>Reference</b>
City of Eureka, CA	Eureka Waterfront Revitalization Program	Waterfront	2007	General Plan - Land Use and Design, Eureka Redevelopment Final Program EIR 2005
City of Arcata, CA	Courtyard Phase II	Unknown	Unknown	General Plan - Housing Element
City of Arcata, CA	Courtyard Phase III	Unknown	Unknown	General Plan - Housing Element
City of Arcata, CA	Samoa Boulevard Revitalization Plan	Samoa Boulevard	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Conservation Easement in Arcata Forest for trails	Arcata Forest	Expected completion 2010	Economic Development Strategic Plan
City of Arcata, CA	Humboldt State University Enrollment Increase	Humboldt State University	Over next 30 to 40 years	Economic Development Strategic Plan
City of Arcata, CA	Humboldt State University College Creek Dormitories	Humboldt State University	Completed by Fall 2010	Economic Development Strategic Plan
City of Arcata, CA	Schatz Energy Research Center	Humboldt State University	Unknown	Economic Development Strategic Plan
City of Arcata, CA	BSS building	Humboldt State University	Fall 2007 completed	Economic Development Strategic Plan
City of Arcata, CA	Carlson Park	At Mad River	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Arcata-Eureka Airport Expansion and remodeling	Airport	2009	Economic Development Strategic Plan
City of Arcata, CA	Hampton Inn Hotel	Valley West	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Mad River Hospital Development and Master Plan	Mad River Hospital area	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Fire Training Center	A parcel off of Sunset Avenue near Arcata skate park	Unknown	Economic Development Strategic Plan
Crescent City, CA	Wastewater Treatment Plant	Unknown	2008	General Plan Housing Element Update
City of Yreka, CA	Expand Fall Creek Pump Station	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Filter Pump Station/Primary Coagulant Facilities	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Water Treatment Plant Upgrade	City of Yreka Water Treatment Plant	Unknown	Steven Baker, City Manager
City of Yreka, CA	2.5 Million Gallon Clear Well	City of Yreka	Unknown	Steven Baker, City Manager

**Table 4-4. Projects Considered in Cumulative Effects Analysis**

<b>Implementing Agency</b>	<b>Project/Program Name</b>	<b>Location</b>	<b>Implementation Timeframe</b>	<b>Reference</b>
City of Yreka, CA	Backwash Pond Improvements	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Zone 1 and 3 Supply Mains	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Rehabilitation of Butcher Hill Reservoir	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Upgrading existing distribution system telemetry system	Distribution system	Unknown	Steven Baker, City Manager
City of Ashland, OR	Bear Creek Greenway and Bear Creek Trail	Mountain Ave to Ashland City Limits in the western portion of city	Unknown	Comprehensive Plan, Parks, Open Space, and Aesthetics
Klamath Falls, OR	Castle Ridge Destination Resort	West Side (West of Highway 97)	2004	Klamath Falls Westside Refinement Plan 2006
Klamath Falls, OR	Pine Valley Planned Unit Development	West Side	Approved April 2006	Klamath Falls Westside Refinement Plan 2006
Klamath Falls, OR	Southview Planned Unit Development	West Side	Preliminary plan approved 2002	Klamath Falls Westside Refinement Plan 2006
<b>Private</b>				
Ruby Pipeline L.L.C.	Ruby Natural Gas Pipeline	Klamath County, OR	July 2010 to June 2011	<a href="http://www.rubypipeline.com/">http://www.rubypipeline.com/</a>
Klamath Falls Bioenergy L.L.C.	Klamath Falls Bioenergy Facility - electric generating facility burning biomass (wood waste), 38.5 megawatts	Klamath Falls, Klamath County, OR	Unknown	<a href="http://www.oregon.gov/ENERGY/SITING/docs/KBE-PublicNotice.pdf">http://www.oregon.gov/ENERGY/SITING/docs/KBE-PublicNotice.pdf</a>

## 4.4 Cumulative Effects Analysis

This section describes, by resource, the cumulative effects of the KHSA and KBRA. For each resource category, the analysis is structured as follows:

- A summary of each resource’s impacts and mitigation measures presented in Chapter 3;
- A discussion of potential cumulative effects utilizing either the project method, the projection method, or a combination of both (as described in Section 4.2.1);
- A discussion of the incremental contribution of the alternative to the cumulative effect and whether that contribution is cumulatively considerable; and
- A discussion of any mitigation measures.

With regard to the summary table of impacts specific to each resource, the delineation of applicable alternatives and conclusions of significance are abbreviated as follows:

### Alternatives

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

### Significance

- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant

This cumulative analysis considers adverse effects of the project identified in Chapter 3 that are less than significant or significant. It also considers beneficial effects. If an impact has been determined to have no effect, then it would not contribute to any cumulative effects and it is not discussed in this section. This cumulative analysis does not evaluate the No Action/No Project Alternative because it already includes reasonably foreseeable past, present, and future projects.

Three resource categories, Environmental Justice, Socioeconomics, and Tribal Trust are NEPA requirements and are analyzed according to NEPA; therefore they do not require a specific determination of significance. The cumulative effects analysis for each of these resource categories describes potential cumulative effects but does not make a determination of whether or not they would be cumulatively considerable or significant (i.e., for all other resource categories, CEQA conclusions, shown in bold type, are presented at the end of each impact discussion).

The KBRA is analyzed at a programmatic level of detail in this cumulative effects analysis because the specific locations, timeframes, and construction methods for KBRA actions are not yet known. Where adequate information on KBRA actions is available, general cumulative effects are discussed. Where information is not sufficient for a detailed cumulative effects analysis, or there is a high level of uncertainty as to what actions would occur and how they would affect resources, this is noted in the text and no attempt at speculation is made. As noted throughout this document, dam removal as contemplated in the KHSR and full implementation of the KBRA are expected to require additional environmental analysis under CEQA and/or NEPA.

#### **4.4.1 Water Quality**

Cumulative effects on water quality could be caused by short-term and long-term water quality impacts of the project, combined with other projects/actions in the Klamath Basin that could contribute to adverse water quality effects. The timeframe for short-term water quality effects related to reservoir drawdown is up to two years after construction, although modeling suggests most water quality effects would be negligible after a year (see Section 3.2.4.3, Water Quality). The timeframe for long-term cumulative water quality effects extends from 2 to 50 years, which includes the remainder of the Project analysis period and applies for the majority of the available numeric models of future water quality in the Klamath River.

The water quality modeling performed for the impact analysis in Chapter 3 already considers some cumulative actions such as implementation of the Total Maximum Daily Loads (TMDLs) in order to forecast future water conditions at the time the Proposed Action and alternatives would be implemented. This cumulative effects analysis focuses on additional projects not already considered in the water quality modeling.

Table 4-5 presents a summary of the water quality impacts identified in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
<b>Water Temperature</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable Oregon DEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the Hydroelectric Reach.	1, 4,5	NCFEC	None	NCFEC
Dam removal and/or elimination of hydropower peaking operations at J.C. Boyle Powerhouse could cause short-term and long-term alterations in daily water temperatures and fluctuations in the J.C. Boyle bypass and peaking reaches.	2, 3, 5	S for J.C. Boyle bypass reach B for J.C. Boyle peaking reach	None	S for J.C. Boyle bypass reach B for J.C. Boyle peaking reach
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term increases in spring time water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir.	2, 3, 5	S for springtime B for late summer/fall	None	S for springtime B for late summer/fall
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term and long-term increases in sediment deposition in the Klamath River or Estuary that could alter morphological characteristics and indirectly affect seasonal water temperatures.	2, 3, 5	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable California North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dam removal and conversion of the reservoir areas to a free flowing river could result in short-term and long-term increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River.	2, 3, 5	S – Iron Gate Dam to Salmon River for springtime	None	S – Iron Gate Dam to Salmon River for springtime
<b>Suspended Sediments</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could result in short-term and long-term interception and retention of mineral (inorganic) suspended material by the KHP dams.	1, 4	NCFEC	None	NCFEC
Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach.	1, 2, 3	LTS	None	LTS
Implementation of IM 8, J.C. Boyle Bypass Barrier Removal, could result in short-term increases in mineral suspended material in the Hydroelectric Reach due to deconstruction activities.	1	LTS	None	LTS
Implementation of IM 16, Water Diversions, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach due to diversion screening deconstruction and construction activities.	2, 3	LTS	None	LTS
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the Hydroelectric Reach due to in-reservoir algal blooms.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam.	2, 3, 5	S	None	S
Construction/deconstruction activities could cause short-term increases in suspended material in the Hydroelectric Reach due to stormwater runoff from construction/deconstruction areas.	2, 3, 4, 5	LTS	None	LTS

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities would include the demolition of various recreation facilities which could cause short-term increases in suspended material in the Hydroelectric Reach from stormwater runoff from the demolition areas.	2, 3, 5	LTS	None	LTS
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the lower Klamath River and the Klamath Estuary.	2, 3	S	None	S
Draining the reservoirs and release of sediment could cause short-term increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material and rates of deposition in the marine nearshore environment.	2, 3, 5	LTS	None	LTS

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water in the reservoirs could cause short-term and long-term interception and retention of mineral (inorganic) sediments by the dams and correspondingly low levels of suspended material immediately downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could result in short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the KHP reservoirs and subsequent transport into the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces into the lower Klamath River and Klamath Estuary.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
<b>Nutrients</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could result in long-term interception and retention of TP and TN in the Hydroelectric Reach on an annual basis but release (export) of TP and TN from reservoir sediments on a seasonal basis.	1, 4	NCFEC	None	NCFEC

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Draining the reservoirs and release of sediment could cause short-term increases in sediment- associated nutrients in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term interception and retention of TP and TN on an annual basis but release (export) of TP and TN on a seasonal basis	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment to the lower Klamath River could cause short-term increases in sediment-associated nutrients in the river and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
<b>Dissolved Oxygen</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term <sup>3</sup> seasonal and daily variability in dissolved oxygen concentrations in the Hydroelectric Reach, such that levels do not meet Oregon DEQ and California North Coast Basin Plan water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term <sup>4</sup> increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir.	2, 3, 5	S	None	S

<sup>3</sup> Long-term is defined as 2-50 years.

<sup>4</sup> Short-term is defined as <2 years.

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dam removal and conversion of reservoir areas to free-flowing river conditions could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach.	2, 3, 5	B	None	B
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term seasonal and daily variability in dissolved oxygen concentrations in the Klamath River downstream of Iron Gate Dam, such that levels do not meet California North Coast Basin Plan and Hoopa Valley Tribe water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC
Dam removal and sediment release could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	S (lower Klamath River from Iron Gate Dam to Clear Creek) NCFEC (Klamath Estuary or Marine Nearshore Environment)	None	S (lower Klamath River from Iron Gate Dam to Clear Creek) NCFEC (Klamath Estuary or Marine Nearshore Environment)
Dam removal and conversion of reservoir areas to a free-flowing river could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the lower Klamath River, particularly for the reach immediately downstream of Iron Gate Dam.	2, 3, 5	B	None	B
<b>pH</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in summertime pH in the Hydroelectric Reach.	2, 3, 5	B	None	B

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the lower Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in summertime pH in the lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term summertime increases in pH in the lower Klamath River downstream of Iron Gate Dam.	2, 3, 5	LTS (from Iron Gate Dam to confluence with the Scott River) NCFEC (Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the Marine Nearshore Environment)	None	LTS (from Iron Gate Dam to confluence with the Scott River) NCFEC (Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the Marine Nearshore Environment)
<b>Chlorophyll-a and Algal Toxins</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as <i>M. aeruginosa</i> , resulting in high seasonal concentrations of chlorophyll-a and algal toxins in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and algal toxins in the Hydroelectric Reach.	2, 3, 5	B	None	B

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as <i>M. aeruginosa</i> , resulting in high seasonal concentrations of chlorophyll-a and algal toxins transported into the Klamath River from downstream of Iron Gate Dam to the Klamath Estuary, and potentially to the marine nearshore environment.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and algal toxins in the lower Klamath River and the Klamath Estuary.	2, 3, 5	B	None	B
<b>Inorganic and Organic Contaminants</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants for freshwater aquatic species in the Hydroelectric Reach.	1, 4, 5	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants in the Hydroelectric Reach through human consumption of resident fish tissue.	1, 4, 5	NCFEC	None	NCFEC
Draining the reservoirs and sediment release could cause short-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed reservoir terraces and river banks within the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction/deconstruction activities could cause short-term increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation equipment in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Reservoir area restoration activities could include herbicide application which could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Dam removal and sediment release could cause short-term and long-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the lower Klamath River and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed downstream river terraces and downstream river banks following reservoir drawdown.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities could cause short-term increases in suspended sediments and the potential for inorganic and organic contaminants from hazardous materials associated with construction equipment to be transported into the lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 4, 5	LTS	None	LTS
<b>Trap and Haul Operations</b>				
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan would affect water quality during construction.	4, 5	LTS	None	LTS
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
<b>East and West Side Facilities</b>				
Decommissioning the East and West Side Facilities could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
Implementation of the Phase I Fisheries Restoration Plan could result in short-term construction-related increases in suspended materials and long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction	2, 3	LTS	None	LTS
Implementation of Wood River Wetland Restoration could result in short-term construction-related increases in suspended materials and long-term warmer spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of Water Diversion Limitations could result in decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)
Implementation of the Water Use Retirement Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)

**Table 4.5. Summary of Water Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)

**Key:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

TMDL=total maximum daily load

TN = total nitrogen

TP = total phosphorus

Water quality in multiple locations in the Klamath River is characterized by seasonally high concentrations of algal-derived (organic) suspended material, high water temperatures, low dissolved oxygen, and high pH levels (North Coast Regional Water Quality Control Board [NCRWQCB] 2010a). A lack of carbonate rock sources in the basin results in generally low alkalinity waters and during the daytime when photosynthesis is occurring, high pH levels can exceed Oregon, California, and Hoopa Valley Tribe water quality objectives (see Section 3.2.3, Water Quality). The export of nutrients and organic matter from Upper Klamath Lake has contributed to water quality issues in the downstream Klamath River, including high levels of biological productivity and respiration (NCRWQCB 2010a).

Many past and present cumulative actions and projects have contributed to the Klamath River's adverse water quality conditions, including the establishment and operation of the Klamath Hydroelectric Project (KHP) and Reclamation's Klamath Project, large-scale conversion of wetlands in the upper basin to irrigated agricultural lands, grazing, road construction and related run-off, timber harvesting, mining, water diversions, and development (see also Section 3.2.3.1, Water Quality).

Future actions that could cumulatively affect water quality in the Klamath Basin include proposed new subdivisions and road improvements in or near the Klamath River. There are also many ongoing restoration actions and projects in the Klamath Basin (identified in Tables 4-3 and 4-4) that have or will contribute to future water quality improvements in the Klamath River.

#### **4.4.1.1 Alternative 2: Full Facilities Removal of Four Dams**

##### **Temperature**

*Removal of the Four Facilities under the Proposed Action and elimination of hydropower peaking operations at J.C. Boyle Powerhouse could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) alterations in daily water temperatures and fluctuations in the J.C. Boyle Bypass and Peaking reaches.* Removal of the reservoirs would have a significant impact on summer/fall water temperatures by increasing temperatures and daily fluctuations in the J.C. Boyle Bypass Reach. However, slight decreases in long-term summer/fall water temperatures and less daily fluctuation in the J.C. Boyle peaking reach would be beneficial.

Water temperatures in the Klamath Hydroelectric Reach are influenced by the presence of the Four Facilities. As noted in Section 3.2, Water Quality, the large thermal mass of the stored water in the reservoirs delays the natural warming and cooling of riverine water temperatures on a seasonal basis such that spring water temperatures in the Klamath Hydroelectric Reach are generally cooler than would be expected under natural conditions, and summer and fall water temperatures are generally warmer (NCRWQCB 2010a). In the Hydroelectric Reach, maximum weekly maximum temperatures (MWMs), which generally occur in late July, regularly exceed the range of chronic effects temperature thresholds (13–20°C [55.4–68°F]) for full salmonid support in California (NCRWQCB 2010a). In addition to the influence of the reservoirs, climate

change is expected to increase summer and fall water temperatures in the Klamath Basin on the order of 1–3°C (1.8–5.4°F) (Bartholow 2005, Perry et al. 2011). The Upper Klamath River from the Oregon-California state line to Iron Gate Dam, the Middle Klamath River from Iron Gate Dam to Scott River, and the Lower Klamath River from Scott River to the mouth are all listed as impaired for water temperature according to the Clean Water Act (CWA) Section 303d list. Water temperature is therefore a significant cumulative effect in the Klamath River and the J.C. Boyle bypass and peaking reaches.

The Proposed Action’s contribution to this cumulative effect would be cumulatively considerable for the area directly downstream of J.C. Boyle dam because it would result in higher daily fluctuations June through September due to the absences of the reservoir. In the J.C. Boyle bypass reach, it would also be cumulatively considerable because this area would no longer be dominated by cold groundwater inputs at a relatively constant temperature and would also result in higher daily fluctuations in water temperatures in the summer.

In the J.C. Boyle peaking reach model results indicate that water temperatures under the would be slightly lower and would exhibit *lower* daily fluctuation during June through September (NCRWQCB 2010a, Asarian and Kann 2006a). At these locations the relative difference in daily water temperature fluctuations is due to the elimination of peaking operations and the associated large daily temperature swings. The Proposed Action’s contribution to the significant effects associated with water temperature would therefore be beneficial for the J.C. Boyle peaking reach. **The Proposed Action’s incremental contribution to the cumulative effects on water temperatures in the J.C. Boyle bypass reach and directly downstream of J.C. Boyle dam would be cumulatively considerable. No feasible mitigation is available to reduce these impacts; therefore they remain cumulatively considerable. The Proposed Action’s incremental contribution to the significant cumulative effects associated with water temperatures in the J.C. Boyle peaking reach would be beneficial.**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in spring water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir and the Lower Klamath River.* Removal of the reservoirs would have a potentially significant impact on spring water temperatures in the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir and in the Lower Klamath River from Iron Gate Dam to the confluence with the Salmon River. Decreases in late summer/fall water temperatures in the J.C. Boyle peaking reach to the Oregon State line, and the hydroelectric reach downstream of Copco 1 Reservoir would be beneficial. There would be no effect on water temperatures for Klamath River downstream of the Salmon River, the Klamath Estuary, and the marine nearshore environment.

Water temperatures in the Klamath Hydroelectric Reach are influenced by the presence of the Four Facilities. As noted in Section 3.2, Water Quality, the large thermal mass of

the stored water in the reservoirs delays the natural warming and cooling of riverine water temperatures on a seasonal basis such that spring water temperatures in the Klamath Hydroelectric Reach are generally cooler than would be expected under natural conditions, and summer and fall water temperatures are generally warmer (NCRWQCB 2010a). The temporal water temperature pattern of the Hydroelectric Reach is repeated in the Klamath River immediately downstream of Iron Gate Dam, where water released from the reservoirs is 1–2.5°C (1.8–4.5°F) cooler in the spring and 2–10°C (3.6–18°F) warmer in the summer and fall as compared to modeled conditions without the dams (PacifiCorp 2004a, Dunsmoor and Huntington 2006, NCRWQCB 2010a). Immediately downstream of Iron Gate Dam (RM 190.1), water temperatures are also less variable than those documented farther downstream in the Klamath River (Karuk Tribe of California 2009, 2010).

Farther downstream, the presence of the Four Facilities exerts less influence and water temperatures are more influenced by the natural heating and cooling regime of ambient air temperatures and tributary inputs of surface water. Meteorological control of water temperatures result in increasing temperature with distance downstream of Iron Gate Dam. By the Salmon River (RM 66), the affects of the dams on water temperature are not discernable.

Besides the influence of the reservoirs, the other factor that could contribute to cumulative effects on water quality is climate change. Climate change is expected to increase summer and fall water temperatures in the Klamath Basin on the order of 1–3°C (1.8–5.4°F) (Bartholow 2005, Perry et al. 2011). The Upper Klamath River from the Oregon-California state line to Iron Gate Dam, the Middle Klamath River from Iron Gate Dam to Scott River, and the Lower Klamath River from Scott River to the mouth are all listed as impaired for water temperature according to the CWA Section 303d list. Water temperature is therefore a significant cumulative effect for the Klamath River in the Hydroelectric Reach downstream of Copco 1 Reservoir.

The Proposed Action's incremental contribution to the cumulative effects on water temperatures would be cumulatively considerable for spring water temperatures in the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir because it would increase daily maximum temperatures in May and June. However, the Proposed Action would also decrease temperatures in this same reach in August and October, contributing to beneficial effects. In the Lower Klamath River from Iron Gate Dam to the confluence with the Scott River, the Proposed Action's incremental contribution to the cumulative effects would also be beneficial in spring by resulting in cooler water temperatures, but would be cumulatively considerable in the late summer/fall months by increasing temperatures. Water temperatures would not be expected to change in the lower river downstream of the confluence with the Salmon River, including the Klamath Estuary and the marine nearshore environment. **The Proposed Action's incremental contribution to the cumulative effects on water temperatures would be cumulatively considerable in the spring for the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir and from Iron Gate Reservoir to the confluence with the Scott River. The Proposed Action's incremental contribution to the cumulative effects on water**

**temperatures would be beneficial in the fall from the J.C. Boyle peaking reach to the Oregon State line, from Copco 1 Reservoir to Iron Gate Reservoir, and from Iron Gate Reservoir to the confluence with the Scott River.**

### **Suspended Sediments**

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam, the Lower Klamath River and the Klamath Estuary due to the release of sediments currently trapped behind the dams at the Four Facilities. Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material in the marine nearshore environment. Stormwater runoff from deconstruction activities under the Proposed Action could cause short-term increases in suspended material in the Hydroelectric Reach during the deconstruction period. Interim Measures (IMs) would cause short-term increases in suspended sediment associated with construction activities. Construction of the Yreka Pipeline under the Proposed Action could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period. Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs will be removed following drawdown, and could release suspended sediment into the Klamath River. Under the Proposed Action, revegetation associated with management of the reservoir footprint area could decrease the erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach. The Proposed Action would increase short-term suspended sediment concentrations through the release of sediment trapped behind the dams. Within the general uncertainty of the model predictions, suspended sediment concentrations (SSCs) at J.C. Boyle Reservoir across the three water year types would have peak values of 2,000–3,000 mg/L and occurring within 1–2 months of reservoir drawdown. Predicted SSCs quickly decrease to less than 100 mg/L for 5–7 months following drawdown, and concentrations less than 10 mg/L for 6–10 months following drawdown.*

Sediment transport modeling of the impacts of dam removal on suspended sediment in the lower Klamath River indicates high short-term loads immediately downstream of Iron Gate Dam under the Proposed Action (Greimann et al. 2011, Stillwater Sciences 2008). Overall, and within the general uncertainty of the model predictions, SSCs across the three water year types would have peak values of 7,000–14,000 mg/L and occurring within 2–3 months of reservoir drawdown. Predicted SSCs would remain greater than or equal to 100 mg/L for 5–7 months following drawdown, and concentrations would remain greater than or equal to 30 mg/L for 6–10 months following drawdown (Table 3.2-12). Model results also indicate that while dilution in the lower river would decrease SSCs to 60–70 percent of their initial value downstream of Seiad Valley (river mile [RM] 129.4) and to 40 percent of their initial value downstream of Orleans (≈RM 59), within a factor of 2 uncertainty for the model results it can be conservatively assumed that SSCs in the lower Klamath River would be sufficient ( $\geq 30$  mg/L) to substantially adversely affect beneficial uses throughout the lower River and the Klamath Estuary for 6–10 months following drawdown (Greimann et al. 2011).

Sediment release associated with the Proposed Action would cause short-term increases in suspended material ( $\geq 30$  mg/L for 6–10 months following drawdown) that would result in non-attainment of applicable North Coast Basin Plan water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary and would substantially adversely affect the cold freshwater habitat (COLD) beneficial use.

The results of model predictions for sediment transport following dam removal under the Proposed Action indicate that dam removal would cause a release of less than 3 million tons of fine sediment to the lower Klamath River downstream of Iron Gate Dam. Due to the relatively small magnitude of SSCs released to the nearshore environment, the anticipated rapid dilution of the sediment plume as it expands in the ocean, and the relatively short duration of high SSCs, the short-term increases in SSCs in the marine nearshore environment under the Proposed Action would not be substantial.

Deconstruction activities, relocation of recreation facilities, and the relocation of the Yreka pipeline could also contribute to erosion and runoff of sediments into the waterway. However, the potential for sediments to enter the water from deconstruction site runoff or in-water deconstruction work could be minimized or eliminated through the implementation of Best Management Practices (BMPs) for deconstruction activities that would occur in or adjacent to the Klamath River. Establishment of herbaceous vegetation in drained reservoir areas would be undertaken to stabilize the surface of the sediment and minimize erosion from exposed terrace surfaces following drawdown.

Several of the cumulative actions and projects identified in Table 4-4 above have the potential to increase erosion and the release of sediment into the Klamath River, including the transportation improvement project in Siskiyou County, construction of approved new subdivisions in Siskiyou County, and any other proposed developments that could involve ground disturbance. Other more general projects and activities that are not easily identifiable but likely to occur, such as timber harvesting, mining, and agriculture, livestock grazing, and road-related erosion, could also contribute to cumulative effects associated with suspended sediment. Climate change could also affect suspended sediment by increasing the number of heavy precipitation events each year. As described in Section 3.10, Greenhouse Gases/Global Climate Change, increases in heavy precipitation may result in a variety of general consequences for the Pacific Northwest:

- Increased fine sediment in streams may result in negative effects on the spawning of native fish that build their nests in the areas of clean rocks and gravel (Barr et al. 2010).
- Increased frequency and severity of flooding may occur.
- Increased runoff may lead to surface water quality changes including increased turbidity, increased organic content, color changes, and alkalinity changes.

The Lower Klamath River from the Trinity River to the mouth is listed as impaired under CWA Section 303(d) for sedimentation/siltation impairment. Suspended sediment is therefore a significant cumulative effect.

The Proposed Action's contribution to the cumulative effects associated with suspended sediment would be short-term but would remain high for several months after reservoir drawdown in the Hydroelectric Reach, the Lower Klamath River, and in the Klamath Estuary and would exceed water quality objectives. **Therefore, the Proposed Action's incremental contribution to the short-term significant cumulative effects associated with suspended sediment concentrations during reservoir drawdown and dam deconstruction would be cumulatively considerable for the Hydroelectric Reach, Lower Klamath River, and the Klamath Estuary. No feasible mitigation is available to reduce these impacts; therefore they remain cumulatively considerable.**

*Under the Proposed Action, the lack of continued interception and retention of mineral (inorganic) and algal-derived (organic) suspended material by the dams at the Four Facilities could result in long-term (2–50 years following dam removal) increases in suspended material in the Hydroelectric Reach, lower Klamath River, Klamath Estuary, and marine nearshore environment.* As noted above, short-term sediment release results in a significant cumulative water quality effect for the Klamath River. The Proposed Action's contribution to the long-term cumulative effects associated with lack of continued interception and retention of inorganic and organic material would be minor. Peak concentrations of mineral (inorganic) suspended material in the Hydroelectric Reach and Lower Klamath Basin during the winter/early spring (November through April) would likely remain associated with high-flow events and any increases due to the lack of interception by the dams would not be large.

Episodic increases (10–20 mg/L) in algal-derived (organic) suspended material resulting from in-reservoir algal productivity are not expected to occur in the Hydroelectric Reach following dam removal. SSCs in the Hydroelectric Reach may attain levels similar to those observed upstream of J.C. Boyle Dam under existing conditions during May through October (>15 mg/L; see Appendix C), as algal-dominated suspended material is transported downstream from Upper Klamath Lake. If slight long-term increases in suspended materials did occur, they would likely be offset by the loss of algal-derived suspended material previously produced in Copco 1 and Iron Gate Reservoirs and would not exceed levels that would substantially adversely affect the cold freshwater habitat (COLD) beneficial uses. **Therefore, the Proposed Action's incremental contribution to the long-term significant cumulative effects associated with sediment would not be cumulatively considerable.**

### **Nutrients**

*Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) increases in sediment-associated nutrients.* Short-term increases in total nitrogen (TN) and total phosphorus (TP) concentrations in the lower Klamath River would occur because particulate (primarily organic) nutrients contained in reservoir sediment deposits would be transported along with the sediments themselves.

While no specific projects, including the projects reviewed for purposes of this analysis of cumulative effects, have been identified that would increase nutrient levels during

reservoir drawdown, general activities that are not easily identifiable but likely to occur, such as grazing and agriculture, could contribute to this cumulative effect. The entire middle and lower reaches of the Klamath River, beginning at state line (RM 208.7) and moving downstream, are currently listed as impaired under California's Section 303(d) list for nutrients (State Water Resources Control Board [SWRCB] 2010). Therefore nutrients represent a significant cumulative water quality effect.

The Proposed Action's contribution to the cumulative effect would be minimal. Minimal deposition of fine suspended sediments, including associated nutrients, would occur in the river channel (Greimann et al. 2011, Stillwater Sciences 2008). Further, reservoir drawdown under the Proposed Action would occur during winter months when rates of primary productivity and microbially mediated nutrient cycling (e.g., nitrification, denitrification) are also expected to be low. Light limitation for primary producers that do persist during winter months is also likely to occur, further decreasing the potential for uptake of TN and TP released along with reservoir sediment deposits. Therefore, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the Hydroelectric Reach. **The Proposed Action's incremental contribution to the short-term significant cumulative effects associated with the increase in nutrients would not be cumulatively considerable.**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause long-term (2–50 years following dam removal) increases in nutrient levels.* Under the Proposed Action, nutrients currently trapped by the dams would be transported downstream and potentially be available for uptake (e.g., by nuisance algae species).

Primary nutrients including nitrogen and phosphorus are affected by the geology of the surrounding watershed of the Klamath River, upland productivity and land uses, as well as a number of physical processes affecting aquatic productivity within reservoir and riverine reaches. The relatively low relief, volcanic terrain of the upper Klamath Basin supports large, shallow natural lakes (Upper Klamath Lake, Agency Lake, Tule Lake, Lower Klamath Lake) and wetlands, with soils that are naturally high in phosphorus. Human activities in the upper basin, including wetland draining, agriculture, ranching, timber harvesting, and water diversions have increased concentrations of nutrients (nitrogen and phosphorus) in waterways.

Nitrogen arriving in Upper Klamath Lake has been attributed to upland soil erosion, runoff and irrigation return flows from agriculture, as well as *in situ* nitrogen fixation by cyanobacteria (Oregon Department of Environmental Quality [ODEQ] 2002). Although the relatively high levels of phosphorus present in the Upper Klamath Basin's volcanic rocks and soils have been identified as a major contributing factor to phosphorus loading to the lake (ODEQ 2002), land use activities in the Upper Klamath Basin have also been linked to increased nutrient loading, subsequent changes in its trophic status, and associated degradation of water quality. Extensive monitoring and research has been conducted for development of the Upper Klamath Lake TMDLs (ODEQ 2002) that

shows the lake is a major source of nitrogen and phosphorus loading to the Klamath River.

While no specific cumulative projects have been identified that would increase nutrient levels, general activities that are not easily identifiable but likely to occur, such as timber harvesting, grazing, and other agricultural activities, could contribute to this cumulative effect. The entire middle and lower reaches of the Klamath River, beginning at Stateline RM 208.7) and moving downstream, are currently listed as impaired under California's Section 303(d) list for nutrients (SWRCB 2010a). Therefore nutrients represent a significant cumulative water quality effect for the Klamath River. The implementation Klamath Basin TMDLs for nutrients would help to reduce nutrient levels over time, but for the purposes of analysis this remains a significant cumulative effect.

The Proposed Action's contribution to the cumulative effect would minimal. Modeling conducted for development of the California Klamath River TMDLs (NCRWQCB 2010a) indicates that under the Proposed Action (similar to the TMDL TOD2RN scenario, which includes Oregon TMDL allocations), TP and TN in the Hydroelectric Reach immediately downstream of J.C. Boyle Dam would increase slightly (<0.015 mg/L and <0.05 mg/L, respectively) during summer months compared to those of the No Action/No Project Alternative (similar to the TMDL T4BSRN scenario) due to the absence of nutrient interception and retention in both Keno Impoundment and J.C. Boyle Reservoir (the former because the TMDL model TOD2RN scenario includes the historic Keno Reef instead of Keno Dam [Appendix D]). Overall, the increases would not be expected to result in exceedances of either Oregon water quality objectives for nuisance algae growth, or California North Coast Basin Plan water quality objectives for biostimulatory substances, beyond levels experienced under the No Action/No Project Alternative. Further, the lacustrine environment that supports the growth of nuisance algae blooms of such as *M. aeruginosa* or other cyanobacteria would be eliminated under the Proposed Action (see Section 3.4, Algae), reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species. Modeling results indicate small increases in TP and relatively larger increases in TN concentrations downstream of the Hydroelectric Reach under the Proposed Action, which diminish with distance downstream due to both tributary dilution and nutrient retention (i.e., uptake of nutrients). **The Proposed Action's incremental contribution to the significant cumulative effect associated long-term increases in nutrients in the lower Klamath River and the Klamath River Estuary after dam removal would not be cumulatively considerable.**

### **Dissolved Oxygen**

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir, the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* Under the Proposed Action, high SSCs are expected in the middle and lower Klamath River immediately following dam removal. The high fraction of organic carbon present in the reservoir sediments (see

Section 3.2.3.1, Water Quality) allows for the possibility of oxygen demand generated by microbial oxidation of organic matter exposed to the water column from deep within the sediment profile and mobilized during dam removal.

The entire middle and lower reaches of the Klamath River, beginning at Stateline (RM 208.7) and moving downstream, are currently listed as impaired under California's Section 303(d) list for dissolved oxygen (SWRCB 2010a). Therefore, dissolved oxygen levels represent a significant cumulative effect for the Klamath River. Other cumulative projects or actions within the Klamath Basin that could decrease dissolved oxygen levels would include any that would increase suspended sediments, such as those noted above under suspended sediments. In addition, climate change impacts in the future could increase average ambient air and water temperatures, thus resulting in decreased and fluctuating dissolved oxygen content.

The Proposed Action's contribution to the cumulative effect on dissolved oxygen would be minimal. While predicted short-term increases in oxygen demand under the Proposed Action generally result in dissolved oxygen concentrations that would meet the acceptable level (5 mg/L) for salmonids, exceptions to this would occur four to eight weeks following drawdown of J.C. Boyle and Iron Gate reservoirs (i.e., in February 2020), when dissolved oxygen would remain below 5 mg/L from Iron Gate Dam to near the confluence with the Shasta River (RM 176.7), or for a distance approximately 20–25 km downstream of the dam. Recovery to the North Coast Basin Plan water quality objective of 90 percent saturation (i.e., 10–11 mg/L) would occur within a distance of 100–150 km (62–93 mi) downstream of Iron Gate Dam, or generally in the reach from Seiad Valley to the mainstem confluence with Clear Creek, and would therefore not effect dissolved oxygen in the estuary or the nearshore environment. **The Proposed Action's incremental contribution to the short-term significant cumulative effect associated with reductions in dissolved oxygen in the lower Klamath River during reservoir drawdown would not be cumulatively considerable.**

*Removal of the Four Facilities under the Proposed Action could cause long-term (2–50 years following dam removal) increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach and in the lower Klamath River, particularly for the reach immediately downstream of Iron Gate Dam.* Modeling conducted for development of the Oregon and California Klamath River TMDLs indicates that under the Proposed Action (similar to the TMDL TOD2RN scenario), dissolved oxygen concentrations in the Hydroelectric Reach downstream of J.C. Boyle Dam and at the Oregon-California state line would be slightly greater during July through October than those under the No Action/No Project (similar to the TMDL T4BSRN scenario), due to the removal of J.C. Boyle Reservoir (Figure 3.2-15 and Figure 3.2-16; NCRWQCB 2010a). Additionally, the removal of the Four Facilities under the Proposed Action would cause long-term increases in summer and fall dissolved oxygen in the lower Klamath River immediately downstream of Iron Gate Dam, along with potentially increasing daily variability. Effects would diminish with distance downstream of Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen by the confluence with the Trinity River.

As noted above, dissolved oxygen is a significant cumulative impact for the Klamath River. The Proposed Action's contribution to this cumulative effect would be beneficial as it would increase long-term dissolved oxygen and daily variability in dissolved oxygen. **The Proposed Action's incremental contribution to the long-term significant cumulative effect associated with increases in dissolved oxygen in the lower Klamath River would be beneficial.**

### **pH**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in summertime pH in the Hydroelectric Reach. Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in long-term (2–50 years following dam removal) summertime increases in pH in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment.* Klamath TMDL model results indicate that under the Proposed Action, pH in the Hydroelectric Reach immediately downstream of J.C. Boyle Dam would be the same as pH levels modeled under the No Action/No Project, with the potential for some decreases in minimum daily values. At the Oregon-California state line, pH levels under the Proposed Action would be roughly the same as those predicted under the No Action/No Project, but with less daily variability during spring (March–May) and fall (October–November) due to the removal of reservoir habitat for suspended algal growth. These decreases in daily minimum values would be beneficial.

Long-term summertime increases in pH could occur under the Proposed Action from Iron Gate Dam to the Scott River (RM 143). There would be no effect on pH in the short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) for the Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the marine nearshore environment.

Currently, reaches upstream of the Hydroelectric Reach (i.e., from RM 231 to RM 251, Upper Klamath Lake, Agency Lake, and the Sprague River) are included on Oregon's 303(d) list for pH, but the Hydropower Reach itself is not identified as impaired. A variety of different cumulative actions could contribute to changes in pH. Increased snowmelt or increased large storm events with heavy precipitation due to climate change, agricultural runoff, and acid rain could change pH in the lower Klamath River. As the newly restored river erodes the river channel, the geology of the materials being eroded could alter the pH. Increases in pH could also occur from enhanced periphyton growth and increased rates of photosynthesis. These actions, considered together with the Proposed Action, could substantially change pH levels and result in significant cumulative water quality effects associated with pH.

The Proposed Action's contribution to the cumulative effect would be minimal. In the Hydroelectric Reach, there would be less daily variability of pH, and this would be beneficial. Predicted differences in pH between the Proposed Action and No Action/No Project Alternative decrease in magnitude with distance downstream of Iron Gate Dam,

and would no longer be evident by Seiad Valley. The Hoopa Valley Tribe water quality objective for pH (7.0-8.5) (see Table 3.2-6) is met at all times under the Proposed Action (similar to the TMDL TCD2RN scenario) for the Klamath River at the reach of Hoopa jurisdiction ( $\approx 45-46$ ). Therefore, under the Proposed Action, pH would not be affected in the lower river downstream of Seiad Valley, including the Klamath Estuary and the marine nearshore environment.

Although the California Klamath River TMDL model predicts long-term increases in pH due to enhanced periphyton growth and increased rates of photosynthesis immediately downstream of Iron Gate Dam, this condition may be counteracted by increased scour and lack of nutrient availability at this location under the Proposed Action (see Section 3.4, Algae). Given the uncertainty in the model output from Iron Gate Dam to the Shasta River, and given the localized and instantaneous nature of the predicted high pH levels during summer months, these long-term pH increases would not be substantial. **The Proposed Action's incremental contribution to the significant cumulative effect associated with pH would be beneficial for the Hydroelectric Reach, and would not be cumulatively considerable from Iron Gate Dam to the Klamath River Estuary and marine nearshore environment.**

#### **Chlorophyll-a and Algal Toxins**

*Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in levels of chlorophyll-a and algal toxins in the Hydroelectric Reach, the lower Klamath River, and the Klamath Estuary.* Elimination of the lacustrine (reservoir) environment that currently supports growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* would result in decreases in high seasonal concentrations of chlorophyll-a ( $>10 \mu\text{g/L}$ ) and periodically high levels of algal toxins ( $> 8 \mu\text{g/L}$  microcystin) generated by suspended blue-green algae. While algal toxins and chlorophyll-a produced in Upper Klamath Lake may still be transported into the Hydroelectric Reach at levels exceeding water quality objectives for Oregon and California, additional *in situ* production of the toxins and chlorophyll-a associated with suspended algae would be significantly less likely to occur in the free-flowing river under the Proposed Action.

In the past, chlorophyll-a and algal toxins have resulted in a significant cumulative water quality impact in the Klamath River and have adversely affected aquatic species and human health. The main cumulative actions/projects contributing to chlorophyll-a and algal toxins are the construction of the KHP, which created reservoirs with conditions that promote nuisance algal growth, and nutrient loading from Upper Klamath Lake, as described above for nutrients. The Proposed Action's contribution to this cumulative effect would be beneficial. The Proposed Action would eliminate conditions promoting algal growth through reservoir drawdown and dam removal. **The Proposed Action's incremental contribution to the short-term and long-term significant cumulative water quality effect associated with chlorophyll-a and algal toxins would be beneficial.**

### **Inorganic and Organic Contaminants**

*Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in concentrations of inorganic and organic contaminants and result in low-level exposure for aquatic species in the Hydroelectric Reach, lower Klamath River, Klamath Estuary, and marine nearshore environment. The Proposed Action could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) human exposure to contaminants from contact with deposited sediments on exposed reservoir terraces, river banks in the Hydroelectric Reach, and downstream river banks following reservoir drawdown. Dam deconstruction and revegetation (i.e., hydroseeding) activities could cause short-term (<2 years following dam removal) increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation (i.e., hydroseeding) equipment in the Hydroelectric Reach, lower Klamath River, Klamath Estuary, and marine nearshore environment. Under the Proposed Action, herbicide application associated with management of the reservoir footprint area could result in short-term (<2 years following dam removal) levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach. The Proposed Action would result in the release of organic and inorganic contaminants through reservoir drawdown and the release of sediment, use of hazardous materials associated with construction and revegetation, and the application of herbicides. Short-term pathways of contaminant exposure for freshwater aquatic species include exposure during sediment transit through the Lower Klamath Basin river reaches and the estuary, as well as exposure following initial deposition of sediments in the river and the estuary. Potential human health risks could occur with exposure to sediments deposited on exposed reservoir terraces and river banks within the Hydroelectric Reach.*

In general, information regarding contaminants in the Upper Klamath Basin upstream of the Hydroelectric Reach is very limited. Human activities such as illegal dumping may be a source of inorganic and organic contaminants to the lower Sprague and Williamson river sub-basins (Rabe and Calonje 2009). Natural geologic sources of arsenic may be causing relatively high levels of this chemical element in the Upper Klamath Basin, as is the case in other south central and southeastern Oregon basins (Sturdevant 2010). Other ongoing actions such as agricultural activities that result in the use of herbicides or pesticides, or large forest fires, may contribute to an increase in inorganic and organic contaminants in the Klamath River through surface water runoff or atmospheric deposition. Together, these actions could combine to result in significant cumulative effects associated with inorganic and organic contaminants.

The Proposed Action's incremental contribution to the significant cumulative effects associated with inorganic and organic contaminants would be minimal. Results from the 2009–2010 Secretarial Determination sediment chemistry analyses indicate that sediment deposits associated with the Proposed Action would cause no adverse effects on humans (CDM 2011). Previous studies and the 2009–2010 Secretarial Determination study (CDM 2011) indicate that in the short-term (<2 years following dam removal), one or more chemicals would be present at levels with potential to cause minor or limited adverse effects on freshwater aquatic species. In the long-term, one or more chemicals would be

present, but at levels unlikely to cause adverse effects based on the lines of evidence. Implementation of BMPs for deconstruction and revegetation activities that would occur in or adjacent to the Klamath River would minimize eliminate the potential for toxic substances to enter the water. With respect to bioaccumulation potential, there are no exceedances of applicable marine bioaccumulation screening levels (CDM 2011). Elutriate chemistry results (prior to consideration for mixing and dilution) do not indicate likely toxicity in the marine nearshore environment under the Proposed Action (CDM 2011). **The Proposed Action's incremental contribution to the significant cumulative effects associated with inorganic and organic contaminants would not be cumulatively considerable.**

### **KBRA**

*Implementation of the Phase I Fisheries Restoration Plan could result in long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels. Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I. Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction. Implementation of Wood River Wetland Restoration could result in warmer long-term spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake. Implementation of Water Diversion Limitations could result in long-term decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach. Implementation of the WURP could result in long-term decreases in summer water temperature and nutrient inputs to Upper Klamath Lake. Implementation of the Interim Flow and Lake Level Program could result in long-term decreases in summer water temperature and nutrient inputs to Upper Klamath Lake. Implementation of the Upper Klamath Lake and Keno Nutrient Reduction Program could result in long-term decreases in nutrient inputs, increases in seasonal dissolved oxygen, and decreases in concentrations of nuisance algal species in these waterbodies. Many KBRA actions have the potential to affect water quality conditions in the various waterways of the Klamath Basin.*

As noted above, temperature, sediment, nutrients, and dissolved oxygen continue to represent significant adverse cumulative water quality effects for the Klamath River. A variety of actions, mainly human-related activities, have contributed to these cumulative impacts. There are also many ongoing actions in the Klamath Basin to improve water quality, including the implementation of TMDLs on the Scott, Salmon, Shasta, and Klamath Rivers as noted in Table 4-3, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004), and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, and the Five Counties Road Maintenance Program. Additionally, the

Northwest Forest Plan contains provisions for reducing water quality impacts from timber harvesting and road construction. Together these cumulative actions and programs would contribute to improving water quality in the Klamath Basin. Removal of the Four Facilities is also expected to help improve water quality by restoring the reservoirs to a more natural river system and reducing conditions that promote algal growth.

The KBRA's incremental contribution to the cumulative effects on water quality would be minimal in the short-term and would generally be beneficial in the long-term. In the short-term, some of the KBRA actions could require construction activities that would have the potential to adversely affect water quality. However, best management practices would be implemented to reduce or avoid water quality impacts. In the long-term, the KBRA actions are intended to be beneficial to water quality by improving water temperatures, reducing fine sediment and nutrient inputs, and increasing dissolved oxygen levels. **The KBRA's incremental contribution to the significant cumulative effects on water quality would not be cumulatively considerable in the short-term, and would be beneficial in the long-term.**

#### **4.4.1.2 Alternatives 3, 4, and 5**

Alternatives 3 and 5 would have similar cumulative short-term and long-term effects on water quality (i.e., water temperature, suspended sediments, nutrients, dissolved oxygen, pH, chlorophyll-a, algal toxins, and inorganic and organic contaminants) as the Proposed Action. Although only two reservoirs are removed under Alternative 5, they are the two largest reservoirs in the Hydroelectric Reach and are responsible for the majority of water quality impacts under existing conditions. Alternative 4 would leave all four reservoirs in place. No short-term cumulative effects associated with high suspended sediment concentrations and low dissolved oxygen due to reservoir drawdown would occur under Alternative 4; however, long-term water quality would not improve and therefore there would be no cumulative benefits. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.1.3 Mitigation Measures**

There would be short-term cumulatively considerable impacts associated with suspended sediment and decreased dissolved oxygen levels during drawdown under the Proposed Action, the Partial Facilities Removal of Four Dams Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. No feasible mitigation is possible to reduce the impacts during reservoir drawdown. Suspended sediment concentrations and dissolved oxygen levels would remain cumulatively considerable water quality impact for up to 1-2 months during reservoir drawdown.

#### **4.4.2 Aquatic Resources**

Cumulative effects on aquatic resources could be caused by short-term and long-term effects on water and quality and habitat associated with the project, combined with other projects/actions in the Klamath Basin that could contribute to adverse aquatic resources effects. The timeframe for short-term construction related cumulative effects analysis is the duration of deconstruction and up to 10 months after reservoir drawdown, as suspended sediments are expected to remain elevated. The timeframe for long-term cumulative effects is indefinitely after construction as conditions for aquatic species would be permanently altered with implementation of any of the proposed alternatives.

Table 4-6 presents a summary of the aquatic resources impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects.

##### **4.4.2.1 Alternative 2: Full Facilities Removal of Four Dams**

###### **Critical Habitat**

*The Proposed Action would alter the availability of critical habitat, which could affect aquatic species.*

###### **Coho Salmon Critical Habitat**

Under the Proposed Action, elevated levels of SSCs occurring during 3 to 4 months of drawdown would degrade critical habitat for coho salmon in the short-term.

Agricultural water diversions, timber harvesting, man-made barriers such as dams, mining, road building, livestock grazing, and streambed alteration have contributed to the degradation of coho salmon critical habitat (64 Federal Register 24049). While no specific activities have been identified that would affect coho salmon critical habitat during reservoir drawdown, ongoing activities such as agriculture, water diversions, and mining, and poor water quality could all contribute to the degradation of critical habitat. Degradation of critical habitat is therefore a significant cumulative impact in the short-term.

The Proposed Action's contribution to the significant cumulative effect on critical habitat would be substantial. There would be 3 to 4 months of high suspended sediment concentrations that would degrade critical habitat for coho salmon.

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Critical Habitat</b>				
Continued impoundment of water within the reservoirs could alter the water quality and habitat suitability within critical habitat.	1,4	NCFEC (coho) NCFEC (Bull Trout and Southern Resident Killer Whale)	None	NCFEC (coho) NCFEC (Bull Trout, Southern Resident Killer Whale)
Reservoir drawdown associated with dam removal could alter the quality of critical habitat.	2, 3, 5	S (short-term for coho) LTS (Bull Trout and Southern Resident Killer Whale)	None	S (short-term for coho) LTS (Bull Trout and Southern Resident Killer Whale)
The removal of dams and reservoirs could alter the availability and quality of critical habitat.	2,3,5	B (coho) LTS (Bull Trout and Southern Resident Killer Whale)	None	B (coho) LTS (Bull Trout, Southern Resident Killer Whale)
<b>Essential Fish Habitat</b>				
Continued impoundment of water within the reservoirs could alter the availability and suitability of Essential Fish Habitat (EFH).	1, 4	NCFEC (Chinook and coho salmon EFH) NCFEC (Groundfish EFH, Pelagic Fish)	None	NCFEC (Chinook and coho salmon EFH) NCFEC (Groundfish EFH, Pelagic Fish)
Reservoir drawdown associated with dam removal could alter the quality of EFH.	2, 3, 5	S (short-term for Chinook and coho) LTS (groundfish and pelagic fish)	None	S (short-term for Chinook and coho) LTS (groundfish and pelagic fish)
The removal of dams and reservoirs could alter the availability and quality of EFH.	2, 3, 5	B (Chinook and coho) LTS (groundfish and pelagic fish)	None	B (Chinook and coho) LTS (groundfish and pelagic fish)
<b>Construction-Related Impacts</b>				
Disturbance to the river channel during construction could affect aquatic species.	2, 3, 4, 5	LTS	None	LTS
The Proposed Action will require the relocation of the City of Yreka water supply pipeline.	2, 3, 5	LTS	None	LTS

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Species Impacts</b>				
<b>Fall-Run Chinook</b>				
Continued impoundment of water within the reservoirs alters habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect fall-run Chinook salmon.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	LTS
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect fall-run Chinook salmon.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect fall-run Chinook salmon.	4	B	None	B
<b>Spring-Run Chinook</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect spring-run Chinook salmon.	2, 3, 5 (would only remove Copco 1 and Iron Gate)	LTS	AR-2: Protection of outmigrating juveniles	LTS

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect spring-run Chinook salmon.	2, 3, 5 (would only remove Copco 1 and Iron Gate)	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect spring-run Chinook salmon.	4	B	None	B
<b>Coho Salmon</b>				
Continued impoundment of water within reservoirs at the Four Facilities could alter habitat suitability affecting aquatic species.	1	NCFEC (for all population units)	None	NCFEC (for all population units)
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC (for all population units)	None	NCFEC (for all population units)
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect coho salmon.	2, 3, 5 (would only remove Copco 1 and Iron Gate)	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units) LTS (Trinity River, Salmon River, and Lower Klamath River population units)	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units) LTS (Trinity River, Salmon River, and Lower Klamath River population units)
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect coho salmon.	2, 3, 5 (would only remove Copco 1 and Iron Gate)	B (Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River population units) LTS (Trinity River population units)	None	B (Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River population units) LTS (Trinity River population units)

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Fish ladders could result in alterations in habitat availability which could affect coho salmon.	4	B (Upper Klamath River population unit) NCFEC (Mid-Klamath River, Shasta River, Scott River, Salmon River, Trinity River, and Lower Klamath River population units)	None	B (Upper Klamath River population unit) NCFEC (Mid-Klamath River, Shasta River, Scott River, Salmon River, Trinity River, and Lower Klamath River population units)
<b>Steelhead</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect steelhead in the short-term.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect steelhead.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect steelhead.	4	B	None	B
<b>Pacific Lamprey</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect Pacific lamprey in the short-term.	2, 3, 5	S	(Alternative 2 only) AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect Pacific lamprey.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect Pacific lamprey.	4	B	None	B
<b>Green Sturgeon</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect green sturgeon.	2, 3, 5	S	AR-3: Fall flow pulses	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect green sturgeon.	2, 3, 5	LTS	None	LTS
Fish passage provisions could result in alterations in habitat availability which could affect green sturgeon.	4	NCFEC	None	NCFEC

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Lost River and Shortnose Sucker</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
	4	LTS	None	LTS
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir removal associated with dam removal could alter habitat availability and affect lost river and shortnose suckers	2, 3, 5	S (short term)	AR-6: Sucker rescue and relocation	LTS
Restoration action associated with KBRA implementation could alter habitat availability and suitability and affect lost river and shortnose suckers.	2	B	None	B
Construction of fishways could affect shortnose and Lost River Sucker populations by continuing poor water quality and high rates of predation.	4	LTS	None	LTS
<b>Redband Trout</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect redband trout.	2, 3, 5	LTS	None	LTS
Removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, which could affect redband trout.	2, 3, 5	B	None	B

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Fish passage provisions could result in alterations in habitat availability which could affect redband trout.	4	B	None	B
<b>Bull Trout</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Dam removal and/or fish passage could alter habitat access for anadromous fish, which could affect bull trout.	2, 3, 4, 5	LTS	None	LTS
<b>Eulachon</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1, 4	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect eulachon.	2, 3, 5	LTS	None	LTS
<b>Longfin Smelt</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1, 4	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect longfin smelt.	2, 3, 5	LTS	None	LTS
<b>Introduced Resident Species</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1, 4	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Fish passage provisions could result in alterations in habitat availability which could affect introduced resident species.	4	NCFEC	None	NCFEC
Mandatory conditions and provisions for continued hydroelectric operations could alter habitat suitability affecting introduced resident species.	4	LTS	None	LTS
<b>Freshwater Mussels</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect freshwater mussels in the short-term.	2, 3, 5	S	AR-7: Freshwater mussel relocation	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect freshwater mussels in the long-term.	2, 3, 5	B	None	B
Dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional riverine habitat within the Hydroelectric Reach.	4	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect freshwater mussels.	4	NCFEC	None	NCFEC
<b>Benthic Macroinvertebrates</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect macroinvertebrates.	2, 3, 5	S	None	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect macroinvertebrates.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect macroinvertebrates.	4	NCFEC	None	NCFEC
Implementation of trap and haul measures could affect aquatic species.	4, 5	B (fall-run Chinook)	None	B (fall-run Chinook)
<b>Interim Measures</b>				
IM 7, implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement could result in alterations to habitat quality and affect aquatic species.	1, 2, 3	B – Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units NCFEC – green sturgeon, eulachon, southern Resident Killer Whales	None	B – Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units NCFEC – green sturgeon, eulachon, southern Resident Killer Whales

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
IM 8, implementation of J.C. Boyle Bypass Barrier removal could result in alterations to habitat availability, and affect aquatic species.	1, 2	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units NCFEC – macroinvertebrates, freshwater muscles, green sturgeon, eulachon, southern Resident Killer Whales	None	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units)  LTS – all other Coho population units NCFEC – macroinvertebrates, freshwater muscles, green sturgeon, eulachon, southern Resident Killer Whales
IM 16, implementation of the interim measure Water Diversions could result in alterations to habitat availability and habitat quality and affect aquatic species.	3	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, southern Resident Killer Whales	None	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units)  LTS – all other Coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, southern Resident Killer Whales
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>East and Westside Facilities</b>				
Decommissioning the East and West Side Facilities could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC
<b>Klamath Basin Restoration Agreement</b>				
Implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could result in alterations to water quantity, water quality, habitat availability and habitat quality, and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers, coho salmon except for the Trinity River Populations); NCFEC (green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels); LTS (coho Trinity River)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers, coho salmon except for the Trinity River Populations); NCFEC (green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels); LTS (coho Trinity River)

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Implementation of Phase I of the Fisheries Reintroduction and Management Plan could result in alterations to habitat availability (fish access), and could affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, benthic macroinvertebrates, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, and freshwater mussels); LTS (redband trout)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, benthic macroinvertebrates, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, and freshwater mussels); LTS (redband trout)
Implementation of Water Diversion Limitations could result in reducing uncertainties associated with maintaining adequate ecological flows for aquatic species and their habitats, especially in low-flow years, and could alter water quality and water temperatures in certain seasons and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Implementation of On-Project Plan could result in alterations to water quantity and water quality and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)
The Water Use Retirement Program could alter water quantity and water quality, and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Implementation of the Fish Entrainment Reduction could result in alterations to potential alterations to mortality risk and affect aquatic species.	2, 3	B (shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey, coho salmon from the Upper Klamath River population unit); NCFEC (all other coho salmon population units, green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey, coho salmon from the Upper Klamath River population unit); NCFEC (all other coho salmon population units, green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)
Implementation of the Klamath River Tribes Interim Fishing Site could result in alterations to managed harvest mortality of fish species that are culturally important to the Klamath River Tribes,	2, 3	NCFEC	None	NCFEC

**Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2,3	N/A	None	N/A

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable
- SSC = suspended sediment concentrations

However, in the long-term, the Proposed Action would increase the amount of habitat available to coho salmon upstream of currently designated critical habitat and improve habitat quality within current critical habitat. Bedload movement following dam removal would cause substantial aggradation and increase supply of gravel below the dam as far downstream as Cottonwood Creek. This effect would potentially improve critical habitat for coho salmon by reducing median substrate to a size more favorable for spawning (Reclamation 2011). Other cumulative actions and programs that could benefit critical habitat for coho salmon include the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat and may benefit coho salmon critical habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve critical habitat for coho salmon. Together, these actions and the Proposed Action would result in cumulatively beneficial impacts on coho salmon critical habitat. **The Proposed Action's incremental contribution to the significant cumulative effect on coho salmon critical habitat would be cumulatively considerable in the short-term during reservoir drawdown, and would be beneficial in the long-term. No feasible mitigation is available to reduce the short-term significant cumulative impacts; therefore they remain cumulatively considerable.**

#### **Bull Trout Critical Habitat**

Implementation of the Proposed Action would not affect the physical or chemical components of bull trout critical habitat, but would allow Chinook salmon and steelhead to access areas they have not been able to access since the completion of the Copco 1 Development in 1918. These species would potentially compete with and prey upon bull trout fry and juveniles; however, bull trout would also be expected to consume the eggs and fry of Chinook salmon and steelhead. These species co-evolved in the watershed together, and it is anticipated that they would be able to co-exist in the future.

Past and present threats to bull trout critical habitat include channelization, water withdrawals, removal of streamside vegetation, elevated water temperatures, and increased sedimentation (United States Fish and Wildlife Service [USFWS] 2002). Degradation of bull trout critical habitat is a significant cumulative impact.

The Proposed Action would not physically alter the bull trout critical habitat. **The Proposed Action's incremental contribution to the significant cumulative effect on bull trout critical habitat would not be cumulatively considerable in the short- or long-term.**

#### **Southern Resident Killer Whale Critical Habitat**

The Klamath River contributes to critical habitat for Southern Resident Killer Whales through its contribution of Chinook salmon to their food supply. The Proposed Action would not affect the geographic extent of critical habitat for this species, as it is located in the state of Washington. The Proposed Action is expected to increase wild populations

of anadromous salmonids, which could increase food supply for Southern Resident Killer Whale.

One of the Primary Constituent Elements for the Southern Resident Killer Whale critical habitat is “Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth” (National Oceanic and Atmospheric Administration [NOAA] Fisheries Service 2006). The Southern Resident Killer Whale population has declined substantially since the mid-to late 1800s. The declining population is partially attributed to a decline in food sources, including stocks of fish, whales, and pinnipeds (NOAA Fisheries Service 2006). Changes to salmon populations, one of their main food sources, are therefore considered a significant cumulative effect on critical habitat.

The Proposed Action’s contribution to the cumulative effect would be minimal. While the Proposed Action is anticipated to increase salmon populations, the Klamath River salmon are anticipated to provide less than 1 percent of the diet of Southern Resident Killer Whale in most months. **The Proposed Action’s incremental contribution to the significant cumulative effect on Southern Resident killer whale critical habitat would not be cumulatively considerable.**

#### Essential Fish Habitat

*The Proposed Action would alter the availability of Essential Fish Habitat (EFH), which could affect aquatic species.*

#### **Chinook and Coho Salmon EFH**

The release of sediment from reservoirs under the Proposed Action would adversely affect Chinook and coho salmon EFH in the short-term during the months when suspended sediment concentrations are elevated. Over the long-term, the Proposed Action would benefit EFH.

Past and present actions have also affected Chinook and coho salmon EFH. Agricultural water diversions, man-made barriers, sedimentation from erosion and runoff, and alteration of stream channels have affected water quality, fish passage, and food sources for salmon. While no other specific activities have been identified that would affect salmon EFH during reservoir drawdown, existing practices such as agriculture, water diversions, mining, and dredging could all contribute to the degradation of essential habitat. Together these actions have had significant cumulative effects on Chinook and coho salmon EFH.

The Proposed Action’s contribution to the short-term cumulative effect would be substantial. There would be 3 to 4 months of high suspended sediment concentrations that would degrade Chinook and coho salmon EFH.

In the long-term the Proposed Action would increase habitat for Chinook and coho salmon (upstream of currently designated EFH) by providing access to habitats upstream of Iron Gate Dam. Improved access to habitats (upstream of designated EFH) and improved water quality would provide a benefit to EFH for Chinook and coho salmon.

Other cumulative actions and programs that could benefit Chinook and coho salmon EFH include the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat and may benefit Chinook and coho salmon EFH. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve critical habitat for Chinook and coho salmon EFH. Together, these actions and the Proposed Action would result in cumulatively beneficial effects on Chinook and coho salmon EFH. **Overall, the Proposed Action's incremental contribution to the significant cumulative effect on Chinook and coho salmon EFH would be cumulatively considerable in the short-term and would be beneficial in the long-term. No feasible mitigation is available to reduce the short-term significant cumulative impacts; therefore they remain cumulatively considerable.**

#### **Groundfish EFH**

Under the Proposed Action, EFH in the estuary could be affected by elevated turbidity from sediment releases during dam removal for about 3 months. After this time, suspended sediment concentrations would return to levels similar to existing conditions. Suspended sediment concentrations in the estuary would be less than 40 percent of the peak concentrations that are anticipated to occur immediately downstream of Iron Gate Dam. These peaks would still be substantial, and would be higher than the extreme values estimated by the sediment transport model for existing conditions (see Section 3.3.4.5, Aquatic Resources).

Groundfish EFH continues to be adversely affected by commercial fishing. Certain types of common fishing gear, such as trawls, have degraded groundfish EFH. Non-fishing activities that have degraded EFH include mining, dredging, fill, impoundment, discharge, water diversions, thermal additions, actions that contribute to non-point source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH (Pacific Fishery Management Council 2005). Together these actions have resulted in significant cumulative effects on groundfish EFH.

The Proposed Action's contribution to the significant cumulative effects would be short-term. Under the Proposed Project under the most likely to occur scenario, suspended sediment concentrations would be elevated relative to existing conditions, but would last a short duration. In the long term, suspended sediment concentrations would be similar to that under existing conditions. **The Proposed Action's contribution to the significant cumulative effect on EFH would not be cumulatively considerable.**

#### **Pelagic Fish EFH**

The cumulative effects on pelagic fish EFH would be similar to those described for groundfish EFH. **The Proposed Action's contribution to the significant cumulative effect on EFH would not be cumulatively considerable.**

Construction-Related Impacts

*Construction of the Proposed Action could affect aquatic species from use of heavy equipment and explosives, or release of sediment or toxic substances.* These effects could include shockwaves associated with breaking down the dam structure using explosives or heavy equipment, potential crushing of aquatic species from operation of heavy equipment in the river, sedimentation, and release of oil, gasoline, or other toxic substances from construction sites.

Other cumulative actions that could affect aquatic species during construction include agricultural activities, timber harvesting, new road construction, and mining that could increase suspended sediments, and construction projects in the surrounding area such as new subdivisions and road improvements planned in Siskiyou County that could introduce sediments or toxic materials into the river. Together these actions could result in cumulative effects on aquatic species.

The Proposed Action’s contribution to the cumulative effect would not be cumulatively considerable. To reduce these potential construction impacts, construction areas would be isolated from the active river where possible, and water would be routed around the construction area, allowing the flow to move down the other portion of the river, while the isolated portion of the dam is removed. After a work area is isolated, fish rescues to remove any native fish trapped in the work area would be conducted. Fish would be relocated to an area of suitable habitat within the Klamath River. Implementation of soil erosion and sedimentation control and stormwater pollution prevention would minimize soil erosion and water quality effects on anadromous fish downstream of the work area, during and after construction. **The Proposed Action’s incremental contribution to the significant cumulative effects on aquatic resources during deconstruction would not be cumulatively considerable.**

Species-Specific Impacts

*The Proposed Action could affect aquatic species.*

Fall-Run Chinook Salmon

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect fall-run Chinook salmon.* Overall, the effect of the Proposed Action on the fall-run Chinook salmon population, under both most-likely and worst-case scenarios, is expected to be relatively minor. Effects would be distributed over three year-classes, rather than a single year-class. Direct mortality is predicted for 4,600 redds (around 8 percent of total redds in the basin), and for around 669 Type III smolts (< 1 percent of production). In addition, sublethal effects on Type I and Type II outmigrants are predicted.

Significant cumulative effects have occurred to fall-run Chinook salmon in the Klamath Basin. Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting fall-run Chinook salmon include the construction of the KHP and other dams, which have severely reduced access to habitat,

altered water quality, adversely affected channel morphology, and created conditions for toxic algal blooms. Downstream of Iron Gate Dam, the mainstem Klamath River experiences occasional blooms of *Microcystis aeruginosa*. During outmigration, juvenile Chinook salmon are vulnerable to contracting disease from pathogens, including the bacterium *Flavobacterium columnare*, and myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta*. Dams have affected the quality of habitat downstream by preventing spawning gravel from traveling downstream (Moyle et al. 2008), releasing limited, warm, and sometimes toxic water, and dictating unnatural stream morphology or structure. Other cumulative activities that have affected Chinook salmon include agriculture, grazing, water diversions, timber harvesting, mining, suction dredging, discharge of toxic substances such as fertilizers or pesticides into the river, overfishing, disease, and predation. There are also many ongoing cumulative actions and programs that are intended to reduce impacts or benefit Chinook salmon and habitat in the long-term. The implementation of the Klamath Basin TMDLs would improve water quality. The Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program would also help to improve water quality and aquatic habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for Chinook salmon.

The Proposed Action's incremental contribution to the short-term significant cumulative effect on fall-run Chinook salmon would be cumulatively considerable. The Proposed Action's contribution to the cumulative effects would be reduced by implementing Mitigation Measures AR-1 through AR-4 to reduce the short-term impacts of suspended sediment concentrations on fall-run Chinook salmon incubating eggs, and smolts. Additionally, Type-II and Type-III progeny of adults that successfully spawn in tributaries during 2020 would produce smolts that outmigrate to the ocean a year after the spring pulse of suspended sediment in 2020 and should not be noticeably affected by the Proposed Action. However, because of the reduced growth, stress, and high reported mortality for Chinook salmon smolts, the suspended sediment concentrations would still have a substantial cumulative effect in the short-term. **The Proposed Action's incremental contribution to the short-term significant cumulative effect on fall-run Chinook salmon would be cumulatively considerable, even with mitigation. No other feasible mitigation is possible to reduce this impact; therefore this impact remains cumulatively considerable.**

*Under the Proposed Action, removal of dams could alter habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins, all of which could affect fall-run Chinook salmon in the long term. Dam removal would restore connectivity to 420 miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach. It is anticipated that as a result of the Proposed Action, the fall-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity.*

Significant cumulative effects have occurred to fall-run Chinook salmon in the Klamath Basin. Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting fall-run Chinook salmon include the construction of the KHP and other dams, which have severely reduced access to habitat, altered water quality, adversely affected channel morphology, and created conditions for toxic algal blooms. Downstream of Iron Gate Dam, the mainstem Klamath River experiences occasional blooms of *Microcystis aeruginosa*. During outmigration, juvenile Chinook salmon are vulnerable to contracting disease from pathogens, including the bacterium *Flavobacterium columnare*, and myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta*. Dams have affected the quality of habitat downstream by preventing spawning gravel from traveling downstream (Moyle et al. 2008), releasing limited, warm, and sometimes toxic water, and dictating unnatural stream morphology or structure. Other cumulative activities that have affected Chinook salmon include agriculture, grazing, water diversions, timber harvesting, mining, suction dredging, discharge of toxic substances such as fertilizers or pesticides into the river, overfishing, disease, and predation. There are also many ongoing cumulative actions and programs that are intended to reduce impacts or benefit Chinook salmon and habitat in the long-term. The implementation of the Klamath Basin TMDLs would improve water quality. The Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program would also help to improve water quality and aquatic habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for Chinook salmon.

The Proposed Action's contribution to the significant cumulative effects on fall-run Chinook salmon would be beneficial in the long term by providing access to habitat, improving water quality, and generally contributing to an increase in abundance, productivity, population spatial structure, and genetic diversity. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on fall-run Chinook salmon would be beneficial.**

#### **Spring-Run Chinook Salmon**

*Reservoir drawdown associated with dam removal under the Proposed Action could alter suspended sediment concentrations and bedload sediment transport and deposition and affect spring-run Chinook salmon.* The overall effect of suspended sediment from the Proposed Action on the spring-run Chinook salmon population is not anticipated to differ much from existing conditions. There is very little effect on adult migrants, and no effects are anticipated for the spawning, incubation, and fry stages because they do not spawn in the mainstem. Type I and II outmigrants are expected to experience very similar conditions under the Proposed Action as under existing conditions and the No Action/No Project Alternative. However, direct mortality is predicted for around 16 to

28 Type III smolts (< 1 percent of production). In addition, sublethal effects on adult migrants and Type I and Type II outmigrants are predicted.

Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting spring-run Chinook salmon are similar to those described above for fall-run Chinook salmon.

The Proposed Action's incremental contribution to the significant cumulative effect on spring-run Chinook salmon would be cumulatively considerable. However, the cumulative impact would be reduced by implementing Mitigation Measure AR-2 to reduce the short-term impacts of suspended sediments on spring-run Chinook salmon Type III smolts. **With mitigation measures AR-2, the Proposed Action's incremental contribution to the short-term significant cumulative effect on spring-run Chinook salmon from sediment release would not be cumulatively considerable.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect spring-run Chinook salmon in the long term.* Dam removal would restore connectivity to 420 miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach.

Significant cumulative effects have occurred to spring-run Chinook salmon in the Klamath Basin. Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting spring-run Chinook salmon are similar to those described above for fall-run Chinook salmon.

The Proposed Action's incremental contribution to significant cumulative effects on spring-run Chinook salmon would be beneficial. It is anticipated that as a result of the Proposed Action, the spring-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity by providing access to additional habitat and improving water quality. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on spring-run Chinook salmon would be beneficial.**

### **Coho Salmon**

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect coho salmon.* In general, the wide distribution and use of tributaries by both juvenile and adult coho salmon would likely protect the population from the worst effects of the Proposed Action. However, direct mortality is anticipated for around 13 redds, or 0.7–26 percent of Upper Klamath River Population unit natural escapement. Direct mortality is also anticipated for 2,668

smolts under the most-likely to occur scenario, or 6,536 smolts under a worst-case scenario. This equates to no mortality for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios, and 9 percent of the production from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units, or 22 percent under a worst-case scenario. Sublethal effects are anticipated for all other life-stages. All population units would be expected to recover from these losses within one or two generations, given the long-term benefits described below. Although no single year-class is expected to be completely lost, mortality of a portion of the smolt outmigration from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units may affect the strength of the 2018 year class, requiring two or three generations to recover from losses.

Significant cumulative effects have occurred to coho salmon in the Klamath Basin. Coho salmon population levels have declined significantly over the last 100 years, and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). A large variety of actions have contributed to significant cumulative adverse effects on coho salmon, including the KHP, which has blocked habitat and resulted in direct entrainment mortality of juvenile salmonids. Additionally, alterations of the natural flow regimes have increased water temperatures, depleted flows necessary for migration, spawning, rearing, flushing of sediments from spawning gravels, gravel recruitment and transport of large woody debris. Land use activities in the Klamath Basin such as logging, road construction, urban development, mining, agriculture, and recreation have altered habitat quantity and quality, resulting in increased stream bank erosion, increased sedimentation input and loss of channel complexity (NOAA Fisheries Service Undated). Some ongoing actions would also benefit coho salmon in the long-term include implementation of Klamath Basin TMDLs to improve water quality, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for coho salmon.

The Proposed Action's incremental contribution to the cumulative effect would be cumulatively considerable; however it would be lessened by implementing Mitigation Measures AR-1 through AR-4 to reduce the short-term impacts of suspended sediment concentrations on coho salmon adults, incubating eggs, and smolts. With implementation of mitigation measures there would still be short term effects for coho salmon including direct mortality to as high as 18 percent of the smolts from some population units under a worst-case scenario. **The Proposed Action's incremental contribution to the short-term significant cumulative effect on coho salmon would remain cumulatively considerable even with mitigation AR-1 through AR-4. No additional feasible mitigation is available to further reduce this cumulative impact; therefore it remains cumulatively considerable.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect coho salmon in the long term.* Dam removal would restore connectivity to habitat on the mainstem Klamath River up to and including Spencer Creek and would create additional habitat within the Hydroelectric Reach. It is anticipated that as a result of the Proposed Action the Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River coho salmon population units would have an increase in abundance, productivity, population spatial structure, and genetic diversity. It is anticipated that as a result of the Proposed Action the three Trinity River population units would have increased productivity.

Significant cumulative effects have occurred to coho salmon in the Klamath Basin. Coho salmon population levels have declined significantly over the last 100 years, and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). A large variety of actions have contributed to significant cumulative adverse effects on coho salmon, including the KHP, which has blocked habitat and resulted in direct entrainment mortality of juvenile salmonids. Additionally, alterations of the natural flow regimes have increased water temperatures, depleted flows necessary for migration, spawning, rearing, flushing of sediments from spawning gravels, gravel recruitment and transport of large woody debris. Land use activities in the Klamath Basin such as logging, road construction, urban development, mining, agriculture, and recreation have altered habitat quantity and quality, resulting in increased stream bank erosion, increased sedimentation input and loss of channel complexity (NOAA Fisheries Service Undated). Some ongoing actions would also benefit coho salmon in the long-term include implementation of Klamath Basin TMDLs to improve water quality, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for coho salmon.

Based on increased habitat availability and improved habitat quality, **the Proposed Action's incremental contribution to the significant long-term cumulative effects on coho salmon would be beneficial for the coho salmon from the Upper Klamath River, Mid-Klamath River, Lower Klamath River, Shasta River, Scott River, and Salmon River population units in the long-term and would not be cumulatively considerable for coho salmon from the three Trinity River population units in the long-term.**

**Steelhead**

*Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect steelhead.* Effects of suspended sediment resulting from the Proposed Action on steelhead are likely to be high for the portion of the population that spawns in tributaries upstream of the Trinity River. For that portion of the population, effects are anticipated for at least six year-classes, including on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and outmigrating smolts.

Significant cumulative effects have occurred on steelhead populations in the Klamath River, including degraded habitat, decreased habitat access, fish passage, predation, and competition (Moyle et al. 2008). Steelhead populations are generally believed to have decreased since the early 1900's. This is likely due to degraded habitat and blocked tributaries (National Research Council 2004).

The Proposed Action's incremental contribution to the cumulative effect on steelhead would be cumulatively considerable; however it would be reduced by the implementation of Mitigation Measures AR-2 and AR-3. These measures would reduce the short-term impacts of suspended sediment concentrations on steelhead adults and outmigrating juveniles. Additionally, the broad spatial distribution of steelhead in the Klamath basin and their flexible life history suggests that some would avoid the most serious effects of the Proposed Action by (1) remaining in tributaries for extended rearing, (2) rearing farther downstream where SSC should be lower due to dilution (e.g., the progeny of the adults that spawn in the Trinity River basin or tributaries downstream of the Trinity River), and/or (3) moving out of the mainstem into tributaries and off-channel habitats during winter. In addition, the life-history variability observed in steelhead means that, although numerous year classes would be affected, not all individuals in any given year class would be exposed to the effects of the Proposed Action. In addition, some portion of the progeny of those adults that spawn successfully would rear in tributaries long enough to not only avoid the most serious impacts of the Proposed Action in 2020, but may also not return to spawn for up to two years, when any suspended sediment resulting from the Proposed Action should be greatly reduced. The high incidence of repeat spawning among summer-run steelhead (ranging from 40 to 64 percent, Hopelain 1998) should also increase that population's resilience (including all year classes) to effects of the Proposed Action. However, because of the potential for reduction in the abundance of a year class in the short-term, **the Proposed Action's incremental contribution to the significant cumulative effects on summer and winter steelhead would be cumulatively considerable even with mitigation measures AR-2 and AR-3. No other feasible mitigation is available to reduce this impact; therefore it remains cumulatively considerable.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and algal toxins which could affect steelhead in the long term.* Dam removal would restore connectivity to 496 miles of historical habitat in the Upper Klamath Basin and would create additional habitat within the Hydroelectric Reach. It is anticipated that as a result of the Proposed Action

the summer and winter steelhead within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. Other cumulative actions that would also benefit steelhead in the long-term include implementation of Klamath Basin TMDLs to improve water quality. Together, these actions could benefit steelhead in the long-term. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on steelhead would be beneficial.**

### **Pacific Lamprey**

*Proposed Action could alter suspended sediment concentrations and bedload sediment transport and deposition and affect Pacific lamprey.* The elevated suspended sediment concentrations under the Proposed Action could adversely affect the Lamprey population. Because multiple year classes of lamprey rear in the mainstem Klamath River at any given time, and since adults would migrate upstream over the entire year, including January 2020 when effects from the Proposed Action would be most pronounced, effects on Pacific lamprey adults and ammocoetes could be high in the mainstem Klamath River. However, most of the population would likely avoid the most severe suspended sediment pulses resulting from the Proposed Action. In addition, Pacific lamprey are considered to have low fidelity to their natal streams, and may not enter the mainstem Klamath River if environmental conditions are unfavorable in 2020. Migration into the Trinity River and other lower Klamath River tributaries may also increase during 2020 because of poor water quality. Low fidelity also increases the potential that lamprey can recolonize mainstem habitat if ammocoetes rearing there suffer high mortality. The Proposed Action's incremental contribution to the short-term cumulative effect on Pacific lamprey would be cumulatively considerable. Implementation of Mitigation Measures AR-2 and AR-5 would be implemented to reduce the short-term impacts of suspended sediment concentrations on lamprey ammocoetes. However, because of the potential for high mortality for multiple year classes of ammocoetes in the mainstem, **the Proposed Action's incremental contribution to the short-term significant cumulative effect on lamprey would remain cumulatively considerable even with mitigation measures AR-2 and AR-5. No other feasible mitigation is available to reduce this impact; therefore it would be cumulatively considerable.**

*Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation which could affect Pacific lamprey in the long term.* The Proposed Action would provide access to habitat in the Hydroelectric Reach and tributaries to this reach. It is anticipated that as a result of the Proposed Action the Pacific lamprey population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. **The Proposed Action's incremental contribution to the long-term significant cumulative effect on Pacific lamprey would be beneficial.**

**Green Sturgeon**

*The Proposed Action would have short-term effects related to suspended sediment concentrations and water quality that could affect green sturgeon. Up to 100 percent mortality is predicted for incubating eggs and larval life stages, and up to 20 percent mortality is predicted for rearing juveniles under a most-likely-to-occur scenario, or up to 40 percent mortality under a worst-case scenario. Overall, the effects of the Proposed Action are most likely to include physiological stress, inhibited growth, and high mortality for some portion of the age-0 2020 cohort and age 1 2019 cohort.*

Green sturgeon populations have severely decreased over time, and while little information is available on the cumulative impacts to green sturgeon, because of their small population, it is assumed that green sturgeon have experienced significant adverse cumulative effects.

The Proposed Action's incremental contribution to the short-term cumulative effect on green sturgeon would be cumulatively considerable. Mitigation Measure AR-3 would be implemented to reduce the short-term impacts of suspended sediment concentrations on green sturgeon adults post-spawning; however, there would still be short-term impacts to green sturgeon including lethal and sublethal effects. **The Proposed Action's incremental contribution to the short-term significant cumulative effects on green sturgeon would remain cumulatively considerable even with mitigation measure AR-3. No other mitigation is available to reduce suspended sediment concentrations; therefore this impact remains cumulatively considerable.**

*In the long term, under the Proposed Action, a more natural flow regime would improve water quality and reduce proliferation of algal toxins, which could affect green sturgeon. It is anticipated that as a result of the Proposed Action the green sturgeon population within the Klamath River watershed would have an increased productivity based on improved habitat conditions. As noted above, significant cumulative effects on green sturgeon exist due to their small population. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on green sturgeon would not be cumulatively considerable.***

**Lost River and Shortnose Sucker**

*Reservoir removal associated with dam removal under the Proposed Action could alter habitat availability and affect Lost River and shortnose suckers. The Proposed Action would eliminate reservoir habitat for the Lost River and shortnose suckers. Lost River and shortnose suckers have experienced significant cumulative effects from loss of habitat and decline in general water quality. Toxic algal blooms have also resulted in large fish kills. Water reclamation projects that have removed a substantial number of wetlands in the Upper Klamath Basin have severely affected the quantity and quality of sucker habitat. Water diversions, dredging of Upper Klamath Lake, and the draining of marshes have also contributed to cumulative effects on suckers.*

The Proposed Action's incremental contribution to cumulative effects on Lost River and shortnose suckers would be cumulatively considerable. Impacts to these suckers would

be minimized by implementing Mitigation Measure AR-6 and removing individuals prior to reservoir drawdown. While some individuals could still be lost, the individuals downstream of Keno Dam have little or no successful reproduction (Buettner et al. 2006), and no connection to upstream populations, and do not contribute substantially to the achievement of conservation goals or recovery (Hamilton et al. 2010). **The Proposed Action's incremental contribution to significant short-term significant cumulative effects on Lost River and shortnose suckers would not be cumulatively considerable with implementation of mitigation measure AR-6.**

### **Redband Trout**

*The Proposed Action would have short-term effects related to suspended sediment concentrations and bed load movement that could affect redband trout.* Redband trout in riverine reaches between the reservoirs in the Hydroelectric Reach would be vulnerable to sublethal and lethal effects of sediment released during dam removal and bed load deposition.

Redband trout in the Klamath River have experienced significant adverse cumulative effects. The construction of the KHP has obstructed passage and reduced habitat, and has also adversely altered stream flows and water quality. Other past and present cumulative impacts to Redband trout in the Klamath River include agricultural and timber harvesting practices which have degraded stream habitat, channelization and sedimentation of the river, irrigation, and water diversions. As a result of these impacts, some streams and populations are fragmented and have lost connection to lakes and marshes (Oregon Department of Fish and Wildlife 2010).

The Proposed Action's contribution to cumulative effects on redband trout would be short-term and minimal. While the release of sediment could affect this species, a large proportion of the adult population should be already spawning in Spencer or Shovel creeks during the dam removal. Juvenile redband trout outmigrating from Spencer Creek would be expected to recolonize the mainstem by late spring or summer when water conditions become suitable. The initial movement of coarse and fine sediment after drawdown would likely create adverse conditions for redband trout within the mainstem Klamath River, but these conditions would be short-term. **Therefore, the Proposed Action's incremental contribution to significant cumulative effects on redband trout would not be cumulatively considerable in the short-term.**

*Dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional riverine habitat within the Hydroelectric Reach, which could affect redband trout.* As noted above, significant cumulative effects have occurred to redband trout. Based on increased habitat availability and improved habitat quality, the effect of the Proposed Action would be beneficial for redband trout in the long-term. **The Proposed Action's incremental contribution to the significant cumulative impact on redband trout would be beneficial in the long-term.**

**Bull Trout**

*Dam removal associated with the Proposed Action could alter habitat availability for anadromous fish, which could affect bull trout.* Bull trout upstream of Upper Klamath Lake could be affected by increased predation from reintroduced salmonids, but this loss might be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Hamilton et al. 2010).

Bull trout have experienced significant cumulative adverse impacts. Bull trout populations in the Klamath Basin have been severely reduced and fragmented. Cumulative actions and projects that have contributed to their decline include channelization, water withdrawals, removal of streamside vegetation, timber harvesting practices, and other actions that have degraded the aquatic environment by elevating water temperatures, reducing water quantity and quality, and increasing sedimentation. Klamath Basin bull trout face a high risk of extirpation and continue to be threatened by habitat degradation, past and present land use management practices, agricultural water diversions, and competition or hybridization from nonnative brown and brook trout (USFWS 2002).

The Proposed Action's contribution to the significant cumulative effects on predation of bull trout would be counteracted by the increase in food source that would become available from eggs, fry, and juveniles of reintroduced salmonids. Additionally, Buchanan et al. (2011) states that the Proposed Action provides promise for preventing extinction of bull trout and for increasing overall population abundance and distribution. **Therefore, the Proposed Action's incremental contribution to the significant cumulative effect on bull trout would not be cumulatively considerable in the short-term or the long-term.**

**Eulachon**

*The Proposed Action would increase suspended sediments during reservoir drawdown that could have an impact on eulachon.* The Proposed Action would release dam-stored sediment downstream to the Lower Klamath River. Adult eulachon entering the Klamath River after January 2020 might be exposed to elevated suspended sediment concentrations for a portion of their migration period. Short-term decreases in water quality associated with the Proposed Action might affect adults and larvae in the mainstem Klamath River.

Significant cumulative adverse effects have occurred to eulachon populations in the Klamath River. Eulachon abundance in the Klamath River is in decline and eulachon spawning populations have severely declined and may become endangered in the future. The main cumulative impacts that threaten eulachon are identified by NOAA Fisheries Service as climate change impacts and ocean conditions, eulachon bycatch, dams/water diversions, water quality, dredging, and predation (NOAA Fisheries Service 2010). Other substantial cumulative impacts include in-water construction or alterations, including channel modifications, shoreline stabilization, sand and gravel mining, and road building and maintenance and pollution and runoff from industrial activities, urbanization, grazing, agriculture, and forestry operations (NOAA Fisheries Service 2010).

The Proposed Action would have short-term impacts on eulachon from increased suspended sediment concentrations during reservoir drawdown. However, these suspended sediment concentrations are expected to be similar to those encountered about one in ten years under existing conditions. Because eulachon generally occur within 8 miles of the coast and dam-release-related suspended sediment concentrations would decrease in the downstream direction from Iron Gate Dam due to dilution from tributaries, the magnitude of the effect would likely be low. Short-term decreases in water quality associated with the Proposed Action might affect adults and larvae in the mainstem Klamath River. As with suspended sediment concentrations, these effects might be muted by tributary inputs. **The Proposed Action's incremental contribution to the significant cumulative effect would not be cumulatively considerable in the short-term or the long-term.**

### **Longfin Smelt**

*The Proposed Action would increase suspended sediments during reservoir drawdown that could have an impact on longfin smelt in the short-term.* The Proposed Action would release dam-stored sediment downstream to the Lower Klamath River. Longfin smelt entering the Klamath River after January 2020 might be exposed to elevated suspended sediment concentrations.

The overall abundance of longfin smelt has declined to very low levels. Significant adverse cumulative effects on longfin smelt have occurred from diversion of surface water, predation, and bycatch in a commercial fishery. They have also been adversely affected by dredging and sand mining, and are susceptible to adverse effects from toxic substances in the water and in the plankton upon which the fish feed.

The Proposed Action would have short-term impacts on longfin smelt from increased suspended sediment concentrations during reservoir drawdown. However, these suspended sediment concentrations are expected to be similar to those encountered about one in ten years under existing conditions. Because longfin smelt would occur close to the coast and dam-release-related suspended sediment concentrations would decrease in the downstream direction from Iron Gate Dam due to dilution from tributaries, the magnitude of the effect would likely be low. Additionally, there are few confirmed records for longfin smelt in the Klamath River Estuary and none since two fish were collected in 1992 (Moyle et al. 1995 in The Bay Institute Center for Biological Diversity Natural Resources Defense Council 2007). **The Proposed Action's incremental contribution to the significant cumulative effects on longfin smelt would not be cumulatively considerable.**

### **Introduced Resident Species**

*The Proposed Action would eliminate habitat for introduced resident species in the Hydroelectric Reach.* Because these species were introduced and they occur in other nearby water bodies, their loss would not be considered significant from a biological perspective, and would benefit native species. No other cumulative actions or programs would eliminate a substantial amount of habitat in the Klamath River for introduced

resident species. **There would be no significant cumulative effects associated with the loss of habitat for introduced resident species.**

### **Freshwater Mussels**

*The Proposed Action would increase suspended sediments during reservoir drawdown that could have an impact on freshwater mussels.* The Proposed Action could affect freshwater mussels through the release of sediments during reservoir drawdown. Very little information exists on population trends in the Klamath River; therefore, it is difficult to determine if other cumulative actions or projects have contributed to significant cumulative effects on freshwater mussels. For the purposes of this analysis, it is assumed that significant cumulative effects have occurred to freshwater mussels from ongoing activities that have increased suspended sediments in the Klamath River, such as timber harvesting, road construction, mining, and agricultural activities.

The Proposed Action's incremental contribution to this short-term significant cumulative effect would be substantial. The suspended sediment concentrations would cause major physiological stress to freshwater mussels and might result in substantial mortality. The most significant impacts would occur downstream of Iron Gate Reservoir, especially to those individual freshwater mussels or freshwater mussel beds upstream of Orleans and closest to Iron Gate Dam. While it is anticipated that mainstem Klamath freshwater mussel populations would rebound, due to the extended time it takes for freshwater mussels to reach sexual maturity (4 years or more, depending on the species), the reestablishment of freshwater mussel populations within affected reaches might be slow and might not be readily noticeable for some time, possibly a decade or more.

Implementation of Mitigation Measure AR-7 could be implemented to reduce the short- and long-term impacts of the Proposed Action on freshwater mussels. With implementation of mitigation there would still be impacts to a portion of the freshwater mussel population, and there could still be a substantial reduction in the abundance of at least one year class. Based on increased habitat availability and habitat quality in the long term, the effect of the Proposed Action would be beneficial for mussels in the long term. **The Proposed Action's incremental contribution to the short-term significant cumulative effects on freshwater mussels would be cumulatively considerable. The Proposed Action's incremental contribution to the long-term cumulative effects on freshwater mussels would be beneficial.**

### **Benthic Macroinvertebrates**

*The Proposed Action would increase suspended sediments during reservoir drawdown that could have an impact on benthic macroinvertebrates.* Under the Proposed Action, increased suspended sediment concentrations would be expected to result in cumulative effects on filter-feeding benthic macroinvertebrates similar to that as described for freshwater mussels. While a large proportion of macroinvertebrate populations in the Hydroelectric Reach and in the mainstem Klamath River downstream of Iron Gate Dam would be affected in the short term by the Proposed Action, their populations would be expected to recover quickly because of the many sources for recolonization and their rapid dispersion through drift or aerial movement of adults. **The Proposed Action's incremental contribution to the short-term significant cumulative effects on benthic macroinvertebrates would be cumulatively considerable. The Proposed Action's**

**incremental contribution to the long-term cumulative effects on benthic macroinvertebrates would be beneficial.**

**Interim Measures**

*Implementation of IMs 7 (J.C. Boyle Gravel Placement and/or Habitat Enhancement) and 16 (Water Diversions) could result in alterations to habitat availability and habitat quality, and affect aquatic species.* These IMs would increase spawning gravel or habitat upstream of Copco Reservoir and would increase flows in Shovel and Negro Creeks. As described above, past and present cumulative projects have resulted in significant cumulative effects to resident and anadromous fish species. These IMs would provide improvements in habitat quality for resident fish prior to dam removal, and for resident and anadromous species following dam removal. **Therefore, the Proposed Action's incremental contribution to the significant cumulative effects on resident and anadromous fish would be beneficial.**

**KBRA**

*Implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could result in alterations to water quantity, water quality, habitat availability and habitat quality, and affect aquatic species. Implementation of Phase I of the Fisheries Reintroduction and Management Plan could result in alterations to habitat availability (fish access), and could affect aquatic species.* The Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plans are designed to improve habitat for aquatic species. The Phase I Fisheries Reintroduction and Management Plan is intended to support the reintroduction and management of fish in the upper basin during and after implementation of the KHSA.

As described above, significant cumulative effects have occurred to many fish species and habitat in the Klamath Basin. However, there are several ongoing cumulative actions or programs that are intended to improve fisheries in the Klamath River and its tributaries, including the removal of the Four Facilities as part of the KHSA, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. The Northwest Forest Plan contains provisions to reduce impacts from timber harvesting on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4), would also improve fisheries.

The KBRA's incremental contribution to the significant cumulative effects on fisheries would be beneficial. These KBRA actions would improve habitat and potentially increase the number of anadromous fish. Increased anadromous fish abundance, especially Chinook salmon, would result in more prey availability for Southern Resident Killer Whales when the whales are near the Oregon and California coasts. Based on anticipated improvements in water quantity, water quality, habitat availability and habitat quality, these actions would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and

shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units. **The incremental contribution of the Fisheries Restoration Plans, Fisheries Monitoring Plans, and Fisheries Reintroduction and Management Plan to the significant cumulative effects on Klamath Basin fisheries would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Implementation of Water Diversion Limitations could result in reducing uncertainties associated with maintaining adequate ecological flows for aquatic species and their habitats, especially in low-flow years, and could alter water quality and water temperatures in certain seasons and affect aquatic species. Implementation of the On-Project Plan could result in alterations to water quantity and water quality and affect aquatic species.* This component of the KBRA would establish limits on specific diversions within Reclamation's Klamath Project to protect flows in the mainstem and ensure that adequate water supply is available for allocation to the wildlife refuges. This reliable source of cool inflow provides benefit to aquatic species by influencing temperature, dissolved oxygen, algal growth, and the dilution of contaminants or natural toxins, such as those produced by *M. aeruginosa*.

As described above, significant cumulative effects have occurred to many fish species and habitat in the Klamath Basin. However, there are several ongoing cumulative actions or programs that are intended to improve fisheries in the Klamath River and its tributaries, including the removal of the Four Facilities as part of the KHSA, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. The Northwest Forest Plan contains provisions to reduce impacts from timber harvesting on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4), would also improve fisheries.

The KBRA's incremental contribution to the significant cumulative effects on fisheries would be beneficial. Based on anticipated improvements in water quantity and water quality, implementation of Water Diversion Limitations under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units. **The incremental contribution of Water Diversion Limitations to the significant cumulative effects on fisheries would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Implementation of the Fish Entrainment Reduction could result in potential alterations to mortality risk and affect aquatic species.* This KBRA action would involve designing and installing fish screens at Project Diversions, including the Lost River Diversion Channel and associated diversion points, North Canal, Ady Canal, and other Reclamation and Reclamation Contractor diversions.

As noted above, significant cumulative impacts have occurred to Klamath Basin fisheries. Additionally, there are many other cumulative actions and programs that would also restore fisheries and habitat in the Klamath Basin. The Proposed Action's incremental contribution to the significant cumulative effect on fisheries would be beneficial. The Fish Entrainment Reduction would reduce mortality caused by entrainment of fish at these diversions, to the benefit of endangered shortnose and Lost River suckers, as well as to redband trout. Steelhead and fall- and spring-run Chinook salmon would also benefit from this action once they recolonize areas upstream of Keno Dam. **The incremental contribution of Fish Entrainment Reduction to the cumulative effect would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.* The KBRA includes a program to study and reduce nutrient concentrations in the Keno Impoundment and Upper Klamath Lake in order to reduce dissolved oxygen problems and algal problems in both water bodies. Restoration actions to control nutrients have not been developed, and there are many diverse possibilities that could require construction of treatment wetlands, construction of facilities, or chemical treatments of bottom sediment, among other possibilities. A nutrient reduction program in the Keno Impoundment and Upper Klamath Lake would be designed to improve water quality (increasing dissolved oxygen and reducing algal concentration) and to provide fish passage through the Keno Impoundment in summer and fall months; however, implementation of this nutrient reduction program will require future environmental compliance investigations and a determination on the significance of cumulative effects cannot be made at this time. Implementation of the KBRA will require future environmental compliance as appropriate.

#### **4.4.2.2 Alternatives 3, 4, and 5**

Alternative 3 and 5 would have similar cumulative effects on aquatic resources as the Proposed Action; however, two dams would remain in place under Alternative 5, reducing the amount of habitat and resulting in fewer water quality improvements. Alternative 4 would involve the creation of fish passage facilities but all four dams would remain in place. No short-term cumulative effects associated with suspended sediment concentrations from reservoir drawdown would occur to aquatic species; however, water quality issues would not improve and therefore there would be no cumulative benefits from improved water quality. Because all four dams would remain in place, some habitat would still be blocked by the presence of the reservoirs. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.2.3 Mitigation Measures**

While there would be cumulatively considerable impacts on aquatic species from Alternatives 2, 3, and 5 even with mitigation, no additional feasible mitigation is

available to reduce these impacts. These impacts would remain cumulatively considerable.

#### 4.4.3 Algae

Potential cumulative effects on the phytoplankton and periphyton communities would occur mainly through changes in temperature, light, and nutrient levels in the Klamath River. The timeframe for the cumulative effects analysis associated with reservoir drawdown is the length of deconstruction. The timeframe for long-term cumulative effects after deconstruction is indefinite, as conditions promoting algae growth would be permanently altered with implementation of any of the proposed alternatives.

Table 4-7 presents a summary of the algae impacts described in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4-7. Summary of Algae Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
<b><i>Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir</i></b>				
Dam removal activities could decrease the spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton in the area of analysis.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities could decrease the spatial extent, temporal duration, or biomass of nuisance periphyton in the area of analysis	2, 3, 5	NCFEC	None	NCFEC
<b><i>Hydroelectric Reach</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton in the area of analysis.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms in the Hydroelectric Reach.	2, 3, 5	B	None	B
Dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton in low-gradient channel margin areas within the Hydroelectric Reach.	2, 3	S	None	S
	5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could impact algae.	2, 3, 5	NCFEC	None	NCFEC

**Table 4-7. Summary of Algae Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction and deconstruction activities would include the demolition of various recreation facilities that could affect algae.	2, 3, 5	NCFEC	None	NCFEC
<b><i>Klamath River Downstream of Iron Gate Dam</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach and subsequent transport into the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities could support long-term growth of nuisance periphyton such as <i>Cladophora spp.</i> downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream of Iron Gate Dam.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.	2, 3, 5	LTS	None	LST
<b><i>Klamath River Estuary</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach and subsequent transport into the Klamath Estuary.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath Estuary.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath Estuary.	2, 3, 5	LTS	None	LTS

**Table 4-7. Summary of Algae Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
<b>Marine Nearshore Environment</b>				
Dam removal and conversion of the reservoir areas could cause long-term increases in freshwater phytoplankton and periphyton species of concern.	2, 3, 5	LTS	None	LTS
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning the East and West Side Facilities could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
<b>Klamath Basin Restoration Agreement</b>				
Implementation of restoration actions, programs, and/or plans presented in the KBRA would accelerate restoration actions currently underway throughout the Klamath Basin and reduce nuisance and/or noxious phytoplankton blooms through their beneficial effects on flow and water quality.	2, 3	B	None	B
Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms.	2, 3	B	None	B
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same impacts as Phase I.	2, 3	B	None	B
Implementation of Wood River Wetland Restoration could result in reduced nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B
Implementation of the Water Use Retirement Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B

**Table 4-7. Summary of Algae Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Implementation of the Interim Flow and Lake Level Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable
- LTS = Less than Significant

The main cumulative action affecting algae growth is the construction and operation of the KHP. The stable lacustrine environment created at the Four Facilities, particularly in the larger Copco 1 and Iron Gate Reservoirs, coupled with high nutrient availability and high water temperatures in summer to fall, provides ideal conditions for phytoplankton growth. Past and present actions potentially contributing to algal growth include agricultural activities, grazing, and sedimentation, which have increased nutrient loading in the Klamath River. Future cumulative actions with the potential to affect algae include implementation of the Klamath Basin TMDLs.

**4.4.3.1 Alternative 2: Full Facilities Removal of Four Dams  
Phytoplankton**

*Under the Proposed Action, removal of the reservoirs would eliminate lacustrine habitat behind the dams and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms. Elimination of lacustrine habitat behind the dams could also substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream of Iron Gate Dam and the Klamath Estuary. In the long-term, dam removal, particularly within the larger Copco 1 and Iron Gate Reservoirs, would decrease or eliminate the system’s support for excessive growth of blue-green algae over the long-term by eliminating quiescent habitat where these algal species can thrive. This change in suitable habitat would occur even if relatively high nutrient concentrations were to remain in the Klamath River system. Additionally, reduced inputs of *M. aeruginosa* and *Anabaena flos-aquae* to the mainstem river downstream of Iron Gate Dam would result in a substantial reduction in the presence of toxic algal cells. Removal of the dams is expected to decrease temperatures in summer and fall, further preventing algal growth downstream of the reservoirs.*

Blue-green algae reach very high densities in the summer months in the Klamath Basin. Some blue-green algae produce toxins that are harmful to fish, mammals and humans (see Section 3.2.3.7, Water Quality). The Klamath River from Copco 1 Reservoir (RM 203.1) to Iron Gate Dam (RM 190.1) is listed as impaired for toxicity due to the presence of microcystin in the reservoirs (see Section 3.2.2.3, Water Quality). Blue-green algae growth represents a significant cumulative effect. The Proposed Action's contribution to cumulative effects associated with blue-green algae would be beneficial by eliminating habitat through removal of the dams, and by reducing transport of nuisance blooms downstream. Other cumulative actions in the area that would reduce the potential for algal growth include implementation of the Klamath River TMDLs (and implementation of TMDLs on Klamath River tributaries) to reduce nutrients, and actions/programs identified in Table 4-3 to reduce sediment input into the Klamath River. Together, the Proposed Action and these cumulative actions would result in beneficial effects by reducing or eliminating conditions supporting blue-green algae. **The Proposed Action's incremental contribution to the significant cumulative effects on phytoplankton would be beneficial.**

### **Periphyton**

*Under the Proposed Action, dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton in low-gradient channel margin areas downstream of J.C. Boyle Dam. Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam and the Klamath Estuary. In the short-term, periphyton growth would likely decrease from decreased light penetration and increased flows during reservoir drawdown that would cause greater bed turnover. In the long-term, periphyton growth in the Hydroelectric Reach could increase because of nutrient inputs from the Upper Klamath Basin and removal of the reservoirs, which would create physical habitat more suitable for periphyton growth.*

Periphyton in the Klamath River plays an important role in nutrient dynamics, affecting nutrient fluxes and resulting in short-term changes in dissolved oxygen and pH. Excessive swings in dissolved oxygen and pH can be stressful to aquatic biota, thus too much periphyton can adversely affect water quality and aquatic resources. The growth of nuisance periphyton is therefore considered a significant cumulative effect. The Proposed Action's contribution to this cumulative effect would not be substantial. While there may be some increases in nutrients and conditions promoting periphyton growth downstream of the Four Facilities, there would also be some decreases in nutrients from implementation of the Klamath Basin TMDLs, the elimination of hydropower peaking, and periphytic nutrient uptake. Additionally, more frequent bed turnover from storm events after reservoirs have been removed may increase scouring of periphyton; however, this effect would likely decrease with distance downstream. Because of the many factors that have the potential to counteract increases in periphyton growth, **the Proposed Action's incremental contribution to the significant cumulative effect associated with nuisance periphyton growth would not be cumulatively considerable.**

### **KBRA**

*Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms. Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same impacts as Phase I. Implementation of Wood River Wetland Restoration could result in reduced nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. Implementation of the Water Use Retirement Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. Implementation of the Interim Flow and Lake Level Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. Many of these KBRA actions and programs would help to decrease nutrient levels through various measures such as decreasing irrigation and fallowing of cropland leading to a reduction in fertilizer inputs, restoration actions to reduce nutrient inputs to waterways, inundating wetland (peat) soils and creating anaerobic conditions that support nutrient retention, and cattle exclusion fencing in waterways. All these actions to reduce nutrients would help to reduce the prevalence of nuisance and/or noxious phytoplankton blooms. As noted above, phytoplankton and periphyton can adversely affect water quality and wildlife and are considered significant cumulative effects. Other cumulative actions that could also improve nutrients and reduce nuisance and/or noxious phytoplankton and periphyton growth include implementation of the Klamath Basin TMDLs, the elimination of hydropower peaking, periphytic nutrient uptake, and implementation of the KHSAs.*

**The Proposed Action's incremental contribution to the cumulative effects on nuisance and/or noxious phytoplankton and periphyton blooms in the Klamath Basin would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

#### **4.4.3.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative effects on nuisance and/or noxious phytoplankton and periphyton growth as the Proposed Action. Alternative 5 would remove two reservoirs; however, two reservoirs would remain and therefore habitat for nuisance and/or noxious phytoplankton would remain and it would have less cumulative benefits than Alternatives 2 and 3. Alternative 4 would not result in any cumulative effects associated with nuisance and/or noxious phytoplankton and periphyton growth. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.3.3 Mitigation Measures**

No cumulative adverse effects related to algae would occur; hence, no mitigation measures are required.

#### 4.4.4 Terrestrial Resources

The timeframe for cumulative effects on terrestrial resources includes the duration of construction (May 2019 through December 2020), during which temporary impacts would occur, and extends for approximately three years following construction to 2023. Three years was selected as an approximate time during which residual longer term impacts would occur to terrestrial habitat and wildlife from loss of vegetation in construction areas. After three years, some grasses would be expected to regain structure and function with implementation of the planned restoration activities.

Table 4-8 presents a summary of terrestrial resources impacts identified in Chapter 3. These impacts are analyzed for cumulative effects.

Several past, present, and reasonably foreseeable future actions were considered during the cumulative effects analysis (see Table 4-3 and 4-4). Within the area of analysis, past, present and future cumulative actions such as timber harvesting, agriculture, recreation, residential developments, water diversions, and mining, have in the past, or have the potential in the future to adversely affect wildlife and alter habitat. Construction of the KHP and associated facilities has reduced some riparian habitat and may have blocked some wildlife corridors for species travelling along the Klamath River shoreline. Reclamation's Klamath Project and associated infrastructure has reduced and fragmented wetland and riparian habitat. Future developments, such as those proposed in Siskiyou County (see Table 4-4), may also contribute to some loss of habitat or impacts on wildlife species.

There are several cumulative plans and programs in place that seek to conserve terrestrial resources while allowing for certain land use activities. For instance, PacifiCorp's hydroelectric project activities must comply with Biological Opinions issued by the USFWS and NOAA Fisheries Service, and ongoing timber harvest activities must comply with the applicable agency land use plan.

**Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities could result in the loss of wetland and riparian vegetation communities and culturally important species including willows.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in direct mortality or harm to special-status amphibian and reptile species during construction.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in nest abandonment by birds, including special-status bird species, during construction.	2, 3, 4, 5	LTS	TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle Surveys	LTS
Construction activities could result in on the loss of special-status plants.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan TER-4: Surveys for Special Status Plants	LTS
Construction activities could result in adverse impacts on wildlife from riparian habitat loss.	2, 3, 4, 5	LTS	None	LTS
Removal of reservoirs and associated loss of habitat could result in impacts on wildlife.	2, 3, 5	LTS	None	LTS
Dam removal and the flushing of sediments could result in long-term impacts on riparian habitat from sedimentation in downstream reaches.	2, 3, 5	LTS	None	LTS
Removal of reservoirs could result in loss of reservoir wetlands.	2, 3, 5	S	TER-5: Permanent Loss of Wetlands at Reservoirs	LTS
Construction activities could result in the removal of trees and other vegetation and could result in long-term impacts on wildlife habitat, particularly for nesting birds.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle Surveys	LTS
Removal of dam facilities could result in long-term impacts on bats from loss of roosting habitat.	2, 3, 5	S	TER-6: Impacts on Special-Status Bats from Loss of Roosting Habitat	LTS
Dam removal and the flushing of sediments could result in long-term impacts on amphibians from changes in habitat due to sedimentation in downstream reaches.	2, 3, 5	LTS	None	LTS
Removal of the reservoirs could result in long-term impacts on special-status species from loss of aquatic habitat at reservoirs.	2, 3, 5	LTS (Special Status Birds; Special Status Plants)	TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle TER-4: Surveys for Special Status Plants	LTS

**Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dam removal and associated sedimentation in downstream reaches could result in impacts on culturally important species.	2, 3, 5	LTS	None	LTS
Removal of reservoirs and associated facilities could result in long-term impacts on wildlife corridors.	2	B	None	B
Continued existence of the reservoirs and/or other facilities could present a barrier to movement of some terrestrial species.	1, 3, 4, 5	NCFEC	None	NCFEC
Exposed reservoir bottoms and other areas of construction disturbance could result in impacts from invasive plants.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could result in impacts on terrestrial resources from construction activities and pipe alignment.	2, 3, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special Status Plants	LTS
Construction activities associated with replacement of the water supply pipeline to the Iron Gate Fish Hatchery could result in impacts on terrestrial resources.	2, 3	LTS	TER-1: Habitat Restoration Plan TER-4: Surveys for Special Status Plants	LTS
Removal of various recreation facilities could result in impacts to terrestrial resources during construction.	2, 3, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special Status Plants	LTS
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause impacts to terrestrial resources.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning the East and West Side Facilities could cause adverse effects to terrestrial resources.	2, 3	NCFEC	None	NCFEC
<b>Klamath Basin Restoration Agreement</b>				
Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II could result in impacts on terrestrial wildlife and/or habitat.	2,3	S	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special-Status Plants TER-4: Permanent Loss of Wetlands at Reservoirs	LTS

**Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities associated with Fish Entrainment Reduction could result in impacts on terrestrial wildlife and/or habitat	2,3	S	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special-Status Plants TER-4: Permanent Loss of Wetlands at Reservoirs	LTS
Modification of aquatic habitat from the Wood River Wetland Restoration project could result in impacts on terrestrial wildlife and/or habitat.	2,3	LTS	None	LTS
The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat.	2,3	LTS	TER-2: Nesting Bird Surveys	LTS
The Mazama Forest Project could result in adverse impacts on terrestrial resources.	2,3	NCFEC	None	NCFEC
The Barnes Ranches Project could result in impacts on terrestrial wildlife and/or habitat.	2,3	LTS	None	LTS

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- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable
- WURP= Water Use Retirement Program

**4.4.4.1 Alternative 2: Full Facilities Removal of Four Dams**

**General Wildlife**

*Construction activities could result in adverse impacts on wildlife from riparian habitat loss.* Some sedimentation from dam removal could decrease riparian habitat temporarily, and this could affect wildlife. Human activity in the Klamath Basin has decreased the abundance of riparian habitat, through development, agricultural activities, timber harvesting, mining, and other activities. Localized disturbance of riparian habitat downstream due to sedimentation is expected to be short-term, with colonization of riparian plant seedlings and subsequent re-vegetation of riparian areas within three years following implementation of the Proposed Action. Additionally, there would be gains in riparian habitat at the reservoirs following dam removal and restoration. **The Proposed Action’s incremental contribution to the cumulative effects on wildlife from loss of riparian habitat would not be cumulatively considerable.**

*The Proposed Action could result in impacts on wildlife from the permanent loss of aquatic habitat.* The Proposed Action would result in the removal of four reservoirs that provide aquatic habitat for wildlife. No other cumulative actions or projects have been identified that would substantially decrease the amount of open water habitat in the Klamath Basin. **There would be no significant cumulative effects on wildlife from the permanent loss of open water habitat at the reservoirs.**

*The Proposed Action could result in impacts on culturally important species.* Willows, which are riparian-dependent plants, are culturally important to American Indians who use them for basket-making. Loss of historical wetland and riparian habitat, as noted above, residential development, and agricultural activities such as grazing, have affected the abundance of culturally important plant species such as willows in the Klamath Basin. This loss of culturally important species represents a significant cumulative effect. The Proposed Action’s incremental contribution to this significant effect would be short-term and minimal. While some riparian habitat could be lost from staging and other construction activities in the short-term, riparian habitat is expected to increase in the long-term at the reservoir sites after restoration, and any loss of riparian habitat from sedimentation downstream of the dams is anticipated to be short-term in nature. **The Proposed Action’s incremental contribution to the significant cumulative effect associated with loss of culturally important species would not be cumulatively considerable.**

*The Proposed Action could result in construction-related impacts to terrestrial resources from relocation of the Yreka water supply pipeline, replacement of the water supply pipeline to the Iron Gate Fish Hatchery, and relocation of existing recreation facilities, which would require the construction of new facilities along the river bank.* Several actions, including relocation of the Yreka water supply pipeline, the replacement of the water supply pipeline to the Iron Gate Fish Hatchery, and the relocation of existing recreation facilities, could adversely affect terrestrial resources during construction. Other cumulative actions or projects that may also disturb birds include ongoing agricultural activities, mining, road improvements, and new subdivisions approved in Siskiyou County near Iron Gate Dam. Together these actions, considered with past human development, represent significant cumulative effects on terrestrial resources. The Proposed Action’s incremental contribution to the significant cumulative effect could be cumulatively considerable; however, several elements would be incorporated into the project to avoid or reduce adverse impacts on special-status species and common wildlife species, including mitigation measures TER-1 through TER-4. **The Proposed Action’s incremental contribution to the significant cumulative effects on terrestrial resources would not be cumulatively considerable.**

### **Birds**

*Construction activities could result in adverse impacts on birds, including special-status bird species, during construction.* The Proposed Action could adversely affect bird species through noise and disturbances from general construction activities. Other cumulative actions or projects that may also disturb birds include ongoing agricultural activities, mining, road improvements, and new subdivisions approved in Siskiyou

County near Iron Gate Dam. If these actions occurred during construction in close proximity to the dams, there could be significant cumulative effects on bird species. However, the Proposed Action's contribution to this cumulative effect would be minimal, and specific mitigation (Mitigation Measure TER-2) would be incorporated into the project to avoid or minimize impacts to bird species, including protocol level surveys to identify nests, clearing and grubbing during the non-nesting season, and establishment of buffer zones around nesting bird species. **With these measures, the Proposed Action's incremental contribution to cumulative effects on bird species would not be cumulatively considerable.**

### **Amphibians**

*Construction activities could result in direct mortality or harm to special-status amphibian and reptile species during construction.* Construction would require heavy machinery to move through construction areas, staging areas, and haul roads where special-status amphibian and reptile species could occur. The past and present activities in the Klamath Basin such as agriculture, timber harvesting, road construction, and residential developments, considered with future developments noted in Table 4-4, have likely result in significant cumulative effects on amphibians. The Proposed Action's incremental contribution to the significant cumulative effects would not be cumulatively considerable, based on the specific measures have that been incorporated into the project to reduce or minimize impacts on special-status amphibians and reptiles. **The Proposed Action's incremental contribution to the significant cumulative effects on special-status amphibians and reptiles would not be cumulatively considerable.**

*Dam removal could result in long-term impacts on amphibians from habitat degradation due to sedimentation in downstream reaches of the Klamath River.* Amphibians are highly sensitive to alternations to their aquatic habitats. Excess sediment inputs in downstream reaches from dam removal would result in filling of riffle substrate necessary for larval phases of amphibian species. The past and present activities in the Klamath Basin such as agriculture, timber harvesting, road construction, and residential developments, combined with the Proposed Action and future developments noted in Table 4-3, could result in significant cumulative effects on amphibians from sedimentation of their habitat. The Proposed Action's contribution to the significant cumulative effects would be minimal. The magnitude of the anticipated sediment release from behind the reservoirs is relatively small when compared to sediment loading from other existing sources along the Klamath River, and most sediment is expected to be flushed out during subsequent high flow events. **The Proposed Action's incremental contribution to the significant long-term cumulative effects on amphibians from sedimentation would not be cumulatively considerable.**

### **Bats**

*The Proposed Action could result in long-term impacts on bats from loss of roosting habitat.* Bats have experienced significant cumulative effects associated with the loss of roosting habitat. This has occurred from past and present human activities in the Klamath Basin that have removed tree habitat, such as timber harvesting, agriculture, and road and residential developments. Proposed Action impacts on bats would occur from the loss of

dam structures and associated facilities used as roosting habitat. The loss of a bat colony site or adverse effects to an active bat colony under the Proposed Action could contribute to these significant cumulative effects to bats. The Proposed Action's incremental contribution to the cumulative effect on bats could be cumulatively considerable because bats roost in all four dams or in their associated facilities and structures (FERC 2007) and these would be removed; however, the Proposed Action would provide mitigation for bats (TER-6) that would include bat surveys, exclusion measures, and the replacement of bat roosting structures that would minimize impacts on bats. **The Proposed Action's incremental contribution to the significant cumulative effects on bats would not be cumulatively considerable.**

### **Special-Status Species**

*Removal of reservoirs could result in impacts on wildlife from the permanent loss of aquatic habitat. The Proposed Action would result in impacts on special-status species from loss of open water habitat at reservoirs.* Permanent loss of wetland and aquatic habitat at reservoirs would adversely affect wildlife and special-status species populations that use these habitats. No other known actions or projects are expected to substantially reduce the amount of open water habitat available in the Klamath Basin. **There would be no significant cumulative effects on special-status species from the loss of open water habitat.**

### **Habitat**

*Dam removal could result in long-term impacts on riparian habitat from sedimentation in downstream reaches.* Sediment inputs in downstream reaches could fill riffle substrate in some areas, reducing localized habitat for the larval phases of amphibian species such as Pacific giant salamander. However, most sediment is expected to be flushed out during subsequent high flow events (Stillwater 2008), and restoring a more natural sediment regime would be expected to benefit amphibian habitat in the long-term. No other cumulative actions or projects have been identified that would adversely affect riparian habitat in the downstream reaches after during drawdown. **There would be no significant cumulative effects associated with loss of riparian habitat.**

*The Proposed Action could result in long-term impacts on wildlife habitat from tree and vegetation removal.* During construction, some trees and other vegetation that provides habitat for birds and other wildlife would be removed at construction areas, upland disposal sites, equipment staging areas, and access and haul roads.

Past, present and future cumulative actions such as timber harvesting, agriculture, recreation, residential developments, water diversions, and mining, have adversely affect wildlife and altered habitat. Construction of the KHP and associated facilities has reduced wildlife habitat. Reclamation's Klamath Project and associated infrastructure has reduced and fragmented wildlife habitat. Future developments, such as those proposed in Siskiyou County (see Table 4-4), may also contribute to some loss of habitat or impacts on wildlife species. Impacts on wildlife habitat are considered significant cumulative effects.

The Proposed Action's incremental contribution to the significant cumulative effects on wildlife habitat would not be cumulatively considerable. Specific measures have been incorporated into the Proposed Action to avoid or reduce impacts on specific bird species, such as bald eagles, if nesting trees are removed during construction. Following construction, restoration of this habitat would be conducted through the planting of native vegetation in accordance with a Habitat Restoration Plan approved by the resource agencies. **The Proposed Action's incremental contribution to the significant cumulative effects on wildlife habitat would not be cumulatively considerable.**

### **Plant Species**

*Construction activities could result in the loss of special-status plants during construction.* Construction activities such as the use of vehicles and equipment could result in the loss of special-status plant species. Past, present and future cumulative actions such as timber harvesting, agriculture, recreation, residential developments, water diversions, and mining, have adversely affect wildlife and altered habitat. Construction of the KHP and associated facilities has reduced wildlife habitat. Reclamation's Klamath Project and associated infrastructure has reduced and fragmented wildlife habitat. Future developments, such as those proposed in Siskiyou County (see Table 4-4), may also contribute to some loss of habitat or impacts on wildlife species.

The Proposed Action's incremental contribution to the significant cumulative effects on special-status plants would not be cumulatively considerable. Specific mitigation would be implemented (TER-1 and TER-4) to avoid or reduce impacts on special-status plants, including focused surveys and compensation measures, where necessary. **The Proposed Action's incremental contribution to the significant cumulative effects on special-status plants during construction would not be cumulatively considerable.**

*The Proposed Action could result in impacts related to invasive plants.* Invasive plants are found throughout the Klamath Basin and have adversely affected agriculture, wildlife, recreation areas, and native plant species. The spread of invasive plants is therefore a significant cumulative effect. The Proposed Action would not have a substantial contribution to this cumulative effect. Measures would be implemented to prevent the introduction of invasive plant species. All construction vehicles and equipment would be cleaned with compressed water or air within a designated containment area to remove pathogens, invasive plant seeds, or plant parts and dispose of them in an appropriate disposal facility. Implementation of the Reservoir Area Management Plan and the Habitat Restoration Plan would include long-term maintenance and monitoring to control invasive species. **The Proposed Action's incremental contribution to the significant cumulative effects associated with the spread of invasive plants would not be cumulatively considerable.**

### **Wetlands**

*Construction of the Proposed Action could result in the loss of wetland and riparian vegetation communities. Dam removal could result in loss of reservoir wetlands.* Disturbances associated with construction areas and haul roads where clearing, grading,

and staging of equipment would occur would have impacts on sensitive habitats, including wetlands and riparian vegetation along reservoirs and river reaches.

Under the Proposed Action, there would be unavoidable impacts on wetland habitat at the J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs (245 acres, see Table 3.5-2). However, wetlands would be expected to become reestablished in some areas along the new river channel with adequate hydrology, soils, and vegetation. As these areas would be prone to colonization by invasive plant species, management and control of invasives would occur as part of the Reservoir Area Management Plan and the Habitat Restoration Plan.

A substantial amount of the historical wetlands of the Upper Klamath Basin have been lost to agricultural developments and water diversions (Larson and Brush 2010). As a result, there is less wetland habitat for waterfowl than there was prior to development, but abundant food for dabbling ducks and geese that feed on small grains in fields surrounding the wetlands (Jarvis 2002). Loss of wetland and riparian habitat is therefore a significant cumulative effect.

The Proposed Action's incremental contribution to the cumulative effect associated with loss of wetlands and riparian vegetation would be cumulatively considerable; however, there would also be gains in wetland and riparian habitat following restoration. Once the Definite Plan is prepared and construction areas are delineated, measures would be implemented prior to and during construction to avoid and mitigate impacts to sensitive vegetation communities such as wetlands and riparian vegetation. Additionally, wetlands within 50 feet of any ground disturbance and construction-related activities (including staging and access roads) would be clearly marked and/or fenced to avoid impacts from construction equipment and vehicles. If new temporary access roads were required, grading would be conducted such that existing hydrology would be maintained. In addition, BMPs would be implemented to address potential water quality impacts on wetlands.

If it is determined that wetland losses would be greater than gains, a Compensatory Wetland Mitigation Plan would be developed and implemented in accordance with the requirements of the United States Army Corps of Engineers Section 404 Permit for impacts on Waters of the United States. Implementation of this mitigation (Mitigation Measure TER-5) would reduce the Proposed Action's contribution to the loss of wetland and riparian habitat. **The Proposed Action's incremental contribution to the significant cumulative effect associated with loss of wetlands and riparian vegetation would not be cumulatively considerable.**

### **Wildlife Corridors**

*The Proposed Action could result in impacts on wildlife corridors.* While there is little information on the extent of the loss of wildlife corridors, it is reasonable to assume that past actions such as residential developments, agriculture, timber harvesting, the KHP, and Reclamation's Klamath Project have all contributed to constructing infrastructure that has either blocked wildlife corridors or removed vegetation, causing a significant cumulative effect. The Proposed Action would have a beneficial contribution to this

cumulative effect. The Proposed Action would remove the Four Facilities and infrastructure and would re-establish native vegetation at the Klamath River reservoir sites, allowing the establishment of wildlife corridors along the Klamath River. **The Proposed Action's incremental contribution to the significant cumulative effect associated with wildlife corridors would be beneficial.**

### **KBRA**

*Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II could result in impacts on terrestrial wildlife and/or habitat. The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat. Construction activities associated with Fish Entrainment Reduction could result in impacts on terrestrial wildlife and/or habitat.* The Fisheries Restoration Plan would include measures to restore riparian and floodplain vegetation throughout the Klamath Basin. While the overall intent of the Fisheries Restoration Plan is to benefit wildlife, there could be some temporary adverse impacts on terrestrial vegetation and wildlife during construction through ground disturbance and the use of construction equipment and vehicles. The WURP program could include juniper removal in order to increase inflow to Upper Klamath Lake. There could be adverse impacts on terrestrial wildlife, including nesting migratory birds, from removal of juniper trees. Fish Entrainment Reduction would entail the installation of fish screens at various water diversion structures for the Klamath Reclamation Project. There could be adverse impacts on riparian vegetation and wildlife habitat within these localized construction areas.

The exact locations for many of the actions planned as part of the KBRA have not yet been identified; therefore, it is difficult to determine what cumulative actions or projects may be occurring that could contribute to cumulative terrestrial wildlife and habitat impacts. However, for the purposes of this analysis, it is assumed that ongoing activities such as timber harvesting, agriculture, livestock grazing, mining, road improvements, and recreation could all be contributing to adverse effects on terrestrial species and could have noise impacts but could also result in adverse changes to habitat or even direct mortality to some species. Therefore, depending on the locations, there could be significant cumulative effects on terrestrial resources. The KBRA's incremental contribution to this significant cumulative effect would be cumulatively considerable. Construction activities and vegetation removal could result in disturbance or mortality to terrestrial wildlife and habitat. However, mitigation measures would be implemented to reduce or avoid these impacts (TER-1 through TER-4). **The KBRA's incremental contribution to the significant cumulative effects on terrestrial wildlife and/or habitat would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat.* In general, additional water supply would be expected to increase the numbers of waterfowl using the National Wildlife Refuges. As described in Section 3.15, Socioeconomics, there

would be an additional 193,830 waterfowl, with corresponding increases in hunting trips and local revenue. As noted above, there has been a considerable amount of wetland and riparian habitat loss in the Klamath Basin over time, and that has resulted in less wetland habitat for waterfowl than there was prior to development. Impacts on waterfowl and habitat are therefore considered significant cumulative effects. The Proposed Action's incremental contribution to this cumulative effect would be beneficial as it would increase water supply at the National Wildlife Refuges and would therefore be expected to increase waterfowl habitat and the number of waterfowl visiting the refuges. **The KBRA's incremental contribution to the cumulative effects on waterfowl and their habitat at the National Wildlife Refuges would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Modification of aquatic habitat from the Wood River Wetland Restoration project could result in impacts on terrestrial wildlife and/or habitat.* Implementation of the Wood River Wetland Restoration may reconnect subsided wetlands adjacent to Agency Lake to provide additional water storage. Therefore, these projects are anticipated to benefit waterfowl, water birds, and other species that utilize wetlands and aquatic habitat through increased reliability of water to wetland habitat. However, some adverse effects could also occur to some species, depending on whether habitats are managed as marsh or open water. There has been a considerable amount of wetland and riparian habitat loss in the Klamath Basin over time, and that has resulted in less wetland habitat for waterfowl than there was prior to development. Impacts on waterfowl and habitat are therefore considered significant cumulative effects. The Proposed Action's contribution to the significant cumulative effects associated with waterfowl and their habitat would be minimal. The KBRA actions would provide more open water and/or marsh habitat. **The KBRA's incremental contribution to the cumulative effects on terrestrial wildlife and habitat would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.4.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative effects as Alternative 2 as all dams would be removed. Alternative 4 would involve fish passage facilities and would not result in any cumulative effects as all wildlife impacts would be temporary and minimal; however no new wildlife corridors would be created. Alternative 5 would have similar cumulative effects to Alternative 2 and 3; however less habitat would be lost during construction and two dam facilities would remain for bat roosting and aquatic habitat. Under Alternative 5, no new wildlife corridors would be created because two dams would still remain in place. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.4.3 Mitigation Measures**

No cumulative adverse effects related to terrestrial resources would occur; hence, no mitigation measures are required.

#### 4.4.5 Flood Hydrology

Cumulative effects associated with flood hydrology could occur through changes in flows on the Klamath River that could increase the flood risk. The timeline for short-term cumulative effects would be the duration of deconstruction (May 2019 through December 2020). The timeline for long-term effects after dam removal would be indefinite. Table 4-9 presents a summary of flood hydrology impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued operation of the Klamath Hydroelectric Project and Reclamation's Klamath Project could alter river flows and result in changes to flood risks.	1	NCFEC	None	NCFEC
Ongoing restoration actions could affect flood hydrology.	1	NCFEC	None	NCFEC
Drawdown of reservoirs could result in short-term increases in downstream surface water flows and could result in changes to flood risk.	2, 3, 5	LTS	None	LTS
Reservoir drawdown and resulting downstream sediment deposition could affect flood risk.	2, 3, 5	LTS	None	LTS
Changes in flows following dam removal could result in changes to the 100-year floodplain downstream of Iron Gate Dam between River Mile 190 and 105.	2, 3, 5	S	H-1: Emergency Response Plan H-2: Move or Relocate Structures	LTS
Removing the Four Facilities could reduce the risks associated with a dam failure.	2	B	None	B
Removing Copco 1 and Iron Gate Dams could reduce the risks associated with a dam failure	5	B	None	B
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect flood risk.	2, 3, 5	NCFEC	None	NCFEC
Removal of recreation facilities located on the banks of the existing reservoirs which could affect flood hydrology.	2, 3, 5	NCFEC	None	NCFEC
Changes in flows in the Hydroelectric Reach including the J.C. Boyle and Copco 2 Bypass Reaches could affect flood hydrology.	4, 5	LTS	None	LTS

**Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction of a new gage within the 100-year floodplain at Copco 2 Dam or J.C. Boyle Dam to measure flows could affect flood hydrology.	5	LTS	None	LTS
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause changes to operations affecting flows downstream of Keno Dam, which could cause changes to flood risks.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning the East and West Side Facilities could cause changes in flood risk downstream of the facilities.	2, 3	NCFEC	None	NCFEC
<b>Klamath Basin Restoration Agreement</b>				
Implementation of the Fisheries Restoration Plans could change flows downstream of Upper Klamath Lake, which could result in changes to flood risks	2,3	LTS	None	LTS
Implementation of Wood River Wetland Restoration by the Bureau of Land Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks.	2,3	B	None	B
Implementation of Future Storage Opportunities by Reclamation may cause changes to flows upstream and down downstream of Upper Klamath Lake, which could result in changes to flood risks	2,3	B	None	B
Implementation of the On-Project Plan may change flows downstream of Upper Klamath Lake during dry years, which could result in changes to flood risks.	2,3	NCFEC	None	NCFEC
Implementation of the WURP would change flows upstream of Upper Klamath Lake, which could result in changes to flood risks.	2,3	NCFEC	None	NCFEC

**Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of an Emergency Response Plan could result in changes to flood risks in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	NCFEC	None	NCFEC
Implementation of Climate Change Assessment and Adaptive Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks.	2,3	B	None	B
Implementation of Interim Flow and Lake Program during the interim period would change river flows, which could result in changes to flood risks.	2,3	NCFEC	None	NCFEC

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable
- WURP = Water Use Retirement Program

Physical changes within a watershed produce changes in runoff patterns and associated surface water hydrographs. Historically, the Klamath Basin has experienced a loss of wetland habitat and a conversion to agricultural areas in the upper watershed and along tributaries such as the Scott and Shasta Rivers. The lower watershed remains largely forested, although localized areas of timber harvest and development exist throughout.

In the future, county and city populations in the Klamath Basin are projected to grow throughout the watershed (see Table 4-10). Increases in population would likely spur development of additional housing and businesses to support this growth. Increased development creates additional impervious surfaces, which often channel precipitation into surface water bodies. Most roads and highways in mountainous regions such as the Klamath Basin are located adjacent to streams and rivers. Additionally, some timber harvest would continue into the future; the construction of logging roads to expand timber harvest could also channel sediment and water into surface water bodies. These actions could increase peak flows during storm events.

**Table 4-10. Population Projections for the Eight Klamath Basin Counties**

Year	California Counties					Oregon Counties		
	Del Norte	Humboldt	Mendocino	Modoc	Siskiyou	Curry	Jackson	Klamath
2020	36,077	142,167	102,017	13,134	51,283	22,671	238,865	70,595
2030	42,420	147,217	111,151	16,250	55,727	22,225	268,385	74,924
2040	49,029	150,121	121,780	20,064	60,656	23,432	297,496	80,159
2050	56,218	152,333	134,358	24,085	66,588	N/A	N/A	N/A

Source: California Department of Finance 2007, Oregon Office of Economics 2004  
N/A – not available

In addition to increasing populations and new development, climate change may also affect future surface water hydrology. The annual snow packs in the mountain ranges may be reduced, decreasing annual surface water supplies. Storm frequency and severity may increase, causing higher peak flows in rivers and their tributaries during storm events (California Department of Water Resources [CDWR] 2010).

#### **4.4.5.1 Alternative 2: Full Facilities Removal of Four Dams**

*Drawdown of reservoirs could result in short-term increases in downstream surface water flows and result in changes to flood risks.* The Proposed Action would result in short-term increases in flows during reservoir drawdown. Because drawdown would not occur until 2019, population growth and associated increases in development, the creation of new impervious surfaces, and construction of new logging roads or other infrastructure that result in run-off and sediment deposition in waterways could all contribute to changes in peak flows in surface water bodies. Climate change could increase the frequency of large storm events, and could cause more snow melt earlier in the season. These changes have the potential to increase flows on the Klamath River and could result in significant cumulative effects associated with flood risks.

The long-term surface water flow changes associated with future climate change and the Proposed Action's increase in flows from reservoir drawdown could result in surface water changes such as increased peak flows during storms that could increase the potential flood risks during drawdown. Higher flows may also change the rates and locations of sediment deposition in the channel bed and banks. Flood risk during reservoir drawdown could be a significant cumulative effect.

The Proposed Action's incremental contribution to the cumulative effect associated with flood risks would be short-term and minimal. The reservoir drawdown plans were made with consideration for minimizing flood risks downstream. The Dam Removal Entity (DRE) would carefully control drawdown to maintain flows that would not cause flood risks. Drawing down the reservoirs would increase storage availability in J.C. Boyle, Copco 1, and Iron Gate Reservoirs. If a flood event occurred during drawdown, the DRE would retain flood flows using the newly available storage capacity and continue drawdown after flood risks have ended. Current conditions do not allow these reservoirs to assist in flood prevention in this manner. While the controlled releases during reservoir

drawdown would be higher than simulated No Action/No Project Alternative releases during the same time period, they would not be likely to increase flood risks because they would still be within the range of historic flows. **The Proposed Action's incremental contribution to the short-term cumulative effects on flood risks from reservoir drawdown would not be cumulatively considerable.**

*The release of sediment stored behind the dams and resulting downstream sediment deposition under the Proposed Action could result in changes to flood risks. The 100-year floodplain inundation area downstream of Iron Gate Dam could change between River Mile 190 and 105.* Removal of the Four Facilities under the Proposed Action would change flow patterns and would cause some small changes to the 100 year flood plain. An additional six structures would fall within the current Federal Emergency Management Agency (FEMA) 100-year flood inundation area. In addition, the Proposed Action would release sediment stored behind the dams that could deposit downstream and change the river bed elevation.

While there may be slight changes in surface water elevation from annual variations in precipitation, or ongoing activities in the basin that could change sedimentation in the river channel, there are no projects or actions that have been identified that would substantially change the current flood risk.

The Proposed Action would implement mitigation measure H-1 that requires development of an emergency response plan for flood risk and an update to the current FEMA maps and mitigation measure H-2 that would elevate or move all six structures within the flood plain to prevent harm to people or structures. **There would be no significant cumulative effects associated with changes in flood risk.**

#### **KBRA**

*Implementation of the Fisheries Restoration Plans could change flows downstream of Upper Klamath Lake, which could result in changes to flood risks.* Actions within the floodplain and river channel could generate minor changes in flood risks in and around the specific restoration locations. There are no other known cumulative actions or projects that would change flood risks by placing structures within the floodplain and river channel. **There would be no significant cumulative effects associated with changes in flood risk. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Wood River Wetland Restoration by the Bureau of Land Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks. Implementation of Future Storage Opportunities by Reclamation may cause changes to flows upstream and down downstream of Upper Klamath Lake, which could result in changes to flood risks.* The KBRA includes a study of Wood River Wetland area management options that could provide additional water storage for a total of 16,000 acre-feet of storage capacity at or adjacent to Agency Lake. Additionally, Reclamation plans to identify and study additional off-stream storage opportunities with a 10,000 acre-feet of storage milestone in implementation of KBRA.

Additional storage upstream of Upper Klamath Lake is likely to decrease potential flood risks downstream of Upper Klamath Lake by potentially storing excess flows. No other cumulative actions or projects have been identified that would increase storage capacity and decrease flood risk. **There would be no significant cumulative effects associated with changes to flood risks. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Climate Change Assessment and Adaptive Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks.* One of the main purposes of Climate Change Assessment and Adaptive Management would be to respond to and protect basin interests from the adverse affects of climate change. Flood risks could be adversely impacted due to climate changes which increase river flows and/or flooding frequency. Klamath Basin Parties including technical experts would be involved in the development of assessment and adaptive management strategies that would be implemented continuously to respond to predicted climate changes. No other known cumulative actions or projects would help to decrease flood risks from climate change. **There would be no significant cumulative effects associated with flood risks. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.5.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative flood hydrology effects as Alternative 2. Alternative 5 would involve removal of two dams, with two dams remaining in place and overall cumulative short-term and long-term effects on flood risks would be slightly less than Alternative 2, but changes in the 100-year floodplain would still occur. Alternative 4 would not remove any dams; cumulative flood hydrology effects would be minimal and would be associated with changes in flows to accommodate fish passage facilities. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.5.3 Mitigation Measures**

No cumulative adverse effects related to flood hydrology would occur; hence, no mitigation measures are required.

#### **4.4.6 Groundwater**

Cumulative effects on groundwater would occur if other projects or actions in the area of analysis and timeframe would result in changes to groundwater levels. The timeframe for the groundwater cumulative effects analysis is after 2020 when the dams would be removed, because groundwater could be permanently changed. Table 4-11 presents a summary of groundwater impacts described in Chapter 3. These impacts are then analyzed for cumulative effects.

Very little information exists on groundwater levels in the area directly around the Four Facilities. The groundwater wells for which existing data are available (and presented in

Section 3.7, Groundwater) are almost all identified as domestic wells. Because of the lack of data, it is not possible to determine if significant cumulative effects have occurred or are presently occurring with respect to groundwater levels. The only actions identified as potentially affecting groundwater levels in the area are the construction of wells as part of past developments, and the potential for construction of new wells for the approved developments in Siskiyou County described in Table 4-4.

**Table 4-11. Summary of Groundwater Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Continued impoundment of water in the reservoirs with no changes in facility operations could result in impacts on groundwater resources.	1, 4	NCFEC	None	NCFEC
Implementation of ongoing restoration activities in the Klamath Basin could impact groundwater levels in the Upper Basin.	1, 4, 5	NCFEC	None	NCFEC
Continued impoundment of the water in the reservoirs could lead to increased groundwater storage.	1, 4, 5	B	None	B
Draining of the reservoirs could lower groundwater levels in the aquifer adjacent to the reservoirs, which could impact existing wells.	2, 3, 5	S	GW-1: Deepen or replace affected groundwater wells	LTS
Removing the dams and eliminating the reservoirs could reduce recharge to groundwater.	2, 3, 5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which would affect groundwater.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities would include the demolition of various recreation facilities which would affect groundwater.	2, 3, 5	NCFEC	None	NCFEC
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause adverse effects to local groundwater.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning the East and West Side Facilities could have adverse effects to local groundwater.	2, 3	NCFEC	None	NCFEC

**Table 4-11. Summary of Groundwater Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
<b>Klamath Basin Restoration Agreement</b>				
The Water Diversion Limitations program could reduce irrigation water in the driest years.	2,3	B (long-term)	None	B (long-term)
Upland vegetation management under the WURP would increase inflow to Upper Klamath Lake.	2,3	B (long-term)	None	B (long-term)
The purchase and lease of water under the Interim Flow and Lake Level Program would increase water for fisheries.	2,3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of an Emergency Response Plan could result in changes to groundwater following the failure of a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	NCFEC	None	NCFEC

Key:

**Key:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

WURP = Water Use Retirement Program

**4.4.6.1 Alternative 2: Full Facilities Removal of Four Dams  
Groundwater Levels**

*Under the Proposed Action, groundwater levels in existing wells adjacent to the reservoirs could decline in response to the drop in surface water elevation when the reservoirs are removed. The Proposed Action could result in a decline in groundwater levels when the reservoirs are removed. Because of the lack of existing data, it is not possible to determine if there are existing significant cumulative groundwater effects in the area around the Four Facilities. However, the approved developments noted in Table 4-4 in Siskiyou County around Iron Gate Reservoir, if constructed, may require development of new wells that could cause future declines in groundwater levels. This new development, combined with the Proposed Action's declines in groundwater levels directly adjacent to the reservoir, could result in a significant cumulative effect associated with declining groundwater levels. The Proposed Action's incremental contribution to significant cumulative groundwater effects would be cumulatively considerable;*

however, impacts would be minimized through mitigation measure GW-1, which would deepen or replace all existing wells that experience declining groundwater levels as a result of the project. With this mitigation, **the Proposed Action's incremental contribution to any significant cumulative effects on groundwater levels would not be cumulatively considerable.**

#### **Groundwater Recharge**

*The Proposed Action could reduce recharge to groundwater.* Because of the lack of existing data, it is not possible to determine if there are existing significant cumulative effects associated with groundwater recharge in the area around the Four Facilities. However, future development near the reservoir sites could, in conjunction with the Proposed Action, contribute to reduced potential for groundwater recharge and declines in groundwater levels after 2020 through an increase in impermeable surfaces and in increase in groundwater use. Overall, a significant cumulative effect associated with declining groundwater levels and reduced recharge could occur; however, the Proposed Action's contribution to this cumulative effect would be inconsequential. Current information indicates that the Klamath River reaches in the area of analysis are gaining (i.e., groundwater discharges to the stream). Additionally, the Proposed Action would not alter the volume of water that would be flowing through the project area in the Klamath River. The change in groundwater recharge would likely be small to negligible because the river would still be present. **The Proposed Action's incremental contribution to significant cumulative effects associated with groundwater recharge would not be cumulatively considerable.**

#### **KBRA**

*The Water Diversion Limitations program and the On-Project Plan could reduce irrigation water in the driest years, which could increase groundwater pumping.* Implementation of the On-Project Plan and Water Diversion Plan has the potential to generate significant short-term localized impacts through the increased use of groundwater to replace surface water deliveries. It is assumed for the purposes of this analysis that there would be significant cumulative groundwater effects because of groundwater pumping in response to overall dry conditions. The Proposed Action's incremental contribution to the significant cumulative effects would be cumulatively considerable, but would be minimized through the implementation groundwater monitoring and pumping restrictions in response to spring flow reductions over 6 percent. In the long-term, implementation of the On-Project Plan (KBRA Section 15.2) and the Water Diversion Plan (KBRA Section 15.2.4) would be expected to protect groundwater from over exploitation (through provisions prohibiting adverse impacts to groundwater, where none currently exist). **Overall, the KBRA's incremental contribution to the significant cumulative effects on groundwater would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Upland vegetation management under the WURP would increase inflow to Upper Klamath Lake, which could increase groundwater recharge.* The WURP is intended to

permanently increase the flow of water into Upper Klamath Lake by 30,000 acre-feet per year to support restoration of fish populations (KBRA Section 16.2.2). The KBRA action of implementing the WURP would increase groundwater recharge and this could have beneficial effect on groundwater levels. No other cumulative actions or projects have been identified that would increase groundwater recharge in the Klamath Basin. **There would be no significant cumulative effects associated with groundwater recharge. Implementation of the KBRA will require future environmental compliance as appropriate.**

*The purchase and lease of water under the Interim Flow and Lake Level Program would increase water for fisheries, which could increase reliance on supplies.* The Interim Flow and Lake Level Program (KBRA Section 20.4) would be an interim program of water purchase and lease to reduce surface water diversions and further the goals of the fisheries programs during the interim period prior to full implementation of the On-Project Allocation and WURP. This could increase the reliance on groundwater sources. It is assumed for the purposes of this analysis that there would be significant cumulative groundwater effects in the basin, given continued use of groundwater substitution for surface water deliveries curtailed in drought years. The Interim Flow and Lake Level Program's incremental contribution to this cumulative groundwater effect would be cumulatively considerable; however, that contribution would be mitigated through, water purchase and lease agreements, with a term greater than the interim period defined in Section 20.4.2, that would be subject to a consistency requirement with the On-Project Plan. Reduced surface water diversions would not be expected to directly result in increased adverse groundwater impacts given provisions developed to prevent impacts to groundwater in the KBRA (see Section 15.2.4). With these measures, **the KBRA's incremental contribution to significant cumulative groundwater effects would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

#### **4.4.6.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative groundwater effects as those described under Alternative 2, as all dams would be removed. Alternative 4 would not result in any cumulative groundwater effects because it would involve construction of fish passage facilities and the dams would remain in place. Alternative 5 could have some similar cumulative groundwater effects as Alternative 2; however two dams and associated reservoirs would remain in place. Any changes in groundwater levels would likely be less than under Alternative 2, but because the remaining reservoirs would be the smallest of the four, the difference in cumulative groundwater effects between Alternative 2 and Alternative 5 would likely be negligible. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.6.3 Mitigation Measures**

No cumulative adverse effects related to groundwater would occur; hence, no mitigation measures are required.

#### 4.4.7 Water Supply/Water Rights

Cumulative effects on water supply and water rights would be associated with changes in Klamath River flow rates as a result of increased demands or diversions from new or existing water supply users. The timeframe for cumulative effects associated with reservoir drawdown impacts is May 2019 through December 2020. The timeframe for long-term cumulative effects is indefinite but would occur after deconstruction is complete (after 2020). Table 4-12 presents a summary of water supply/water rights impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Continued operation of the Four Facilities could affect water supply operations.	1, 4	NCFEC	None	NCFEC
Ongoing restoration actions would continue to be implemented and could affect water supply availability.	1	NCFEC	None	NCFEC
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect water supply.	2, 3, 5	NCFEC	None	NCFEC
Removal of various recreation facilities located on the banks of the existing reservoirs which could affect water supply or water rights.	2, 3, 5	NCFEC	None	NCFEC
Flow changes downstream of Iron Gate Dam could affect water supply downstream of Seiad Valley.	2, 3, 5	LTS	None	LTS
Changes in flow downstream of Iron Gate Dam could affect water rights holders.	2, 3, 5	LTS	None	LTS
Sediment release during reservoir drawdown could affect Klamath River geomorphology and water intake pumps downstream of Iron Gate Dam.	2, 3, 5	S	WRWS-1: Modifications to intake points	LTS
Implementation of the trap and haul measures could require water rights to divert water for the fish handling facilities.	4, 5	LTS	None	LTS

**Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause changes to operations affecting water levels upstream of Keno Dam, which could cause changes to water supply or water rights.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning of the East and Westside Facilities and redirecting of water flows could affect water users reliant on a diversion from the West Canal.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
Implementation of the trap and haul element of the Fisheries Reintroduction and Management would require water rights to divert water for the fish handling facilities.	2, 3	LTS	None	LTS
Implementation of Wood River Wetland Restoration by the Bureau of Land Management would result in changes to storage opportunities at Agency Lake, which could affect water supply.	2,3	LTS	None	LTS
The study of additional off-stream storage opportunities in the Upper Klamath Basin to identify new storage opportunities, could affect water supply.	2,3	NCFEC	None	NCFEC
Implementation of Water Diversion Limitations to Reclamation's Klamath Project could result in changes to water diversions, which may affect water rights and water supply.	2,3	LTS	None	LTS

**Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Implementation of the On-Project Plan to allow for full implementation of Water Diversion Limitations to Reclamation's Klamath Project would result in changes to water diversions for irrigation in dry years, which could affect water rights or adjudicated rights.	2,3	B	None	B
Implementation of the Water Use Retirement Program increases instream flow to Upper Klamath Lake which could affect water rights and water supply upstream of Upper Klamath Lake.	2,3	LTS/NCFEC	None	LTS/NCFEC
Implementation of Off-Project Water Settlement negotiations could affect water rights and adjudicated rights upstream of Upper Klamath Lake.	2,3	B/LTS	None	B/LTS
Implementation of Off-Project Reliance Program could change water deliveries for irrigation downstream of Upper Klamath Lake to Off-Project water users affecting water rights.	2,3	LTS	None	LTS
Implementation of Drought Plan water and resource management actions could result in changes to water supply deliveries for Klamath Basin interests during drought years.	2,3	B/LTS	None	B/LTS
Implementation of an Emergency Response Plan could result in a change to water supply deliveries in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	B	None	B
Implementation of Climate Change Assessment and Adaptive Management could result in changes to water deliveries depending on climatic changes	2,3	B	None	B

**Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Implementation of Interim Flow and Lake Program during the interim period could change water deliveries affecting water supply	2,3	LTS	None	LTS

**Key:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

As described in Section 3.8, Water Supply/Water Rights, Oregon is currently undergoing an effort to adjudicate water rights on the Klamath River; this effort will define existing water rights. There are no other known past, present, or future actions or projects that would specifically affect existing water rights on the Klamath River. However, there are several projects described in Section 4.4.5, Flood Hydrology, that have the potential to alter surface water flows, which could affect water supply and the exercise of water rights.

**4.4.7.1 Alternative 2: Full Facilities Removal of Four Dams**

*Dam removal would change surface water flows available for diversion downstream of Iron Gate Dam. Klamath River water right holders between Iron Gate Dam and Seiad Valley have the potential to be affected by the changes in water supply.* Modeling results show that the Proposed Action would change flows downstream of Iron Gate Dam, and this could affect water diversions and existing water rights. The modeling considers KBRA actions in addition to dam removal.

Water supply in the Klamath Basin has been affected by the construction of Reclamation's Klamath Project, the KHP, variations in annual precipitation throughout the Klamath Basin, drought, and regulatory requirements such as the recommendations in the Biological Opinions for Reclamation's Klamath Project and the KHP that contain specific stream flow requirements. Water demands for industries such as agricultural, timber harvesting, and mining also affect water supply. Changes in water supply therefore represent significant cumulative effects in the Klamath Basin.

The Proposed Action's contribution to this cumulative effect would be minimal. The modeling results showed either a slightly higher or slightly lower flow rate on the

Klamath River downstream of Iron Gate Dam. These differences would diminish farther downstream from Iron Gate Dam. The modeling results show that at Seiad Valley, approximately 62 miles downstream from the Iron Gate Dam, the flow rates would have almost no change.

The Proposed Action would change the flows in the river downstream of Iron Gate Dam, but the flows available in the river would still be substantially greater than the peak diversion. The most conservative comparison is just downstream of Iron Gate Dam, where the flows would be the lowest in the potentially affected reach. Comparing the peak potential diversion with low flow conditions, the diversions would be approximately 16 percent of the Klamath River flows during a dry year<sup>5</sup>. The flow rate of 824 cfs is the seasonal low during the month of July, when irrigation and livestock demands are the greatest. Because the amount of flow diverted for water right users between Iron Gate Dam and Seiad Valley would be less than 20 percent of the flow in the Klamath River in the upstream portions of this reach during dry year, low flow conditions, water right users are not likely to experience decreased supplies because of the changes in flows. **The Proposed Action's incremental contribution to the significant cumulative effect on water supply and water rights would not be cumulatively considerable.**

*Release of stored sediment during drawdown of reservoirs could change Klamath River geomorphology and affect water intake pumps downstream of Iron Gate Dam.* The release of sediment from the drawdown of the reservoirs could affect downstream water intake systems. Individual downstream intake facilities could be inundated with sediment deposits, causing operational problems.

Other cumulative actions that may increase sediment and could affect downstream water intake pumps include transportation improvement project identified in Table 4-4 for Siskiyou County, new subdivisions near Iron Gate Dam in Siskiyou County, and other proposed developments. Other more general projects and activities that are not easily identifiable but likely to occur, such as timber harvesting, mining, and agriculture, livestock grazing, and road-related erosion could also contribute to cumulative effects associated with sediment. Climate change could also affect sediment by increasing the number of heavy precipitation events each year.

Increased sediment in the Klamath River could result in significant cumulative effects on downstream water intake pumps. The Proposed Action's contribution to the significant cumulative impacts on water intake pumps from increased sediment would be cumulatively considerable; however, mitigation measure WRWS-1 would mitigate that contribution. The subject measure would provide for an investigation of potentially affected intake and pump sites at the request of the water user. If effects on water supply intakes occur as a result of dam removal, the DRE will complete modifications to intake points as necessary to reduce effects to a less-than-significant level. **With implementation of this mitigation, the Proposed Action's incremental contribution**

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<sup>5</sup> The increase during July and August is an average based on reported values on Statement Diversion and Use forms available on California Electronic Water Rights Information Management System for the Klamath River.

**to the cumulative effects on water intake pumps from sedimentation associated with reservoir drawdown would not be cumulatively considerable.**

*Activities associated with IMs could result in changes to PacifiCorp's water rights.* Prior to construction, IM 16 (Water Diversions) would eliminate three screened diversions from Shovel and Negro Creeks and would seek to modify PacifiCorp's water rights to move the points of diversion to the mainstem Klamath River. As discussed above, water supply in the Klamath Basin has been adversely affected over time, and changes in water supply represent significant cumulative effects.

The Proposed Action's contribution to this cumulative effect through implementation of IMs would be minimal. While this measure would require a change to PacifiCorp's water rights, it would not affect the exercise of the water right (i.e., the quantity of water diversions) or flow in the Klamath River. **Therefore, the Proposed Action's incremental contribution to the significant cumulative effect on water supply and water rights would not be cumulatively considerable.**

#### **KBRA**

*Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan would require water rights to divert water for the fish handling facilities.* Fish handling facilities to collect fish downstream of Keno Dam and at Link River Dam would require water sources. The facilities would not consumptively use the water; the water would pass through the facilities for release back into the system. The geographic separation between this project and the hydroelectric facility removal actions analyzed above eliminate any potential for negative water supply effects generated by this program from contributing to water supply effects generated by facility removal. **The trap and haul element of the Fisheries Reintroduction and Management Plan would not contribute to the significant cumulative effects on water supply would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of the Wood River Wetland Restoration Project would result in changes to water storage opportunities at Agency Lake, which could affect water supply. The study of additional off-stream storage opportunities in the Upper Klamath Basin to identify new storage opportunities could affect water supply.* A study of Wood River Wetland area management options would investigate the potential for providing additional water storage for a total of 16,000 acre-feet of storage capacity at or adjacent to Agency Lake. Additionally, Reclamation plans to identify and study additional off-stream storage opportunities. KBRA parties would support ongoing investigations and acquisition of additional storage. This additional storage would improve water supply reliability and assist with alleviating short-term impacts related to water supply delivery during Water Diversion Limitations (another KBRA program) helping to offset a portion of the deficiencies. No other cumulative actions or projects have been identified that would increase storage on the Klamath River. **There would be no significant cumulative effects on water supply from changes in water storage. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Water Diversion Limitations to Reclamation's Klamath Project could result in changes to water diversions, which may affect the exercise of certain water rights and water supply.* Water Diversion Limitations provide specific allocation of water for refuges and limitations on specific diversions for the Reclamation's Klamath Project intended to increase water availability for fisheries purposes. While reducing diversions during the driest years would affect water supply for irrigation, it would not affect what is needed for public health and safety. Water may not be available to fulfill some water rights or adjudication claims during dry years; however, the On-Project Plan, Drought Plan, and Future Storage Opportunities to be implemented as part of the KBRA would help to offset a portion of these deficiencies. No other cumulative actions or projects have been identified that would change water diversions and affect water rights and water supply. **There would be no significant cumulative effects associated with water supply and water rights. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of the On-Project Plan to allow for full implementation of Water Diversion Limitations to Reclamation's Klamath Project would result in changes to water diversions for irrigation in dry years, which could affect the exercise of certain water rights or adjudicated rights.* The purpose of the On-Project Plan is to provide additional water supply or reduce the demand for Reclamation's Klamath Project to make up the differences between anticipated use and actual diversion. These actions include: land fallowing and shifting to dryland crop alternatives, efficiency and conservation measures (i.e. drip irrigation), development of groundwater sources, or creation of additional storage. No other cumulative actions or projects have been identified that would affect water supply and water rights. **There would be no significant cumulative impacts associated with water supply and water rights. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of the WURP increases instream flow to Upper Klamath Lake which could affect water rights and water supply upstream of Upper Klamath Lake.* The WURP is a voluntary program for the purpose of supporting fish populations restoration by permanently increasing inflow to Upper Klamath Lake by 30,000 acre-feet per year. Some measures include implementing water efficiency projects, increasing natural storage through wetland or improved riparian area performance, and purchase and retirement of water rights from willing sellers. This could affect water rights, although retirement of water rights would be voluntary. No other cumulative actions or projects have been identified that would result in the purchase or retirement of water rights from willing sellers. **The KBRA's incremental contribution to the significant cumulative effects on water supply would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Off-Project Water Settlement (OPWAS) negotiations could affect the exercise of certain water rights and adjudicated rights upstream of Upper Klamath Lake.* The intent of OPWAS is to negotiate a settlement of long-standing water disputes

between the Upper Klamath Water Users Association, Klamath Tribes and the Bureau of Indian Affairs. The negotiated settlements would resolve certain contests to significant major water right claims in the Upper Klamath Basin. Implementation of OPWAS would be a beneficial impact to resolve water rights and adjudicated rights and a less than significant impact to unresolved cases due to reciprocal assurances. There are no cumulative actions or projects that have been identified that would resolve certain contests to major water rights claims that could affect water supply/water rights. **The KBRA’s incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Off-Project Reliance Program could change water deliveries for irrigation upstream of Upper Klamath Lake to Off-Project water users, affecting the water supply.* The agreement establishes a program to avoid or mitigate the immediate effects of unexpected circumstances affecting water availability for irrigation in the Off-Project area. Activities under the Off-Project Reliance Program may include: funding water leasing to increase water supply availability for irrigation in the Upper Klamath Basin or mitigating the economic impacts of lost agricultural production by Off-Project irrigators. The program it is intended to provide additional water availability and help minimize reductions in water supply. No other cumulative actions or projects have been identified that would substantially change water supply availability. **The KBRA’s incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Drought Plan water and resource management actions could result in changes to water supply deliveries for Klamath Basin interests during drought years. Implementation of an Emergency Response Plan could result in a change to water supply deliveries in the event of failure to a facility in Reclamation’s Klamath Project or dike on Upper Klamath Lake or Lake Ewauna. Implementation of Climate Change Assessment and Adaptive Management could result in changes to water deliveries depending on climatic changes.* The Drought Plan would improve short-term water supply reliability during drought by releasing stored water, paid forbearance agreements, conservation, groundwater substitution, or groundwater sharing. The Emergency Response Plan would prepare water managers for an emergency affecting the storage and delivery of water needed for KBRA implementation. The Climate Change Assessment and Adaptive Management program would respond to and protect basin interests from the adverse affects of climate change by improving storage capabilities during the wet years and conservation during dry years. Implementation of these programs would be beneficial to water supply because they would help to reduce the effects of drought, climate change, and emergencies by increasing water supplies and/or improving water supply reliability. No other known cumulative actions or plans would increase water supply reliability or water supply during drought, climate change, or emergency situations. **The KBRA’s incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects**

**described in the KBRA will require future environmental compliance as appropriate.**

*Implementation of Interim Flow and Lake Program during the interim period could change water deliveries affecting water supply.* The goal of the Interim Flow and Lake Level Program is to “further the goals of the Fisheries Program” through an interim program of water purchases and leases during the interim period prior to full implementation of the On-Project Plan and WURP. Leases and purchases of water under this interim program shall be from willing sellers and counted towards instream water supply. No other known cumulative actions or projects would result in the purchase or lease of water during the interim period. **The KBRA’s incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.7.2 Alternatives 3, 4, and 5**

Alternatives 3 and 5 would have similar cumulative water supply and water rights impacts as described for Alternative 2 because both alternatives would involve dam removal. Alternative 4 would have no cumulative water supply or water rights impacts because it would involve construction of fish passage facilities and would not affect water supply or water rights. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.7.3 Mitigation Measures**

No cumulative adverse effects related to water supply and water rights would occur; hence, no mitigation measures are required.

#### **4.4.8 Air Quality**

Cumulative air quality effects occur when a variety of projects or sources contribute to emissions in the area of analysis. The timeframe for air quality impacts associated with deconstruction would be the length of the deconstruction/construction period.

Deconstruction and construction activities would occur during 2019 and 2020 for Alternatives 2, 3, and 5. Construction activities for Alternative 4 would occur during 2022 through 2025.

Table 4-13 presents a summary of air quality impacts described in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4-13. Summary of Air Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Vehicle exhaust and fugitive dust emissions from dam removal activities and construction of fish passage could increase emissions of VOC, NOx, CO, SO <sub>2</sub> , PM <sub>10</sub> , and PM <sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks AQ-4: Dust control measures during blasting operations	S
	4	LTS	None	LTS
	5	S	AQ-1: MY 2015 or newer engines for offroad construction equipment	LTS
Relocation of the City of Yreka water supply pipeline could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
<b>Interim Measures (IM's)</b>				
Activities associated with interim measure (IM) 7 J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	1,2,3	LTS	None	LTS

**Table 4-13. Summary of Air Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Activities associated with interim measure (IM) 8 J.C. Boyle Bypass Barrier Removal could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	1	LTS	None	LTS
Activities associated with interim measure (IM) 16 Water Diversions could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	2,3	LTS	None	LTS
Reservoir restoration actions could result in short-term and temporary increases in criteria pollutant emissions from the use of helicopters, trucks, and barges that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	S	None	S
Relocation and the demolition of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from the operation of construction equipment that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas.	2, 3, 4, 5	LTS	None	LTS

**Table 4-13. Summary of Air Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could have adverse effects on air quality.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning the East and West Side Facilities could cause adverse air quality effects.	2, 3	LTS	None	LTS
<b>KBRA</b>				
Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.	2, 3	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	S <sup>6</sup>
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap-and-haul activities.	2, 3	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	S <sup>3</sup>
<b>Air Quality – Trap and Haul</b>				
Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.	4, 5	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	LTS

<sup>6</sup> While Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce impacts to LTS, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

**Table 4-13. Summary of Air Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
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**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

**4.4.8.1 Alternative 2: Full Facilities Removal of Four Dams**

*Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of volatile organic carbon (VOC), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), inhalable particulate matter < 10 microns (PM<sub>10</sub>), and fine particulate matter < 2.5 microns (PM<sub>2.5</sub>) to levels that could exceed Siskiyou County's thresholds of significance. Under the Proposed Action, total emissions of NO<sub>x</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> exceed the significance criteria for the Four Facilities. The greatest source of NO<sub>x</sub> emissions from each of the dams would be off-road construction equipment, followed by on-road trucks, and then employee commuting vehicles. The major sources of PM<sub>10</sub> and PM<sub>2.5</sub> emissions would be fugitive dust from unpaved roads and then cut/fill activities. Secondary formation of PM<sub>2.5</sub> could also occur from NO<sub>x</sub> and sulfur oxide (SO<sub>x</sub>) emissions; however, these pollutants are not emitted in sufficient quantities to affect the Klamath Falls Nonattainment Area. Any adverse impacts would be temporary.*

The population in the affected counties is expected to increase in the future. Increases in population and housing could increase traffic, utility demands, and construction projects, which could all result in increased air pollution. Additionally, air pollutant emissions associated with past and present development and activities have contributed to local and regional air pollution. As a result, the air quality emissions in the region create significant cumulative air quality effects. Dam removal would have an incremental contribution to the cumulative effect that would be cumulatively considerable. Dam removal would result in substantial, albeit temporary emissions, of construction-related air pollutants (i.e., equipment emissions and fugitive dust) and resultant air quality impacts near the project sites. Even with all feasible mitigation measures (AQ-1 through AQ-4), the Proposed Action would cause a substantial air quality impact associated with PM<sub>10</sub> emissions because it would exceed Siskiyou County Air Pollution Control District Rule 6.1 permitting criteria. The Proposed Action's contribution to the cumulative effect would be significant. No additional feasible mitigation is available to adequately reduce project-related impacts below the criteria. **The incremental contribution to the significant cumulative effect on air quality from dam removal would be cumulatively considerable. No other feasible mitigation is available to reduce these impacts; therefore, they remain cumulatively considerable.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.* Although criteria pollutant emissions are expected to be less than significant for the construction of the City of Yreka water supply pipeline, air pollutant emissions associated with past and present development have contributed to local air pollution. As a result, the air quality emissions in the region are considered significant cumulative effects. The contribution to the significant cumulative air quality effect from construction of the water supply pipeline would not be cumulatively considerable. Relocation of the pipeline is expected to result in some air quality effects from the use of equipment; however, the duration would be very short and equipment use would be minimal. These construction activities would occur before demolition activities at Iron Gate and would not overlap with other construction or demolition activities. Peak emissions are not expected to exceed significance criteria. No long-term effects air quality effects would occur. **The incremental contribution to significant cumulative air quality effects from construction of the City of Yreka's water supply pipeline would not be cumulatively considerable.**

*Activities associated with several IMs could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.* As discussed above, air pollutant emissions associated with past and present development and activities have contributed to local and regional air pollution; therefore, air quality emissions are considered significant cumulative effects. IMs would be implemented prior to facilities removal; therefore, they would not contribute to the emissions from those activities. IMs 7 and 16 would result in a small increase in emissions associated with construction vehicles, haul trucks, and construction workers. However, based on the limited amount of construction equipment expected to be used simultaneously, peak daily emissions are not expected to exceed the significance criteria described previously and would not result in long-term effects. **The incremental contribution to significant air quality effects from implementation of IMs would not be cumulatively considerable.**

*Restoration actions could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust from the use of helicopters, trucks, and barges.* As discussed above, air pollutant emissions associated with past and present development and activities have contributed to local and regional air pollution. As a result, the air quality emissions in the region are considered significant cumulative effects. Restoring the reservoir areas would produce an incremental contribution to the cumulative effect that would be cumulatively considerable. Restoration actions would result in substantial, albeit temporary emissions, of construction-related air pollutants (i.e., equipment emissions and fugitive dust) and resultant air quality impacts near the project sites. Even with all feasible mitigation measures (AQ-1 through AQ-4), the restoration actions would cause substantial air quality impacts. These revegetation actions would be happening simultaneously with the demolition of the Four Facilities; therefore,

emissions would contribute to those already occurring for dam removal. **The restoration actions' incremental contribution to the significant cumulative effect on air quality would be cumulatively considerable. No additional feasible mitigation is available to adequately reduce project-related impacts below the criteria; therefore, impacts remain cumulatively considerable.**

*Relocation and demolition of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust.* Air pollutant emissions associated with past and present development have contributed to local air pollution. As a result, the air quality emissions in the region are considered significant cumulative effects. Demolition and relocation of recreation facilities would result in contributions to the cumulative effect that would be cumulatively considerable. On- and off-road construction equipment would be used to complete these activities, which would occur after the dam demolition actions. Based on the number of recreation facilities that would be relocated or demolished, it is assumed that emissions could exceed existing criteria; however, implementation of mitigation measure AQ-1, AQ-2, and AQ-3 would be implemented to reduce emissions to levels to less than significant and minimize the contribution to cumulative impacts. **The incremental contribution to the significant cumulative effect on air quality from relocation and demolition of recreation facilities would not be cumulatively considerable.**

*Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas.* Dam demolition activities would create fugitive dust and could temporarily impair visibility. No other known cumulative actions or projects would substantially increase dust and impair visibility during reservoir demolition because most of the area would be closed to outside traffic and restricted to construction worker use for safety concerns. **There would be no significant cumulative fugitive dust effects that could impair visibility.**

#### **KBRA**

*Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.* *Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap-and-haul activities.* Potential construction activities include channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. Several of these activities would require construction equipment with the potential to emit air quality pollutants. As noted above, the air quality emissions in the region are considered significant cumulative effects. Due to the potentially large amount of construction activities that would occur for the various KBRA programs, it is anticipated that the KBRA's incremental contribution to the significant cumulative air quality effects would be cumulatively considerable. Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce these effects. **With mitigation, the KBRA's incremental contribution to the cumulative effects on air quality would not be cumulatively considerable; however, emissions from any**

**construction actions completed in the same year as hydroelectric facility removal actions may remain cumulatively considerable even with all feasible mitigation. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.8.2 Alternatives 3, 4, and 5**

Alternatives 3 and 5 would have similar cumulative effects to the Proposed Action as both of these alternatives would exceed existing criteria and would cause cumulatively considerable air quality impacts during construction. Alternative 4 would have less cumulative effects because no dams would be removed. Alternative 4 would not result in cumulatively considerable impacts from construction emissions. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.8.3 Mitigation Measures**

The Proposed Action, Alternative 3, and Alternative 5 would have cumulatively considerable impacts associated with construction emissions, even with implementation of all feasible mitigation. No other feasible mitigation is available to reduce these emissions; therefore, the cumulative effects associated with on- and off-road construction equipment would remain cumulatively considerable for Alternatives 2, 3, and 5.

#### **4.4.9 Greenhouse Gases/Global Climate Change**

By its very nature, climate change is a cumulative impact from various global sources of activities that incrementally contribute to global GHG concentrations. Individual projects provide a small addition to total concentrations, but contribute cumulatively to a global phenomenon. The goal of California Assembly Bill (AB) 32 and Oregon House Bill 3543 both require GHG emission reductions from existing conditions. As a result, cumulative GHG and climate change impacts must be analyzed from the perspective of whether they would impede each state's ability to meet its emission reduction goals. While it is not necessary to show zero or negative GHG emission impacts, the project must show a reduction in emissions from business-as-usual. The timeframe for short-term deconstruction/construction related effects is the duration of construction. The timeframe for the power replacement is indefinite as this would be a permanent change. Table 4-14 presents a summary of GHG/climate change impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-14. Summary of Greenhouse Gases/Global Climate Change Impacts from Chapter 3**

<b>Potential Impact</b>	<b>Alternative(s)</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Vehicle exhaust from dam removal activities and construction of fish passage could increase GHG emissions in the short-term to levels that could exceed the designated significance criteria.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	LTS	None	LTS
Relocation of the City of Yreka water supply pipeline could result in short-term increases in GHG emissions from vehicle exhaust.	2, 3, 5	LTS	None	LTS
Activities associated with interim measures (IM) 7 J.C. Boyle Gravel Placement and/or Habitat could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	1,2,3	LTS	None	LTS
Activities associated with interim measures (IM) 8 J.C. Boyle Bypass Barrier Removal Enhancement could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	1	LTS	None	LTS
Activities associated with interim measures (IM) 16 Water Divisions could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	2,3	LTS	None	LTS
Reservoir restoration actions could result in short-term increases in GHG emissions from the use of helicopters, trucks, and barges.	1, 2, 3, 5	LTS	None	LTS
The demolition of various recreation facilities which could result in short-term increases in GHG emissions from vehicle exhaust.	2, 3, 5	LTS	None	LTS
Removing or reducing a renewable source of power by removing the dams or developing fish passage could result in increased GHG emissions from possible non-renewable alternate sources of power.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	S	CC-1: Market mechanisms CC-2: Energy audit program CC-3: Energy conservation plan	S

**Table 4-14. Summary of Greenhouse Gases/Global Climate Change Impacts from Chapter 3**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of trap and haul measures could result in temporary increases in GHG emissions from vehicle exhaust	4, 5	LTS	None	LTS
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause short-term and temporary increases in GHG emissions.	2,3	NCFEC	None	NCFEC
<b>East and West Side Facility Decommissioning</b>				
Decommissioning the East and West Side Facilities could cause short-term and temporary increases in GHG emissions.	2,3	LTS	None	LTS
<b>KBRA</b>				
Construction activities associated with the KBRA programs involving construction could cause temporary increases in GHG emissions and climate change	2,3	LTS	None	LTS
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in GHG emissions from vehicle exhaust associated with trap-and-haul activities.	2,3	LTS	None	LTS
Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources which would provide affordable electricity to allow efficient use, distribution, and management of water.	2,3	B	None	B
Implementation of the Drought Plan and the Climate Change Assessment and Adaptive Management Plan could affect climate change-related impacts.	2,3	B	None	B

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

#### **4.4.9.1 Alternative 2: Full Facilities Removal of Four Dams Effects of the Proposed Action on Climate Change**

*Vehicle exhaust from dam removal activities could increase GHG emissions in the short-term to levels that could exceed the significance criteria.* Under the Proposed Action, there would be a net increase in GHG emissions from deconstruction of the facilities; however, these emissions would be temporary and would not contribute to long-term emissions. Construction related activities associated with decommissioning of the dams would contribute 8,747 metric tons per carbon dioxide (CO<sub>2</sub>) equivalent (MTCO<sub>2</sub>e) to California's GHG emission for one year<sup>7</sup>. Amortizing these construction emissions over thirty years results in approximately 292 MTCO<sub>2</sub>e per year, well below the 10,000 MTCO<sub>2</sub>e threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 1,253 MTCO<sub>2</sub>e below the threshold. The 1990 GHG emissions level (and so the 2020 emissions target ascribed by AB 32) is 427 million metric tons of CO<sub>2</sub>e (MMTCO<sub>2</sub>e). The emissions from dam removal would be 0.002 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 MMTCO<sub>2</sub>e; therefore, the Proposed Action would equal approximately 1 percent of allowable construction emissions.

Climate change by nature is a result of cumulative emissions of GHG on a global scale. Worldwide, California<sup>8</sup> is the twelfth to sixteenth largest emitter of CO<sub>2</sub>, and is responsible for approximately two percent of the world's CO<sub>2</sub> emissions (California Energy Commission [CEC] 2006). As shown in Figure 3.10-1, transportation is responsible for 37 percent of the State's GHG emissions, followed by electricity generation (24 percent), the industrial sector (19 percent), commercial and residential (9 percent), agriculture and forestry (6 percent) and other sources (5 percent). It is reasonable to expect that these sectors would continue to contribute to GHG emissions in the future. Climate change therefore represents a significant cumulative effect for the entire State and could have a variety of meteorological and hydrologic implications, described in Section 3.10.4.1, Greenhouse Gases/Global Climate Change.

The Proposed Action would generate GHG emissions only for the duration of construction; no long-term GHG emissions would be produced. Because emissions would represent 1 percent of allowable construction emissions at the 1990 level, **the incremental contribution to the significant cumulative effect on climate change from deconstruction would not be cumulatively considerable.**

*Activities associated with several IMs could result in short-term and temporary increases in GHG emissions from vehicle exhaust. Restoration actions could result in short-term*

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<sup>7</sup> The value of 8,747 MTCO<sub>2</sub>e includes emissions from the JC Boyle Dam. Although J.C. Boyle Dam is located in Oregon, CEQA requires project impacts to be evaluated for significance. Since the Proposed Action includes the removal of J.C. Boyle Dam, emissions from its removal were included in the significance determination.

<sup>8</sup> Although the area of analysis for the project is restricted to portions of northern California and southern Oregon, GHG emissions data is not available at this level of detail; therefore, background emissions data (i.e., existing conditions) is presented at the state-level for both California and Oregon.

*and temporary increases in GHG emissions from the use of helicopters, trucks, and barges. Relocation and demolition of various recreation facilities could result in short-term and temporary increases in GHG emissions from vehicle exhaust.* Before deconstruction activities begin, IMs 7 and 16 would involve vehicle traffic that would temporarily increase GHG emissions. Following drawdown of the reservoirs, revegetation efforts would be initiated using helicopters, trucks, and barges that would produce emissions. Some recreation facilities would be relocated or demolished. These activities would produce GHG emissions and could contribute to climate change. As noted above, climate change represents a significant cumulative effect for the entire State and could have a variety of meteorological and hydrologic implications, described in Section 3.10.4.1, Greenhouse Gases/Global Climate Change. Restoration actions and relocation or demolition of recreation facilities would make a minimal incremental contribution to significant cumulative climate change effects. Sufficient information is not currently available to quantify emissions; however, emissions are not expected to impede compliance with AB 32. The short duration of restoration actions and recreation facility demolition and relocation would minimize any emissions that would occur. Furthermore, the addition of new grassland and other vegetation would sequester CO<sub>2</sub> emissions in the long-term, but the sequestered CO<sub>2</sub> would likely not offset all of the emissions occurring during restoration on an annual basis. It is possible that the addition of emissions from the barges and trucks to other dam demolition activities could cause emissions to exceed the 10,000 MTCO<sub>2</sub>e per year threshold; however, even if emissions doubled, amortized emissions over thirty years would not exceed the applicable threshold. **The incremental contribution to the significant cumulative effects associated with GHG emissions from restoration and recreation facility relocation or demolition would not be cumulatively considerable.**

#### **Power Replacement**

*Removing a renewable source of power by removing the dams could result in increased GHG emissions from possible non-renewable alternate sources of power.* As described above, climate change from GHG emissions represents a significant cumulative effect for the State. The emissions generated from power replacement would be permanent. The possible increase that may result from replacing the dam facilities with higher emitting power producing facilities would account for three percent of the expected emissions reduction. Under a business-as-usual scenario, which assumes that the Scoping Plan would not be implemented, this would impede California's ability to meet its emission reduction goal. The Proposed Action's incremental contribution to cumulative effects on climate change would be cumulatively considerable. Mitigation Measures CC-1 through CC-3 would be implemented to reduce emissions from power replacement. While these measures would lessen emissions, **the incremental contribution to the significant cumulative effect associated with GHG emissions and climate change from power replacement would remain cumulatively considerable until PacifiCorp adds new sources of renewable power that would replace the removed dams.**

#### **KBRA**

*Construction activities associated with the KBRA could cause temporary increases in GHG emissions and climate change. Operational activities associated with the Fisheries*

*Reintroduction and Management Plan could result in temporary increases in GHG emissions from vehicle exhaust associated with trap-and-haul activities.* Several KBRA programs may cause some GHG emission impacts from the use of vehicles and heavy equipment. As described above, climate change from GHG emissions represents a significant cumulative effect for the State. The KBRA's incremental contribution to GHG emissions and climate change would be minimal and short-term. Sufficient information is not currently available to quantify emissions; however, the quantity of equipment required to complete these activities is expected to be less than that required to complete the dam removal activities. Emissions are not expected to exceed the South Coast Air Quality Management District (SCAQMD)'s threshold of significance for industrial emissions (10,000 MTCO<sub>2</sub>e per year), especially when amortized over thirty years. **The incremental contribution to significant cumulative effects associated with GHG emissions and climate change from KBRA construction activities would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources which would provide affordable electricity to allow efficient use, distribution, and management of water. Implementation of the Drought Plan and the Climate Change Assessment and Adaptive Management Plan could affect climate change-related impacts.* KBRA actions could involve the development of renewable energy sources, which would provide green energy. The Drought Plan would identify water and resource management actions to minimize risk associated with drought, which is a projected climate change impact for the Klamath Basin and the Pacific Northwest. The Climate Change Assessment and Adaptive Management Plan includes early and frequent assessment of the existing and future impacts of climate change. Together, these actions and programs would have beneficial effects associated with climate change. One other project, the Klamath Falls Bioenergy Facility, is in the early stages of planning but has issued a Notice of Intent to file an application from the Oregon Department of Energy (ODE) (see Table 4-4). This facility would burn wood waste and would produce up to 38.5 megawatts (MW) of electrical power. Together these actions would result in beneficial cumulative effects on climate change by providing electricity produced by renewable resources. **The incremental contribution to the significant cumulative effects associated with climate change and GHG from the Power for Water Management Program, the Drought Plan, and the Climate Change Assessment and Adaptive Management Plan would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

#### **4.4.9.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative effects to the Proposed Action as all Four Facilities would be removed. Alternative 5 would have similar construction related cumulative effects to the Proposed Action, although there would be less of a contribution to the cumulative GHG impacts because there would be less overall emissions as only two dams would be removed. Alternative 4 would have construction-related emissions but they would be less than Alternatives 2 and 3 because Alternative 4 would involve fish passage facility construction rather than dam removal. The Proposed Action, Alternative

3, and Alternative 5 would have cumulatively considerable impacts associated with the loss of hydropower and the replacement of the power with alternate sources. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### 4.4.9.3 Mitigation Measures

The loss of hydropower and the possible replacement of that power with another energy source would have cumulatively considerable impacts associated with GHG emissions and climate change. No additional feasible mitigation is available to reduce these emissions; therefore, the impact remains cumulatively considerable for Alternatives 2, 3, and 5.

#### 4.4.10 Geology, Soils and Geologic Hazards

Cumulative effects on geology, soils, and geologic hazards would be associated with erosion and sedimentation downstream of Iron Gate Dam. The timeframe for the cumulative effects analysis includes the duration of construction and continues up to ten years afterwards (the expected duration for sand in the bed to return to equilibrium levels between Willow Creek and Cottonwood Creek).

Table 4-15 lists the impacts and mitigation presented in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4-15. Summary of Geology, Soils and Geologic Hazards Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Continued impoundment of water in the reservoirs could continue to trap sediment at rates similar to historical rates.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could continue to prevent access to the diatomite beds at Copco 1 Reservoir.	1, 4	NCFEC	None	NCFEC
Draining of the reservoirs could uncover diatomite beds at Copco 1 Reservoir; however the land would be transferred to a State agency which would not allow commercial use, access to the mineral resource would not be changed.	2, 3, 5	NCFEC	None	NCFEC
Construction and deconstruction activities could change erosion patterns through heavy vehicle use, excavation, and grading which could result in soil erosion.	2, 3, 4, 5	LTS	None	LTS
Draining of the reservoirs could cause instability along the banks of the reservoirs	2, 3, 5	LTS	None	LTS

**Table 4-15. Summary of Geology, Soils and Geologic Hazards Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Draining of Copco 1 Reservoir could eliminate wave induced erosion thereby improving stability for upland hillsides and reducing the potential for erosion.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could cause river bank erosion downstream.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in short-term increases in sedimentation in slow-moving eddies and pools downstream from the reservoirs to the Klamath River estuary.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in changes to seismic or volcanic activity.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in long-term changes in the amount of erosion of the exposed reservoir bottom sediment remaining in the river channel.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in long-term changes to downstream sediment deposition from the erosion of remaining reservoir sediments.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could leave sediments that would dry out and could affect restoration activities and/or future road construction activities.	2, 3, 5	S	GEO-1: Geotechnical analysis of the site	LTS
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect geology and soils.	2, 3,5	NCFEC	None	NCFEC
Dam removal activities would include the removal of various recreation facilities which could affect geology and soils.	2, 3, 5	NCFEC	None	NCFEC
<b>Keno Transfer</b>				
The Keno Transfer could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
The decommissioning of the East and West Side Facilities could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
Implementation of the Phase I Fisheries Restoration Plan could result in construction related sediment erosion.	2, 3	LTS/B	None	LTS/B

**Table 4-15. Summary of Geology, Soils and Geologic Hazards Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
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**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

The major past actions that have affected geology, soils, and geologic hazards in the area of analysis are the construction of the KHP and Reclamation’s Klamath Project. These actions have permanently altered the natural erosion and deposition processes of the Klamath River, increased the potential for landslides and erosion in some areas, and restricted access to mineral resources through the presence of the reservoirs. These actions continue to affect geology, soils, and geologic hazards today. Past actions that have increased soil erosion or altered soils include timber harvesting, urban development, agriculture, and mining. Actions potentially benefitting soil erosion include soil erosion control measures required by the Five Counties Road Maintenance Program, and the Northwest Forest Plan, as well as existing water quality and stormwater regulations (CWA Section 401, and 402, TMDLs). In the future, proposed new subdivisions identified in Table 4-3 could increase soil erosion; however, they are expected to adhere to existing regulations and implement measures to minimize soil erosion and stormwater runoff.

**4.4.10.1 Alternative 2: Full Facilities Removal of Four Dams Alternative  
Soil Erosion and Sedimentation during Deconstruction**

*Soil disturbance associated with heavy vehicle use, excavation, and grading could result in erosion during removal activities. Drawdown of reservoirs could cause bank erosion downstream. Drawdown of reservoirs and release of sediment would result in short-term increases in sedimentation in slow-moving eddies and pools downstream from the reservoirs and in the Klamath River estuary. Soil erosion has increased in the past due to human activity and has altered the Klamath River’s banks. Increased sedimentation in the Klamath River has also adversely affect water quality and aquatic species. Other cumulative actions and projects that could contribute to soil erosion and sedimentation in the river include road improvement projects, new subdivisions, and other future developments. Other more general projects and activities that are likely to occur, such as timber harvesting, mining, agriculture, livestock grazing, and road-related erosion could also contribute to cumulative effects associated with sediment. Soil erosion and sedimentation represent significant cumulative effects.*

Because soil disturbance from heavy vehicle use, excavation, and grading could result in erosion during deconstruction activities, the Proposed Action's incremental contribution to the cumulative effect associated with soil erosion would be cumulatively considerable; however, mitigation would be implemented to minimize these impacts. The Proposed Action would obtain coverage under the General Stormwater National Pollution Discharge Elimination System Permit (NPDES) for Construction Activities in both Oregon and California would be required as per Section 402 of the CWA. Coverage under this permit requires the development and implementation of an Erosion and Sediment Control Plan prior to deconstruction that describes BMPs to prevent erosion. Implementation of these BMPs would minimize the potential for erosion into the reservoir areas and would reduce the Proposed Action's contribution to the cumulative effect. Inasmuch as the requirements of the General Stormwater NPDES Permit for Construction Activities apply to all new construction, such BMPs would also be implemented in other projects, thereby reducing overall cumulative effects.

Drawdown of the Four Facilities would occur simultaneously beginning in January 2020, but is not expected to substantially increase soil erosion through landslides or declining water levels. Although some landslides and erosive areas have been identified in the lower river, based on the expected flow rates that are similar to existing flow rates, substantial amounts of additional erosion are not expected to occur downstream from any of the dams as a result of reservoir drawdown. The proposed drawdown rates are consistent with the historic discharge rates from the reservoirs and would be adjusted depending on the water year; therefore, flow rates downstream from the dams are not anticipated to increase substantially above median historic rates, if at all (discharges from the reservoirs would be similar to seasonal 10-year flood flows from the reservoirs). Additionally, existing erosion at Copco 1 Reservoir is largely the result of wave action, and emptying the reservoir would remove the source of shoreline erosion and future landslides and would ultimately result in improved stability for the upland hillsides and existing development.

During reservoir drawdown in 2020, the sediment behind the four dams would be released downstream. Since all reservoirs would be drawn down concurrently, sediment released from the upstream reservoirs would remain suspended and is not anticipated to settle within Iron Gate Reservoir. However, the released sediment would likely exceed the carrying capacity of the river during some water year types, and would result in sedimentation and particle settling downstream in eddies, pools, and the Klamath River estuary. Any settling or sedimentation of fine sediment in eddies or pools is expected to be minimal and short-lived. Little settling or sedimentation is expected to occur in the Klamath River estuary, particularly due to the location of its sandbar offshore (rather than within the mouth itself). Overall, the release of sediment downstream during reservoir drawdown would not exceed the existing sediment load added by any tributary, and as such the transport capacity of the river may be sufficient to transport the additional load, particularly since the river is supply-limited in regards to fine-grained material and sand.

**The Proposed Action's incremental contribution to the short-term significant cumulative effects associated with soil erosion and sedimentation from**

**deconstruction activities and reservoir drawdown would not be cumulatively considerable.**

### **Bank Stability and Landslides**

*Drawdown of the four reservoirs could cause instability along the banks of the reservoirs. Reservoir drawdown at Copco 1 would reduce the potential for erosion and future landslides.* No large-scale landslides are anticipated in newly exposed areas during drawdown. In the long-term with implementation of reservoir restoration actions including hydro seeding, landslides and erosion would not be expected at a higher frequency or of a larger size than what is currently contributed from the slopes currently adjacent to the reservoirs. Because existing erosion at Copco 1 Reservoir is largely the result of wave action, emptying the reservoir would remove this source of shoreline erosion. No other cumulative actions or projects would substantially change the stability of the banks or the potential for landslides during reservoir drawdown. **There would be no significant cumulative effects associated with bank stability and landslides during reservoir drawdown.**

### **Seismic Activity**

*Drawdown of reservoirs could result in changes to seismic or volcanic activity.* Reservoir drawdown is not expected to result in substantial changes in seismic or volcanic activity in the area of analysis. No other known actions or projects in the area of analysis would have the potential to change the seismic or volcanic risk in the area of analysis. **There would be no significant cumulative effects.**

### **Soil Erosion and Sediment Deposition after Dam Removal**

*Following dam removal, reservoir sediment remaining could result in changes in the amount of erosion in the river channel. Following dam removal, reservoir sediments remaining could result in changes to downstream sediment deposition.* As noted above, soil erosion and sediment deposition have adversely affected the Klamath River and are considered significant cumulative effects. The Proposed Action's contribution to these cumulative effects would be short-term and minimal.

After dam removal, approximately 38 to 56 percent of sediment would be eroded, depending on the water year type. The remaining sediment would remain on the reservoir terraces and dry. Minimal erosion is expected following completion of reservoir drawdown and dam removal activities.

After it is dry, the remaining sediment would be unlikely to erode downstream except during storm and other high-flow events. As previously discussed, the Klamath River is supply-limited for fine-grained material. Further, based on the estimated settling velocity of the remaining sediment and average flows during wet years and storm events, it is expected that any eroded sediment would be transported as suspended sediment flushed downstream. There would be minimal erosion and sediment deposition from the remaining sediments after dam removal.

Additionally, many of the ongoing programs such as the TMDLs, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality

Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, the Northwest Forest Plan, and the Five Counties Road Maintenance Program may actually reduce soil erosion and sediment deposition in the Klamath River, and help to reduce the overall cumulative effect. **The Proposed Action's incremental contribution to the significant cumulative effect associated with erosion and downstream sediment deposition after reservoir drawdown would not be cumulatively considerable.**

### **Unstable Soils**

*Following dam removal, the reservoir sediment remaining would dry and could affect restoration activities and/or future road construction activities.* After dam removal, an estimated 44 to 62 percent of the sediment in the reservoirs would remain and settle on the terraces of the new river channel. Initial sampling conducted on the sediment indicates that once dry, it has a tendency to crack and substantially decrease in porosity. This characteristic could limit future construction activities (e.g., access road construction, recreation facilities). No other known actions or projects would change the amount of unstable soils in the area of analysis. Additionally, implementation of mitigation measure GEO-1 would reduce potential impacts of the Proposed Action by requiring a geotechnical analysis to determine suitability for any planned developments. **No significant cumulative effects associated with unstable soils would occur.**

### **KBRA**

*Implementation of the Phase I Fisheries Restoration Plan could result in construction related sediment erosion.* Construction actions including the operation of construction equipment and the associated soil disturbance could result in erosion into the active river channel and could cause new or exacerbate existing landslide areas. Additionally gravel augmentation could result in temporary sediment transport and deposition downstream of the construction site.

Soil erosion has increased in the past due to human activity and has altered the Klamath River's banks. Increased sedimentation in the Klamath River has also adversely affect water quality and aquatic species. Other cumulative actions and projects that could contribute to soil erosion and sedimentation in the river include road improvement projects, new subdivisions, and other future developments. Other more general projects and activities that are likely to occur, such as timber harvesting, mining, agriculture, livestock grazing, and road-related erosion could also contribute to cumulative effects associated with sediment. There are also several ongoing programs such as implementation of the Klamath Basin TMDLs, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, the Northwest Forest Plan, and the Five Counties Road Maintenance Program may actually reduce soil erosion and sediment deposition in the Klamath River.

The KBRA's contribution to the significant cumulative effects associated with soil erosion and landslides would be cumulatively considerable; however, BMPs would be implemented to minimize these impacts. Given these BMPs (see Appendix B), the short-term effects on sediment erosion and landslides would be reduced. Moreover, in the long-term implementation of the Phase 1 and 2 Fisheries Restoration Plans would be expected to generate a beneficial reduction in sediment erosion through improved river channel stability, and generate no change from existing conditions for landslides. **The KBRA's incremental contribution to cumulative effects on soil erosion and landslides would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.10.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative effects to the Proposed Action as all Four Facilities would be removed. Alternative 4 could have some erosion during construction, but would not involve reservoir drawdown or dam removal and would therefore contribute to fewer cumulative effects. Alternative 5 would have similar effects to those described for the Proposed Action; however, two dams would remain in place so less sediment would be released and less deconstruction would occur. This would reduce the amount of soil erosion and sedimentation. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.10.3 Mitigation Measures**

No cumulative adverse effects related to geology, soils and geologic hazards would occur; hence, no mitigation measures are required.

#### **4.4.11 Tribal Trust**

A large number of past, present, and future actions have contributed to cumulative effects associated with Tribal Trusts. The timeframe for cumulative effects includes the duration of construction (May 2019 through December 2020), during which temporary impacts would occur, and extends indefinitely following construction for long-term effects associated with restoration of the Klamath River fisheries.

Several past, present, and future actions were considered during the cumulative effects analysis, including those identified by the tribes as having the greatest cumulative potential to adversely impact Tribal Trust Assets: hydroelectric energy production, mining, timber extraction, agricultural production, and cattle grazing. These actions have resulted in poor water quality, a decline in fisheries, and decline in culturally important plants and animals, and have affected tribal health, economies, cultural practices and traditional ceremonies. Impacts on Tribal Trust Assets from some of these land uses, particularly mining and timber extraction, have decreased in the last few decades due to better land management practices. In addition, restoration projects, including those being carried out by the tribes themselves, have mitigated some of these impacts. However, the

KHP significantly affects the trust resources of the Klamath Basin tribes and, by extension, their cultural values. Therefore, this evaluation was based on the potential for the project alternatives to result in cumulative effects on Tribal Trust Assets when considered along with the past, present, and future activities.

#### **4.4.11.1 Alternative 2: Full Facilities Removal of Four Dams**

To the federally recognized Tribes in the Klamath Basin, the KHP dams and associated reservoirs, along with other actions identified above, represent a significant cumulative adverse effect on Tribal Trust Assets. Removal of the four dams under the Proposed Action would result in long-term benefits to Tribal Trust Assets through the restoration of salmon fisheries and traditional fishing sites, improved water quality, and restored riparian habitats that support culturally important plants and animals. The restoration of salmon fisheries would allow the Tribes to return to a salmon-based economy and would promote more hunting and gathering. It would improve the diets of the Tribes, allow for cultural practices and traditional ceremonies to continue, and would help the Tribes become self-sufficient by creating a source of income. Water quality, including temperature and toxic algal blooms, would improve with removal of the dams, benefitting culturally important plants and animals and allowing traditional practices and ceremonies that require bathing to resume. **Together, the Proposed Action's benefits, along with ongoing fisheries restoration and water quality actions identified in Table 4-4, and better mining and timber extraction land management practices, would result in cumulative benefits to Tribal Trust Assets.**

#### **KBRA**

*Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources. Implementation of the Mazama Forest Project could result in impacts/effects to Trust Resources and other traditionally used resources.* Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the Klamath Tribes in developing their capacity to participate in resource management activities within the basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. Actions associated with the Mazama Forest Project would help the Klamath Tribe gain back culturally important lands and become more economically self-reliant. The other main cumulative action that would benefit the Klamath Tribes would be the implementation of the KHSA and removal of the Four Facilities. This would help to restore fisheries and improve water quality. Other actions that would also contribute benefits include the implementation of the Klamath Basin TMDLs to improve water quality, various restoration projects noted in Table 4-4 above, and the Northwest Forest Plan, the Trinity River Restoration Program, and the Five Counties Road Maintenance Program which contain provisions for improving water quality and enhancing fisheries on the Klamath River. Together these would provide substantial cumulative benefits to the Klamath Tribes. **The KBRA's incremental contribution to the significant cumulative effects on Trust Resources and other traditionally used resources would be beneficial. Implementation of specific plans and projects associated with the KBRA will require future environmental compliance as appropriate.**

**4.4.11.2 Alternatives 3, 4, and 5**

Alternative 3 would result in cumulatively beneficial effects on Tribal Trust Assets similar to those described for Alternative 2. Alternative 5 would also result in some cumulative benefits, although these would be less than Alternative 2 and 3 because two dams would remain in place and could block some fish passage and would not substantially improve water quality conditions. Alternative 4 would have little cumulative benefits because water quality issues associated with the reservoirs would remain. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

**4.4.11.3 Mitigation Measures**

No cumulative adverse effects related to Tribal Trust Assets would occur; hence, no mitigation measures are required.

**4.4.12 Cultural and Historic Resources**

Cumulative effects would result from the loss or degradation of important historic and cultural resources in the Klamath Basin.

Table 4-16 lists the impacts and mitigation presented in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Current effects/impacts on historic properties/ historical resources, other cultural resources, and human remains would continue to occur.	1	NCFEC	None	NCFEC
The Alternative would result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD considered eligible for inclusion on the National Register and California Register.	2,3,5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	S

**Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Reservoir drawdown could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Native American human remains.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
Installation of the Yreka Water Supply Pipeline could affect/impact archaeological and historic sites that are eligible for inclusion on the National Register or California Register.	2,3,5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
Construction activities including use of haul roads and disposal sites for demolition debris under the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register or California Register.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS

**Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3**

<b>Potential Impacts</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Removal of the recreational facilities after reservoir drawdown may affect archaeological or historic sites that could be eligible for inclusion on the National Register or California Register or human remains.	2,3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
The Fish Passage at Four Dams Alternative could affect/impact the four dams and the KHHD, other historic properties/historical resources, TCPs, cultural landscapes, or human burials.	4, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
<b>Keno Transfer</b>				
The Transfer of Keno Dam to the DOI could have adverse effects to historic properties or historic resources.	2, 3	B	None	B
<b>East and Westside Facilities</b>				
The decommissioning of the East and West Side Facilities could have adverse effects on historic resources or historic properties.	2, 3	LTS	None	LTS

**Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3**

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Implementation of the KBRA fisheries restoration program, Klamath Tribes Interim Fishing Site, and the Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2,3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

Table 4-4 presents the projects that were considered in the analysis, including the KHP, road improvements, and future proposed subdivisions around Iron Gate Dam. In addition to these projects, past, present, and future county, municipal, and private development in the region surrounding the reservoirs is also considered in this analysis.

**4.4.12.1 Alternative 2: Full Facilities Removal of Four Dams**

*The Proposed Action would result in direct effects to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the Klamath Hydroelectric Historic District (KHHD) considered eligible for inclusion on the National Register and California Register. The Four Facilities contribute to the KHHD, which is presumed eligible for inclusion on the National Register and on the California Register. Removal of the four dams and all associated facilities would adversely affect each dam’s eligibility and the overall integrity of the KHHD because a large portion of this district would be removed.*

The Proposed Action would result in adverse effects on an important and unique cultural resource. There are very few of these types of facilities in existence today. Other actions that are likely to occur and could adversely affect the KHHD include additions to

buildings, replacement of equipment, internal reconfiguration of buildings, demolition of structures, or lack of maintenance of facilities. Adverse impacts on the KHHD would be considered significant regional and statewide cumulative effects.

The Proposed Action’s incremental contribution to the significant cumulative effects on the KHHD would be cumulatively considerable. The Proposed Action would remove the Four Facilities, eliminating a large portion of the district. Mitigation measure CHR-1 would be implemented to reduce the impacts; however, even with this mitigation the incremental contribution to the significant cumulative effects would remain cumulatively considerable. No additional feasible mitigation is available to reduce these cumulative impacts. **The Proposed Action’s incremental contribution to the significant cumulative effect on the KHHD would be cumulatively considerable.**

*Reservoir drawdown and construction activities, including use of haul roads and disposal sites for demolition debris, could affect archaeological and historic sites, Traditional Cultural Properties (TCPs), and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Native American human remains. Installation of the Yreka Water Supply Pipeline could affect archaeological and historic sites that are eligible for inclusion on the National Register or California Register.* Archaeological and historic sites, TCPs, and cultural landscapes in the vicinity of the Four Facilities and have been adversely affected through human activity, development, and construction of the KHP. Historically, the displacement of Indian Tribes by Euroamericans led to the loss of their traditional lands and culture. Economic pursuits such as mining, logging, ranching, and farming further contributed to these impacts. The construction of towns, roads, and other developments over time have likely disturbed or altered many sites in the area. The KHP, constructed in phases from 1918 through 1962, brought power to region and has been recommended as eligible for inclusion on the National Register as the KHHD under criterion a for its association with the industrial and economic development of southern Oregon and northern California. However, the creation of the reservoirs has likely inundated some cultural sites and the build-up of sediment behind the reservoirs may have buried some of these sites. Artificial water fluctuations from the reservoirs have resulted in erosion along the lower terraces. Cultural resources have been impacted by these changing water levels. Known impacts include exposing cultural materials to the public, sometimes leading to illegal excavation of these sites. At least one site is known to have exposed human remains from these circumstances. Actions by a federal agency resulted in the reburial of the exposed remains and temporary stabilization of the river bank. Therefore, significant cumulative effects have occurred to archaeological and historic sites, TCPs, and cultural landscapes within the Area of Potential Effect.

The Proposed Action’s incremental contribution to the cumulative effects on archaeological and historic sites, TCPs, and cultural landscapes would be cumulatively considerable. The dam removal and reservoir drawdown could affect 32 known sites located along the current shores of the reservoirs, ten ethnographic village sites, an unknown number of sites that may be submerged in the reservoirs and human remains that may be isolated or associated with those sites. Also, several hundred sites along and

near the Klamath River downstream from the dams and reservoirs may be exposed or damaged from temporary increase in flows during reservoir drawdowns. Associated riverscape sites could be adversely affected through erosion, exposure, and vandalism. Increased flows along the Klamath River could undercut, erode, or flood sites along or near the banks of the river, also affecting contributing elements of the riverscape. Drawdown of the reservoirs and the flushing of sediment would likely expose submerged sites around and under the reservoirs. After reservoir drawdown, any cultural sites that become exposed could be damaged through vandalism or natural processes, especially if they occur in areas proposed for public recreation.

Modifications of the proposed haul roads and use of disposal sites could affect/impact sites (including 17 sites previously identified during earlier survey coverage of the roads) that are located along the haul roads and/or at the disposal sites. In addition, the location of disposal sites at features associated with construction of the dams may contribute to the KHHD and be historic properties/historical resources.

The existing water supply pipeline for the City of Yreka passes under Iron Gate Reservoir and would have to be relocated. The pipeline itself may be a historic property or historical resource and would need to be evaluated for eligibility. Ground disturbance could result in the discovery of historic and/or archaeologically significant sites. The construction of footing to support the pipe bridge and the trenching and rerouting of the pipeline to reach Lakeview Bridge could uncover previously unknown sites.

However, additional cultural resources surveys and monitoring of the drawdown zone would be conducted as land is exposed. Avoidance, minimization, and mitigation measures would be implemented, as appropriate. A cultural resources management plan would be developed, through consultations, to manage and protect endangered and exposed cultural resources. Mitigation measures CHR-1 through CHR-4 would be implemented to minimize or avoid impacts to these resources. **The Proposed Action's incremental contribution to the significant cumulative effect on archaeological and historic sites, TCPs, and cultural landscapes would not be cumulatively considerable.**

#### **KBRA**

*Implementation of the KBRA actions could result in impacts to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.* Implementation of the KBRA could result in river restoration actions, ground disturbing activities, or forest management practices that could have a significant impact on cultural and historic resources that are eligible for inclusion on the National Register and/or California Register.

Given the past and present significant cumulative effects on cultural resources in the area, as described above for the Proposed Action, it is assumed that the KBRA's incremental contribution to cumulative effects on cultural resources would be cumulatively considerable; however, mitigation measures, including CHR-2, CHR-3, and CHR-4, as

appropriate, would be implemented to reduce such contribution. **With mitigation, the KBRA’s incremental contribution to significant cumulative effects on historic properties, historical resources, human remains, or archaeological and historic sites would not reduce these effects to a less than significant level; therefore, it would be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.12.2 Alternatives 3, 4, and 5**

All alternatives would have cumulatively considerable impacts on the KHHD. Alternatives 3 would have similar cumulative cultural resources effects as described for Alternative 2. Alternative 4 would not require relocation of the Yreka pipeline and would not contribute to cumulative effects associated with the pipeline relocation. Alternative 4 would likely affect a smaller overall area during construction and would therefore decrease the potential for disturbing previously unknown resources. Alternative 5 would leave two dams and reservoirs in place, and would expose less area that may contain cultural resources. Alternative 5 would likely require less overall general construction, roads, and ground disturbance than Alternatives 2 and 3; therefore it could result in fewer impacts to previously unknown resources. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.12.3 Mitigation Measures**

While there would be cumulatively considerable impacts on the KHHD under Alternatives 2, 3, 4, and 5 even with mitigation, no additional feasible mitigation is available to substantially reduce or avoid these cumulative effects. They would remain cumulatively considerable.

#### **4.4.13 Land Use, Agricultural and Forest Resources**

Cumulative effects on land use, agriculture, and forest resources would be associated with changes in existing zoning, or conversion of agriculture and forest lands to non-agriculture and non-forest lands. The timeframe for agricultural and forest resources includes the duration of construction (May 2019 through December 2020). Table 4-17 lists a summary of land use, agriculture, and forest resources impacts presented in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-17. Summary of Land Use, Agricultural and Forest Resources Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
The continued operation of and impoundment of water at the Four Facilities could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	1	NCFEC	None	NCFEC
The exposure of the currently inundated lands from the removal of the Four Facilities could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	2, 3	NCFEC	None	NCFEC
The construction of fish passage infrastructure at the Four Facilities, or the construction activities associated with the removal of Copco 1 and Iron Gate dams and the construction of fish passage infrastructure at J.C. Boyle and Copco 2 could conflict with applicable land use plans, policies, or regulations adopted for the purpose of mitigating an environmental effect.	4, 5	NCFEC	None	NCFEC
The alternatives could result in the indirect conversion of farmland to non-agricultural uses or conflict with Williamson Act land or agricultural zoning in the upper Klamath Basin due to uncertain water supplies.	1, 2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities associated with full or partial dam removal, the construction of fish passage infrastructure, or the continued impoundment of water at Copco 2 and J.C. Boyle dams could result in the conversion of forest lands to non-forest use or conflict with forest zoning.	2,3,4,5	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities and construction activities associated with the development of fish passage could indirectly convert farmland to non-agricultural use or forest land to non-forest use.	1, 4	NCFEC	None	NCFEC
Construction activities associated with dam removal and the draining of the reservoirs could result in changes in the existing physical environment that could convert farmland to non agricultural use or convert forest land to non forest use.	2, 3, 5	LTS	None	LTS
Construction activities associated with dam removal could require new, permanent roads to be constructed to provide access to new recreation areas, which could constitute a change in the existing environment.	2, 3, 5	LTS	None	LTS

**Table 4-17. Summary of Land Use, Agricultural and Forest Resources Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Dam removal would require the relocation of the Yreka water supply line and could result in a change in the existing environment and surrounding environment.	2,3,5	NCFEC	None	NCFEC
Construction and restoration activities associated with dam removal would include the demolition of various recreation facilities which could affect land use.	2, 3, 5	NCFEC	None	NCFEC
The construction and development of fish passage facilities would require new permanent roads to be created to provide access to the Klamath Hydroelectric Project facilities which could create conflicts with applicable plans and policies or otherwise cause a significant land use impact due to existing zoning and land uses.	4, 5	LTS	None	LTS
<b>Keno Transfer</b>				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could result in a change in land use.	2,3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
The decommissioning of the East and West Side facilities could impact land use.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
The KBRA could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	2,3	LTS	None	LTS
The implementation of the Water Diversion Limitation Program could convert farmland to non-agricultural uses, a potentially significant effect.	2,3	LTS	None	LTS
The Water Use Retirement Program could result in the fallowing or conversion of agricultural land non agricultural uses, such as open space or wetland restoration areas.	2,3	LTS	None	LTS
The Power for Water Management Program could affect Land Use in the Klamath Project area.	2,3	LTS	None	LTS
The KBRA's Mazama Forest Project could result in the conversion of forest land to non-forest use or conflict with forest zoning.	2,3	NCFEC	None	NCFEC

**Table 4-17. Summary of Land Use, Agricultural and Forest Resources Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
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**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
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- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

While there are many different past, present, and potentially future cumulative activities that could affect land use, such as agriculture, timber harvesting, mining, and new subdivisions planned in Siskiyou County, there are no cumulative activities that have been identified that would specifically conflict with existing land use plans or zoning, or result in a conversion of agricultural lands to non-agricultural uses or forest lands to non-forest uses.

**4.4.13.1 Alternative 2: Full Facilities Removal of Four Dams**

*The Proposed Action could result in conversion of farmland to non agricultural use or conversion of forest land to non forest use. New, permanent roads constructed to provide access to recreation areas could constitute a change in the existing environment. The Proposed Action would require the use of land for temporary access roads, stockpiling, staging, and other general construction activities. These would generally be temporary and would occur on lands designated for industrial (dam) or open space use or on currently inundated lands, and could be returned to their original or alternate use following deconstruction. New, permanent roads associated with achieving public access to the river would be created. However, these roads would be constructed on formerly inundated lands and would not affect land use. There are no other cumulative actions or projects that would result in changes to land use in and around the reservoirs. **There would be no significant cumulative effects associated with land use, agriculture, and forest resources.***

**KBRA**

*The KBRA could conflict with applicable land use plans, policies, or regulations. The KBRA may conflict with applicable land use plans, policies or regulations because it is designed to enact policies at a regional (basin) level, and may not be consistent with local city or county plans and policies. However, Humboldt County in California and Klamath County in Oregon signed the KBRA, and any subsequent conflicts with their plans and policies would be handled by the county Board of Supervisors/Commissioners or other authorizing body. At this time, no other cumulative actions or projects have been identified that would conflict with applicable land use plans, policies, or regulations*

adopted for the purpose of avoiding or mitigating an environmental effect. However, additional analysis would be completed when locations and specific KBRA program details are available. **There would be no significant cumulative effects.**

**Implementation of the KBRA will require future environmental compliance as appropriate.**

*Construction of fish handling facilities for trap and haul operations within the Fisheries Reintroduction and Management Plan could change land use.* The Fisheries Reintroduction and Management Plan includes trap and haul operations that move fish around Keno Impoundment and Link River during times of poor water quality. Trap and haul operations would require construction of new fish handling facilities near Keno Dam and Link River Dam. At this time, no other cumulative actions or projects have been identified that would conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect. However, additional analysis would be completed when locations and specific KBRA program details are available. Because these new facilities would be built on lands designated for industrial (dam) use, their construction would not conflict with applicable plans and policies or otherwise cause a significant land use impact. The potential land use conversions generated by development of trap and haul facilities would not be expected to contribute to any land use effects generated by the hydroelectric facility removal action analyzed above. **There would be no significant cumulative effects. Implementation of the KBRA will require future environmental compliance as appropriate.**

*The implementation of the Water Diversion Limitation Program could convert farmland to non-agricultural uses. Implementation of the measures in the WURP could result in conversion of farmland to non-agricultural use in the Off Project areas. The Power for Water Management Program could affect land use in the Reclamation's Klamath Project area.* Several of the KBRA actions and programs have the potential to result in the conversion of agricultural land to non-agricultural uses. This could occur indirectly through the retirement of water rights or as a result of decreases in water diversions, or directly through crop fallowing, short-term water leasing, split season irrigation, natural storage improvement or siting of renewable energy infrastructure on agricultural lands. Overall, the KBRA is intended to provide long-term benefits by ensuring sustainable agriculture. No other cumulative actions or programs have been identified that would convert agricultural lands to non-agricultural uses in the Klamath Basin; however additional analysis would be completed when specific locations and additional KBRA program details are available. **There would be no significant cumulative effects. Implementation of the KBRA will require future environmental compliance as appropriate.**

#### **4.4.13.2 Alternatives 3, 4, and 5**

Alternatives 3, 4, and 5 would have similar cumulative land use impacts as those described for the Proposed Action. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be

implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.13.3 Mitigation Measures**

No cumulative adverse effects related to land use and agriculture would occur; hence, no mitigation measures are required.

#### **4.4.14 Socioeconomics**

Under the cumulative condition, counties and cities have developed general plans and other planning documents that identify economic development, transportation, housing, public facilities, and energy conservation projects. There are also federal and state plans that support regional resource management that could affect economic conditions. Table 4-3 lists existing planning documents relevant to the socioeconomic cumulative condition. The cumulative condition also considers population growth expected in the counties that would increase housing demand, attract businesses, and increase overall economic activity. The timeframe for the cumulative condition would be during the construction period, during implementation of mitigation measures, and long-term effects from increased fish populations as a result of the Proposed Action and alternatives.

##### **4.4.14.1 Alternative 2: Full Facilities Removal of Four Dams**

*Construction activities associated with dam removal and mitigation could increase economic output, employment, and labor income during the construction period.* The national economic recession, which started in December 2007, has affected county economies in the area of analysis. County economies have been in decline in employment, income, and output in some industries. Appendix O details economic conditions in the counties in the area of analysis. Unemployment rates in 2009 and 2010 have been the highest in the past decade in all eight counties in the area of analysis. The number of people living in poverty in the counties has been consistently higher than California and Oregon rates. Total industry earnings increased from 2005 to 2008 in all counties, but some individual industries had decreased earnings. In all counties, except Modoc County, which had undisclosed data, earnings in the construction industry decreased from 2005 to 2008. The manufacturing industry also had decreased earnings from 2005 to 2008 in most counties. In Siskiyou County, the timber industry has had substantial declines in timber harvested and value in 2008 and 2009 relative to previous years.

Housing, commercial, transportation, and other development projects under the cumulative condition would help generate activity in the local economy and result in long-term term improvements in overall economic conditions. However, publicly funded projects could face delays as counties have had smaller operating budgets and tax revenues during years of economic recession.

Population growth also helps to generate economic activity. As people move into the region, they purchase houses, food, fuel, and other goods and services in the region. As demands for goods and services increase, businesses move into the area and jobs are

created. New residents also pay property taxes and sales taxes, typically the largest contributors to county revenues (Table 3.15-19 shows tax revenues for Siskiyou County).

The Proposed Action would benefit county economies by increasing spending and providing temporary employment during the construction and mitigation period. The Proposed Action would contribute to increased sales and sales tax revenues by bringing workers into the region. Under the cumulative condition, the Proposed Action would not contribute to long-term employment, income, or output in the regional economy.

*Changes in commercial fishing harvests could change fishing revenues and affect employment, labor income, and output in the regional economy.* The commercial fishing industry in coastal counties in the area of analysis has been in decline in recent years. Implementation of regulations and at times, complete closure, of the commercial salmon fishery have affected commercial revenues, sales, income, and employment of fishing operators and businesses that support the fishing industry. In the cumulative condition, reduced salmon fishing opportunities would continue to occur if salmon populations remain low. The Proposed Action would increase fish populations under the cumulative condition and contribute positively to commercial fishing revenues and fishing-support businesses.

*Changes in recreational opportunities could affect the regional economy.* Recreation is an important industry in the area of analysis to support economic activity and growth. In their general plans, counties emphasize the importance of maintaining and creating recreation opportunities in the area. No cumulative projects were identified that would further reduce reservoir/lake based recreation opportunities including reservoir-based fishing, flat water boating, and camping and day use facilities adjacent to a lake. The Proposed Action would permanently remove J.C. Boyle, Copco 1, and Iron Gate Reservoirs, which are frequently visited recreation sites and contribute to economic output, labor income, and jobs. Loss of recreation at the reservoirs would be an adverse cumulative effect to the economies of Siskiyou and Klamath Counties.

Proposed water diversion activities on tributaries (Scott River and Trinity River) to the Klamath River could affect flows and result in a decrease of available flows for recreational activities, namely whitewater boating and fishing. Lower flows could reduce boating opportunities and trips booked in the region, which would be an adverse cumulative economic effect. Loss of whitewater boating opportunities at Hell's Corner Reach under the Proposed Action would also adversely affect Klamath County's economy under the cumulative condition. Increased in-river and ocean fishing opportunities from the Proposed Action would have cumulative positive regional economic effects if more visitors come to the area for improved fishing conditions and spend money in the regional economies.

*The Proposed Action could affect the existing economic conditions of Indian Tribes in the area of analysis.* Hydroelectric energy production, mining, timber extraction, agricultural production, and cattle grazing have resulted in poor water quality, a decline in fisheries, and decline in culturally important plants and animals, and have cumulatively affected

tribal health, economies, cultural practices and traditional ceremonies. Tribal harvests for subsistence would also increase, which would improve social conditions and offset costs of purchasing store-bought food.

*Removal of the Four Facilities could result in increased energy rates for PacifiCorp customers.* PacifiCorp has added an approximately 2 percent surcharge to customer rates in Oregon and California to cover costs of dam removal, which was approved by the Oregon Public Utilities Commission (OPUC) and California Public Utilities Commission (CPUC). Under the KHSA, ratepayer liability is capped at \$200 million, prorated between PacifiCorp's customers in Oregon (up to \$184 million) and California (up to \$16 million). PacifiCorp sets customer rates based on multiple factors, including energy prices, future demands, resource adequacy, overhead costs, and long-term investments. PacifiCorp's Integrated Resource Plan from 2008 and the 2010 update its plans to increase the percentage of renewable energy in the company's portfolio, establish new sources of energy to meet the increasing base load and higher peak demands, and upgrade or maintain existing power sources. These actions would affect PacifiCorp's decisions to change customer rates, which in turn are subject to OPUC and CPUC approval. It is difficult to assess the size of potential rate effects under the cumulative condition.

*Removal of the Four Facilities could affect property values of parcels near Copco 1 and Iron Gate Reservoirs.* Under the cumulative condition, land values would fluctuate with market conditions. In Siskiyou County, median home prices have declined since 2006 (See Real Estate Evaluation Report, DOI 2011a in Section 3.15, Socioeconomics). Land values have followed similar trends. It is difficult to predict future market conditions; therefore, land values cannot be evaluated during and after the construction period. Values could increase or decrease under the future cumulative condition. The Proposed Action would contribute to decrease land values under the cumulative condition because of the changes in value to lake-front property. In the long-term values could increase as restored river views replace lake views.

*Removal of the Four Facilities could affect tax revenues to Siskiyou and Klamath Counties.* Decreased land values and associated property taxes would affect local government revenues. Under the cumulative condition, Siskiyou and Klamath Counties are projecting increased need for housing to support population growth. Increased homeowners in the counties would increase property taxes to the counties that could offset some losses as a result of the Proposed Action. Increased residents would also increase sales in the region and sales tax revenues to the county.

#### **KBRA**

*Fish habitat restoration for the Fisheries Programs could affect employment, labor income, and output in the regional economy.* The KBRA includes fishery restoration, reintroduction and monitoring actions in the Upper and Lower Basin. Restoration activities would involve some degree of construction including floodplain rehabilitation, large woody debris placement/replacement, fish passage correction, cattle exclusion fencing, and riparian vegetation planting. It is likely that much of the construction could be done by local construction workers from the region. The KBRA also includes

construction of new fish facilities, which may require more out of region contractors. State and local government workers in the region would likely implement many actions, including monitoring and administration. KBRA actions would provide new jobs and increase labor income within the region during the implementation period. This would be a positive effect of the Proposed Action under the cumulative condition.

*Implementation of the Water Resources Program could affect employment, labor income, and output in the regional economy.* The KBRA includes water resource actions to improve water supply reliability in Reclamation’s Klamath Project. Actions include monitoring, analysis, and construction. It is likely that much of the construction could be done by local construction workers from the region. State and local government workers in the region would likely implement many actions, including monitoring, analysis, and administration. KBRA actions would provide new jobs and increase labor income within the region during the implementation period. This would be a positive effect of the Proposed Action under the cumulative condition.

*Water acquisitions could affect farm revenues and reduce employment, labor income, and output in the regional economy.* Water right transfers proposed as part of WURP could affect the regional economy. The land once irrigated with the surface water right would be converted to either dryland production or fallow. If all or part of the land is converted to dryland and/or fallow, the losses to economy would be the gross revenue produced on this land. Farm workers, agribusiness firms such as fertilizer and chemical dealers, wholesale and agricultural service providers are examples of those who do not receive compensation but would be adversely affected by the water right sale.

Water lease programs are short term programs that may have negative effects to the regional economy during water short years. The programs allow farmers to sell or lease their water for fisheries programs on a short term basis when sufficient water is unavailable for fish. The regional economy would be affected by the loss in gross farm revenue generated on the land idled by farmers who voluntarily lease water. Some of these regional effects would be offset by household induced effects when farmers spend a portion of the compensation in the local area. Under the cumulative condition, water acquisitions would be offset by other KBRA programs that aim to improve water supply reliability in the area of analysis.

*Changes in Reclamation’s Klamath Project hydrology could affect gross farm revenue and the regional economy.* In drought years, the gross farm revenue would increase under the Proposed Action, which would increase regional employment, labor income and output increase. This would benefit the current economic conditions in the Klamath, Siskiyou, and Modoc counties and would be a long term, positive effect of the Proposed Action under the cumulative condition.

*Implementation of regulatory programs, county programs, and tribal programs could support long-term economic growth in counties in the Klamath Basin.* Under the cumulative condition, the KBRA program would contribute to employment, labor income, and output in the regional economy. Implementation of the programs would

support local jobs and provide incomes to residents in the region. This would be a positive effect of the Proposed Action under the cumulative condition. Long-term benefits of restoration actions would improve fisheries, which could attract visitors to the region that would spend money on local goods and services. Commercial fishing catches could also improve which would increase revenues in the region. Tribal program actions would mostly be implemented by tribal staff and would positively affect the economic conditions of the tribes under the cumulative condition.

#### **4.4.14.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative socioeconomic effects as those described for Alternative 2 for all potential effects. Relative to recreation, Alternatives 4 and 5 would have similar cumulative effects from reductions in whitewater boating activities at Hell's Corner Reach than Alternative 2. Alternatives 4 and 5 would maintain all or some reservoir recreation opportunities relative to Alternative 2, which would continue to result in spending for reservoir recreation in the region. All alternatives would have similar cumulative effects from increased fishing catch as a result of increased fish populations. Alternative 4 would have fewer effects to local tax revenues because PacifiCorp would maintain hydroelectric facilities and property values would not be affected by dam removal. Alternatives 4 and 5 would likely result in increased rates for PacifiCorp customers relative to Alternative 2. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.14.3 Mitigation Measures**

No cumulative adverse effects related to socioeconomics would occur; hence, no mitigation measures are required.

#### **4.4.15 Environmental Justice**

Cumulative environmental justice effects would be associated primarily with effects on water quality, aquatic resources, air quality, traffic and noise, and socioeconomics from implementation of the project and other past, present and reasonably foreseeable actions.

The timeframe for environmental justice concerns includes both the duration of construction (May 2019 through December 2020), as some environmental justice issues would only occur during construction (air quality, traffic, noise, water quality, employment), and the years following completion of construction (water quality). The timeframe would extend beyond the construction period indefinitely because impacts on socioeconomics and county revenues would be long-term and could continue to occur after construction.

##### **4.4.15.1 Alternative 2: Full Facilities Removal of Four Dams**

*Dam removal activities could affect fisheries and disproportionately affect tribal people.* Dam removal would improve anadromous fisheries in the Klamath River and help recovery of the endangered sucker fisheries. The construction of the Klamath

Hydroelectric Facility has resulted in significant cumulative effects on fisheries that have disproportionately affected tribal people because it has blocked access to habitat, impaired water quality, and increased the potential for nuisance algae. The Proposed Action's contribution to this cumulative environmental justice effect would be beneficial. Restored fisheries would help reverse the environmental justice impacts to the tribes that the dams created. Other cumulative actions that would also contribute to restoring fisheries include ongoing restoration actions by the tribes (see Table 4-4), implementation of Klamath Basin TMDLs, the Trinity River Restoration Program, the Five Counties Road Maintenance Program, the Northwest Forest Plan, which contain provisions for improving water quality, restoring habitat, and reduce impacts on fisheries. Together these cumulative actions and the Proposed Action would have environmental justice benefits for tribal people by improving fisheries.

*Increased air pollutants and noise associated with dam removal activities could disproportionately affect county residents and tribal people. The traffic on the associated haul roads could disproportionately affect tribal people.* Temporary, short term air quality and noise impacts from deconstruction would occur (see Sections 3.9, Air Quality, and 3.23, Noise) that would disproportionately affect Siskiyou and Klamath County residents and tribal people, which as a whole are low income relative to California and Oregon. Implementation of mitigation measures in Sections 3.9, Air Quality, and 3.23, Noise, would reduce the severity of these short term construction impacts. Additionally, residents in Siskiyou and Klamath Counties would be disproportionately affected by increased traffic on local roads during the construction period. Residents would be subject to short term impacts, such as increased congestion, potential traffic delays, slow moving trucks and potential safety hazards. Section 3.22, Traffic and Transportation identifies measures to be taken to reduce traffic effects of the Proposed Action.

New subdivisions approved for Siskiyou County, timber harvesting, mining, recreation, and agricultural activities could result in significant cumulative air quality, traffic, and noise effects. The Proposed Action's contribution to the cumulative effect would be minimized by implementation of mitigation measures in Sections 3.9, Air Quality, 3.22, Traffic and Transportation, and 3.23, Noise, to reduce the severity of these short-term impacts and would ensure impacts are not disproportionately adverse for tribal people. There would be no long-term cumulative environmental justice effects from construction.

*Dam removal activities could provide jobs for county residents and tribal people that are low income and minority.* Deconstruction activities would generate jobs in the area of analysis. Approximately 90 construction workers would be hired locally during peak deconstruction period and about 60 workers would be hired locally on average during the deconstruction period from Klamath or Siskiyou Counties. Increased employment would support low income individuals, resulting in a beneficial effect. There are no other cumulative actions such as construction projects that have been identified that would generate a substantial number of local jobs in the area of analysis; therefore, there would be no substantial cumulative effects associated with increases in jobs for low income and minority people.

*Release of sediment from reservoirs could cause disproportionate short term impacts on county residents and tribal people.* The short-term sediment impacts that would occur from reservoir drawdown would be significant for 6-8 months. This could result in a significant cumulative environmental justice effect because of the tribes' dependency on the river for subsistence, cultural ceremonies, and a source of income. The short-term sediment impacts could hurt fisheries or other aquatic plants or animals the tribes rely on. Considering the current decline in fisheries, the high unemployment rates and high poverty rates of the tribes, this could result in cumulative economic and social environmental justice effects. However, the sediment release would be short term in duration. It would occur during the winter to minimize the impacts to fisheries. Because of the short-term nature of the impacts, any potential cumulative effects would be minimal.

*Dam removal activities could cause disproportionate long-term water quality impacts on county residents and tribal people.* As stated in Sections 3.2, Water Quality, and 3.3, Aquatic Resources, under the Proposed Action water quality would be expected to improve in the Hydroelectric Reach over the long term. Additionally, there would be long-term beneficial effects on dissolved oxygen concentrations and decreased water temperatures downstream of Iron Gate Dam. Ongoing programs and actions in the Klamath Basin, including implementation of TMDLs to improve water quality, programs identified in Table 4-3 and 4-4 to improve water quality, and actions to improve water quality such as the Five Counties Road Maintenance Program and the Northwest Forest Plan, all have the potential to result in cumulative beneficial effects on water quality. Therefore, the Proposed Action in addition to other ongoing programs and actions to improve water quality, would contribute to beneficial cumulative environmental justice impacts on water quality.

*Changes in county revenues associated with dam removal could decrease county funding of social programs.* As described in Section 3.15, Socioeconomics, the Proposed Action could cause a short- and long-term decline in tax revenue to the counties associated with a discontinuation of tax revenue from PacifiCorp and a decrease in property values near the reservoirs. It is speculative to quantify short- and long-term impacts on county social programs because many of these programs receive funding from the state and federal governments, and would be unaffected by the Proposed Action. However, the recent economic recession and forthcoming budget cuts to federal, state, and local governments could also result in a decrease in funding of social programs. Together these could create a cumulative effect associated with social program funding. It is not possible to quantify the Proposed Action's contribution to this cumulative effect. The Proposed Action would allow tribal people to gain increased self-reliance and self-sufficiency through increased subsistence and the restoration of the tribal commercial fishery. This might help offset cumulative environmental justice effects associated with social program funding decreases in the long-term.

*Dam removal activities could disproportionately impact tribal health and social wellbeing in the long term.* Ongoing programs and actions in the Klamath Basin, including implementation of programs identified in Table 4-3 and 4-4 to improve

fisheries and actions to improve water quality such as implementation of TMDLs, the Five Counties Road Maintenance Program, and the Northwest Forest Plan, all have the potential to result in cumulative beneficial effects on water quality and fisheries. Removal of the dam as part of the KHSA is expected to be beneficial to fall- and spring-run Chinook salmon, coho salmon, and summer and winter steelhead in the long-term. Fish population increases would allow the tribes to increase subsistence fishing and once again make fish a larger component of their diet and ceremonies. The Proposed Action, in addition to other ongoing programs and actions to improve water quality and fisheries, would contribute to beneficial cumulative environmental justice impacts on tribal health.

### **KBRA**

*Implementation of the WURP, Off Project Reliance Program, and Interim Flow and Lake Level Program could disproportionately affect low income and minority farm workers.*

The KBRA proposes voluntary land fallowing and permanent water right sales which could disproportionately affect farm workers in Klamath, Siskiyou, and Modoc Counties. Loss of farm labor jobs could disproportionately affect low-income, minority farm workers, who could lose a portion of their income if farms no longer required their labor. This would be a disproportionate effect on farm workers. Recent drought, regulatory requirements for fish and stream flows and the resulting water supply unreliability, and the recent economic downturn have contributed to cumulative impacts on agriculture and farm workers in the Klamath Basin. The Proposed Action's contribution to this cumulative impact could be substantial because it could result in loss of jobs and income. However, land fallowing and permanent water rights sales would be voluntary. The impacts on farm workers would depend on the number of willing participants in the Programs. The core of the KBRA is to provide water reliability to farmers, which would ensure continuation of agricultural jobs in the area of analysis. In the long term, the KBRA has the potential to offset any loss of agricultural jobs because of increased water reliability.

*Implementation of the Klamath County Economic Development Plan could disproportionately affect low income and minority people in Klamath County.*

*Implementation of the California Water Bond Legislation could disproportionately affect low income and minority people in Siskiyou County.* Both Klamath County and Siskiyou County have a larger percentage of persons and families living below the poverty line than their respective states. They also have lower per capita and median family incomes than their respective states. Significant cumulative environmental justice impacts have affected these counties, such as the decline in the timber industry, drought conditions that severely decreased agricultural production, and the recent economic downturn. The KBRA could help to provide some environmental justice benefits to these low income and minority groups in Klamath and Siskiyou Counties. The Klamath County Economic Development Plan would provide \$3.2 million of funding to Klamath County. Funding would support long-term economic growth in Klamath County and could create new job opportunities and improve public programs for county residents. Depending on how funding is used within the county, this action could benefit low income and minority populations. If approved, bond funds would provide \$20 million to Siskiyou County to

use for economic development. It cannot be determined at this time how Siskiyou would distribute funds from the California Water Bond Legislation; this is a general discussion. The bond funds could assist Siskiyou County in addressing unemployment, poverty, bankruptcy, and social problems and continuing funding for other county programs. Programs could benefit low income and minority populations in Siskiyou County.

*Implementation of the Tribal Program Fisheries and Conservation Management, Mazama Forest Project, Tribal Programs Economic Revitalization, Fisheries Reintroduction and Management Plan, and Fishery Program could disproportionately affect the tribes.* As described in Section 3.16, Environmental Justice, adverse cumulative environmental justice effects on tribes have occurred through the decline in fisheries and the loss of subsistence fishing, including economic, cultural, and social impacts. The KBRA's contribution to this cumulative effect would be beneficial. Implementation of several KBRA programs and projects would have beneficial environmental justice impacts on tribes because they would restore anadromous fish species in the Klamath River and upper Klamath Basin, return 90,000 acres of the Mazama Forest back to the Klamath Tribes, and provide funding for the Klamath, Karuk, and Yurok Tribes to develop economic revitalization plans, programs and projects and to assist the tribes in developing their capacity to participate in resource management activities within the basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. These actions, and other ongoing river restoration actions, as well as implementation of the KHSA and removal of the Four Facilities, would have cumulative environmental justice benefits on the tribes.

#### **4.4.15.2 Alternatives 3, 4, and 5**

Alternatives 3, 4, and 5 would have similar construction-related environmental justice cumulative effects as Alternative 2. Under Alternatives 4 and 5, dams would still block fish passage and increase the potential for disease; therefore, there would be no cumulative benefits on tribes. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.15.3 Mitigation Measures**

There are no cumulatively considerable impacts; therefore, no mitigation measures are required.

#### **4.4.16 Population and Housing**

Cumulative effects on population and housing would be associated with the cumulative need for housing that would result by including the influx of construction workers associated with dam removal and future population growth. The timeframe for population and housing includes the duration of construction (May 2019 through December 2020) because the impacts on population and housing would only occur during construction.

Table 4-18 presents a summary of the potential impacts on population and housing presented in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4.18. Summary of Population and Housing Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities could employ non-local workers, who would need housing for the duration of their employment.	1	NCFEC	None	NCFEC
	2,3,4,5	LTS	None	LTS
Construction, restoration, and monitoring activities associated with new programs could create new jobs and could employ non-local workers, who would need housing for the duration of their employment.	1	LTS	None	LTS
Dam removal would require relocation of the Yreka water supply pipeline and could result in an increase in construction workers requiring housing.	2,3,5	NCFEC	None	NCFEC
Removal of recreation facilities and related construction activities could result in an increase in construction workers requiring housing.	2,3,5	NCFEC	None	NCFEC
<b>Keno Transfer</b>				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could affect population and housing.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
The decommissioning of the East and Westside Facilities could impact population and housing.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
Construction and monitoring activities associated with the KBRA programs could employ non-local workers who would need housing for the duration of their employment.	2,3	LTS	None	LTS

**Key:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

The 2020 population projection for Siskiyou County is 51,283, an increase of 4,174 from 2010 (Siskiyou County Community Development Department 2010). The Siskiyou County General Plan (2010) states that based on current population and housing trends, there will be a need for an additional 720 new residential units in the county by the year 2014 (Siskiyou County 2010). The projections do not extend to 2020; however, the Lead Agencies assume that there will still be some housing needs within the Siskiyou County.

Klamath County's population is expected to increase from 66,243 in 2008 to 71,440 in 2020 (U.S. Census Bureau, 2006-2008 Community Survey; Klamath County Planning Department 2009). No housing estimates are available for the year 2020. The Klamath Falls urban growth boundary is expected to experience the most growth of all urban areas in Klamath County over the next twenty years. The forecasted range for the Klamath Falls urban growth boundary population in 2020 is 47,420 to 49,471, from 44,321 in 2007 (Klamath County Planning Department 2009).

In 2006, Jackson County's population was 198,615. The Jackson County Comprehensive Plan, Revised Population Element (2007) projects that Jackson County's 2020 population will be 238,865.<sup>9</sup> The majority of Jackson County's population growth from 1980 to 2005 was in the city of Medford. It is reasonable to assume that Medford will continue to account for a large share of Jackson County's growth in the future (Jackson County 2007). The Comprehensive Plan states that the County has been experiencing a scarcity of workforce housing (low- and middle-income housing), especially from 2002 to 2005 when housing prices rapidly increased. Much of the new housing in Jackson County has been for higher income retirees (Jackson County Undated).

#### **4.4.16.1 Alternative 2: Full Facilities Removal of Four Dams**

*Construction activities could employ non-local workers, who would need housing for the duration of their employment.* Implementation of the Proposed Action could create a temporary increase in population as non-local workers migrate to the dam sites for deconstruction. During peak deconstruction periods, implementation of the Proposed Action would require up to 250 total workers with 195 working at the Copco and Iron Gate Facilities combined, and up to 55 workers at the J.C. Boyle Facility. Both of these numbers include administrative and management staff. At the Copco and Iron Gate Facilities, 78 workers would be provided from within the region and 117 would be required from outside of the region. At J.C. Boyle, 20 workers would come from within the region and 35 from outside of the region. Therefore, the housing need would be up to 117 housing units for the California facilities and 35 housing units for the Oregon facility. Peak worker needs would occur between November 2019 and September 2020.

Population increases are expected for all counties in the area of analysis by the year 2020, and many of the affected counties have noted that housing is needed in the future, especially workforce housing for low- to middle-income groups. The need for housing would be considered a significant cumulative effect. However, the Proposed Action

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<sup>9</sup> The 238,865 projection was made in 2004. A forecast made in 1997 projected the 2020 population to be slightly less at 221,665. The Revised Population Element (Jackson County 2007) presents both projections.

would not have a cumulatively considerable contribution to the cumulative effect. The temporary work force needed for the Proposed Action would likely spread out to cities with available accommodations. It is also possible that some temporary workers would stay in hotels or motels in Klamath Falls or Yreka, local recreational vehicle parks, or available rentals in the rural areas surrounding the dam facilities. The Proposed Action would not require permanent new residences and most workers would leave the area after construction was complete. **The Proposed Action’s incremental contribution to the significant cumulative effect associated with population and housing would not be cumulatively considerable.**

#### **KBRA**

*Construction and monitoring activities associated with KBRA programs could employ non-local workers who would need housing for the duration of their employment.* The creation of jobs and potential need to employ non-local workers could strain local housing availability and result in short and long-term increases in population in communities with the potential to house workers migrating into the area.

Population increases are expected for all counties in the area of analysis by the year 2020, and many of the affected counties have noted that housing is needed in the future, especially workforce housing for low- to middle-income groups. The need for housing would be considered a significant cumulative effect.

The Proposed Action’s incremental contribution to this significant cumulative effect would be temporary. It is anticipated that the majority of workers could be satisfied locally. The timing of and specific locations where these KBRA programs could be undertaken is not certain but it assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. However, as described in Section 3.17.3, Population and Housing, Existing Conditions/Affected Environment, it is assumed that there is sufficient housing supply in the current stock to temporarily accommodate non-local workers. **The KBRA’s incremental contribution to the significant cumulative effect on housing would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

#### **4.4.16.2 Alternatives 3, 4, and 5**

Alternatives 3, 4, and 5 would have similar cumulative effects on population and housing as those described for Alternative 2. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.16.3 Mitigation Measures**

There are no cumulatively considerable cumulative effects associated with population and housing; therefore, no mitigation measures are required.

#### 4.4.17 Public Health and Safety, Utilities and Public Services, Solid Waste, and Power

Cumulative effects on utilities and public services, solid waste, and public health and safety could occur through increasing the demand for utilities and services, increasing solid waste, and creating additional public health and safety risks. The timeframe for this analysis includes the duration of construction (January through December 2020) because the impacts would only occur during construction.

Cumulative effects on hydropower would be associated with the cumulative demand for power that may exceed generation capabilities. The timeframe for this analysis includes the end of construction (December 2020) and beyond, as the demand for power is expected to be needed indefinitely into the future.

Table 4-19 presents a summary of utilities and public services, solid waste, and public health and safety, and power impacts presented in Chapter 3. These impacts are analyzed for cumulative effects

**Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water at the reservoirs under annual license renewals would allow hydropower generation to continue subject to the conditions of the Reclamation Biological Opinions, which would have the potential to decrease hydropower production.	1	NCFEC	None	NCFEC
Construction activities related to the ongoing restoration and management activities could impact public health and safety	1	NCFEC	None	NCFEC
Construction activities from dam removal could result in public health and safety risks.	2, 3, 4, 5	S	PHS-1: Public Safety Management Plan	LTS
Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities.	2, 3, 4, 5	S	PHS-1: Public Safety Management Plan; PHS-2: Fire Management Plan	LTS
Construction and demolition activities could increase the risk of wildfires.	2, 3, 4, 5	S	PHS-2: Fire Management Plan	LTS

**Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Removal of the dams would eliminate a water source for wildfire services and could increase response times.	2, 3, 5	LTS	None	LTS
Dam removal would eliminate a water source for residential firefighting in and around Copco Village, and could increase the risk to homes from fire.	2, 3, 5	LTS	None	LTS
Construction activities could affect police services by temporarily increasing the population of construction workers, lengthening response times due to construction traffic on area roads, and exposing construction areas to theft and/or vandalism.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could require the use of electricity and natural gas supplies in the study area.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could affect the City of Yreka's municipal water supply by damaging or exposing the Yreka water supply pipeline prior to its relocation.	2, 3, 5	LTS	None	LTS
The removal of recreational facilities currently located on the banks of the existing reservoirs could affect public health and safety	2, 3, 5	S	PS-1: Public Safety Management Plan PHS-2: Fire Management Plan	LTS
Construction activities could affect public services and utilities in the counties and cities in the study area.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in the need for new construction and access roads.	2, 3, 4, 5	LTS	None	LTS
Dam removal would require the construction of new access roads for recreation facilities which could affect public health and safety.	2, 3, 4, 5	LTS	None	LTS
Construction activities (including Signage and Construction Traffic Management BMP) could affect road conditions by increasing traffic from heavy construction vehicles which could affect public health and safety.	2, 3, 4, 5	LTS	None	LTS

**Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities could generate a substantial amount of solid waste which could affect public services and utilities.	2, 3, 5	LTS	None	LTS
Dam removal would remove existing hydropower facilities, resulting in a loss of hydropower generation which could affect the supply of electricity.	2, 3, 5	LTS	None	LTS
Development of fish passage would reduce power generation at the existing hydropower facilities due to bypass stream flow requirements which could affect the supply of electricity.	4, 5	LTS	None	LTS
Dam removal could increase available mosquito habitat and could increase the risk of disease transmission in the short-term.	2, 3, 5	LTS	None	LTS
Leaving dam facilities and infrastructure in place could have the potential to result in public health and safety risks.	4	NCFEC	None	NCFEC
	3, 5	LTS	None	LTS
<b>Keno Transfer</b>				
The Keno Facility would be transferred to the DOI, which could cause adverse effects to Public Health and Safety.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
The East and West Side Facilities would be decommissioned, resulting in the loss of generated power.	2, 3	LTS	None	LTS
<b>KBRA</b>				
Prescribed burning and mechanical thinning under the Phase I and II Fisheries Restoration Plans could affect Public Services and Utilities.	2,3	S (short-term) B (long-term)	PHS-2: Fire Management Plan	LTS/B
Construction activities associated with the KBRA programs could result in public health and safety impacts	2,3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the Power for Water Management Program could create new renewable energy sources.	2,3	B	None	B
Completing the Emergency Response Plan could have beneficial effects on Public Services and Public Safety.	2,3	B	None	B

**Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
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**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
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- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

The 2020 population projection for Siskiyou County is 51,283, an increase of 4,174 from 2010 (Siskiyou County Community Development Department 2010). The Siskiyou County General Plan (2010) states that based on current population and housing trends, there will be a need for an additional 720 new residential units in the county by the year 2014 (Siskiyou County 2010). Klamath County’s population is expected to increase to 71,440 in 2020 (Klamath County Planning Department 2009).

**4.4.17.1 Alternative 2: Full Facilities Removal of Four Dams**

*Construction activities could result in public health and safety risks.* Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities. Earthwork, blasting, construction vehicles, and work within the waterway could have public safety risks. The placement of construction equipment in areas potentially accessible by residents and recreational visitors would be a safety hazard. Blockage of existing roadways and or use of the roadways for truck hauling of materials would also be a safety hazard. There are no other known actions or projects that would affect public health and safety directly at the reservoir sites during deconstruction. There could be construction of new subdivisions or road improvements adjacent to the reservoirs; however, the timeframe for these projects is not known. If these projects occurred at the same time as dam deconstruction, they could result in significant cumulative public health and safety effects. The Proposed Action’s incremental contribution to the cumulative effects would be cumulatively considerable; however, mitigation measures would be implemented to reduce these impacts. A public safety plan (PHS-1) and a Fire Management Plan (PHS-2) would be developed that would ensure measures are taken to protect public safety during deconstruction. With mitigation, **the Proposed Action’s incremental contribution to the significant cumulative effect would not be cumulatively considerable.**

*Construction and demolition activities could increase the risk of wildfires.* The fire threat in the areas surrounding the four facilities is categorized as high to very high. Deconstruction activities could further aggravate the risk of fire. Other future actions or projects in the vicinity of the facilities that could also increase the risk of fire include

development of new subdivisions, road improvements, and even recreation activities such as camping with fires. A decline in the timber industry and a decrease in timber harvesting has also occurred in Siskiyou County and the surrounding counties. If this trend continues, it could leave more dry flammable brush that could increase the potential for wildfires. Together, these actions could result in significant cumulative risks associated with wildfires. The Proposed Action's incremental contribution to the cumulative effect associated with wildfires would be cumulatively considerable; however mitigation measures would be implemented to reduce these impacts. A Fire Management Plan (PHS-2) would be developed to reduce the risks of fires and ensure fire suppression tools are on-site at all times. **With mitigation, the Proposed Action's incremental contribution to the significant cumulative effect would not be cumulatively considerable.**

*Removal of the dams would eliminate a water source for wildfire services and could increase response times.* Removal of the reservoirs would eliminate a water source for residential firefighting in and around Copco Village, potentially increasing the risk to homes from fire. Dam removal would eliminate a source of water for fire services and could therefore increase response times. The Klamath River would remain after dam removal, and surface water modeling (described in Section 3.6, Flood Hydrology, and Section 3.8, Water Supply/Water Rights) indicates that flows in the Klamath River downstream of the removed dams would remain unchanged. As such, helicopter fire crews could still obtain water from the Klamath River, Ewauna Lake, or Upper Klamath Lake. The presence of the Klamath River, existing water systems, and existing fire fighting resources ensures that assets for firefighting are present in the area. No other known actions or projects in the area would substantially change response times or decrease water availability for fire services. **There would be no significant cumulative effects associated with increased response times for fire services or elimination of water sources for firefighting.**

*Construction of the Proposed Action could affect the City of Yreka's municipal water supply.* The Proposed Action would require relocating the City of Yreka's municipal water supply pipeline that is currently under Iron Gate Reservoir. No other known cumulative actions or projects would affect the City of Yreka's municipal water supply pipeline. **There would be no significant cumulative effects.**

*Construction of the Proposed Action could affect public services and utilities in the counties and cities in the area of analysis.* The large number of construction workers required for the project could increase the demand on existing services and utilities. Both Siskiyou County and Klamath County are projecting population increases in 2020, and this would also increase the demand for public services and utilities. Together these actions could result in significant cumulative effects associated with the demand for public services and utilities. However, the workers for the Proposed Action would likely stay in existing residences, hotels, or campgrounds with adequate existing utilities and services. In addition, the workers and their associated utility and service demands would be temporary, and by December 2020 they would likely return to their city or county of origin. No new long-term utility or services demands would occur. **The Proposed**

**Action’s incremental contribution to the significant cumulative effect associated with increased demands for utilities and services would not be cumulatively considerable.**

*Implementation of the Proposed Action could affect road conditions.* Construction equipment could damage existing roads during deconstruction. Siskiyou County has had reduced budgets and has several existing roads that they cannot afford to maintain. Other proposed projects such as the new subdivisions around Iron Gate Dam, mining activities, and general wear and tear from seasonal traffic all contribute to degrade the current road system over time. Together these actions and the Proposed Action would result in significant cumulative effects on road conditions. However, the DRE would be responsible for repairing all damages to roads during deconstruction activities. The use of roads during deconstruction would be temporary and would be over after deconstruction is complete. No long-term use of the roads would occur. **The Proposed Action’s incremental contribution to the significant cumulative effect associated with road conditions would not be cumulatively considerable.**

*Activities associated with the Proposed Action could generate a substantial amount of solid waste.* Deconstruction of the four facilities is expected to generate a substantial amount of solid waste. The population in Siskiyou and Klamath Counties is expected to increase in the future. As a consequence of this projected population growth, the generation of solid waste would also be expected to increase proportionally. Solid waste facilities have a finite amount of space and can only accept waste if space is available. The Proposed Action’s generation of solid waste, combined with the expected increases in solid waste generation from population increases, and any future construction projects such as the proposed subdivisions described in Table 4-3 above, could create a significant cumulative solid waste impact. The Proposed Action’s contribution to the cumulative effect would be less than cumulatively considerable. The earth, concrete, and rebar waste that would be removed from the facilities under the Proposed Action would be sent to local landfills. The selected landfills in the region have adequate capacity to absorb the debris from this temporary project. A portion of the waste would be sent to recycling facilities. The Proposed Action would not create a new permanent stream of solid waste generation; the solid waste impacts would be temporary and only last the duration of construction. **The Proposed Action’s incremental contribution to the significant cumulative effects associated with solid waste would not be cumulatively considerable.**

*The Proposed Action would remove existing hydropower facilities, resulting in a loss of hydropower.* Under the Proposed Action, the East and West Side Facilities would be decommissioned, resulting in the loss of generated power. Under the Proposed Action, four of the seven power generating facilities of the KHP would be removed and the Eastside and Westside Facilities would be decommissioned. The combined output of the four facilities that would be removed is approximately 169 MW, and FERC rates the

project's dependable capacity as 42.7 MW<sup>10</sup> (M-Cubed 2006). The total combined power generating capacity of the Eastside and Westside Facilities is approximately 3.8 MW.

This accounts for less than 2 percent of PacifiCorp's power portfolio. While the loss of the power generated may have some impact to the local area, the effects of the loss to the Northwest Power Pool, in light of the scale of the additional generation needed to meet demand over the next 10 years, is minimal.

Significant cumulative effects have occurred associated with power supply and demand in the west. Declining power supply margins over the next 10 years will require an upgraded transmission system across the western interconnection in order to balance the surplus of generation in the northern and eastern portions with the higher demands in the western and southern areas of the region. Planning for these upgrades has already begun independently of the Proposed Action in order to meet the growing energy demand across the western states, and construction on several of these projects is already underway. The need for these transmission upgrades was established independently of the Proposed Action and the impacts associated with them cannot be attributed to the potential loss of energy as a result of this project. Many of the major portions of the transmission upgrades will be completed by 2014, prior to the decommissioning of the hydropower facilities discussed in this EIS/EIR.

The need for new generation facilities to meet the needs of PacifiCorp customers has already been established as well. Increasing the percentage of renewable energy in the company's portfolio, establishing new sources of energy to meet the increasing base load demand as well as higher peak demand, and upgrading or maintaining existing power sources are all delineated in PacifiCorp's Integrated Resource Plan from 2008 and the 2010 update. These improvements have been outlined as necessary in order to continue to provide reliable service to their customers, and will occur regardless of the Proposed Action.

One cumulative project has been identified that could potentially supply electricity to the region. The Klamath Falls Bioenergy Facility is in the early stages of planning but has issued a Notice of Intent to file an application from the ODE for construction of a bioenergy facility. This facility would burn wood waste and would produce up to 38.5 MW of electrical power. This might help to offset lost power in the region from removal of the Four Facilities.

While the Proposed Action would result in the loss of approximately 173.8 MW of power, it would represent less than 2 percent of PacifiCorp's power portfolio. Independent of the Proposed Action, additional improvements are planned by PacifiCorp to increase power generation to meet growing demands. **The Proposed Action's incremental contribution to the significant cumulative effects associated with the**

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<sup>10</sup> Dependable capacity is the MW output of a generator or group of generators during a period of low water or other operational constraints that coincide with a peak electrical system load -- essentially a worst case generation capacity, where low water coincides with peak demand. This is generation based on real world operations at a hydropower generating facility, whereas nameplate capacity is the amount of power that the turbines are capable of generating with all other conditions being perfect.

**loss of electrical generating capacity/hydropower would not be cumulatively considerable.**

*The loss of the reservoirs could increase available mosquito habitat and the increase the risk of disease transmission.* No other known actions or projects would affect standing water or increase mosquito habitat. **There would be no significant cumulative effects associated with mosquito habitat and increased risk of disease.**

### **KBRA**

*Implementation of the Power for Water Management Program could create new renewable energy sources.* Implementation of the Power for Water Management Program (KBRA Section 17) would provide affordable electricity to allow efficient use, distribution, and management of water. This could also involve the development of renewable energy sources, which would provide green energy. One other project, the Klamath Falls Bioenergy Facility, is in the early stages of planning but has issued a Notice of Intent to file an application from the ODE. This facility would burn wood waste and would produce up to 35 MW of electrical power. Together, these actions could provide new sources of power to the region. **The KBRA's incremental contribution to the cumulative effect on electricity would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Completing the Emergency Response Plan could have beneficial effects on Public Services and Public Safety.* The Emergency Response Plan is intended to prepare water managers and emergency responders for potential failure of Reclamation's Klamath Project dikes or other facilities that affect the storage and delivery of water to Klamath Project irrigators. The plan would include a process to prepare for potential emergencies, identify available funding sources for responding to emergencies, a prioritization method for funding emergency responses, and a process to implement emergency responses. No other known cumulative actions would involve emergency response for Reclamation's Klamath Project. **There would be no significant cumulative impacts. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Prescribed burning and mechanical thinning under the Phase I and II Fisheries Restoration Plans could affect Public Services and Utilities.* Prescribed burning and mechanical thinning in forests could damage to utility lines from falling trees and branches, and could also require using public resources to monitor and manage burning which can leave other areas more vulnerable during the prescribed burn. There are no other cumulative actions or projects that have been identified that would specifically require the use of public resources such as firefighters or that could damage public utilities in forests; however the risk of forest fires is high in many areas of the Klamath Basin. If forest fires occurred during prescribed burning, this could put stress on existing public resources such as firefighters. The KBRA's incremental contribution to this cumulative effect would be minimal. All prescribed burns would be scheduled so as to ensure firefighters remain available to assist with any wildfires. **The KBRA's incremental contribution to the cumulative effects on public services would not be**

**cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Construction activities associated with the KBRA programs could result in public health and safety impacts.* Potential construction activities could include a variety of restoration actions and habitat improvements. The Fisheries Reintroduction and Management Plan, the Agency and Barnes Ranches projects, the Wood River Wetland Restoration Program, and elements of the On-Project Plan contain construction components that could have health and safety issues related to the construction activities.

While the exact locations for some of these actions is not yet known, there could be significant cumulative health and safety impacts if the KBRA actions were to take place adjacent to other large construction projects or in areas with substantial public health and safety risks. The KBRA's incremental contribution to the significant cumulative public health and safety impacts would be minimal. Prior to implementing construction, an applicable public health and safety plan would be developed to ensure construction workers and the public would not be adversely affected during construction and operation. **The KBRA's incremental contribution to the significant cumulative effects associated with public health and safety impacts during construction would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.17.2 Alternatives 3, 4, and 5**

Alternatives 3 and 5 would have similar cumulative public health and safety, utility, and services effects as those described for Alternative 2. Alternative 4 would have a smaller workforce and a smaller construction area and would therefore have less cumulative effects on public health and safety, utilities, and services. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.17.3 Mitigation Measures**

There would be no cumulatively considerable impacts; therefore, no mitigation measures are required.

#### **4.4.18 Scenic Quality**

Cumulative effects on scenic quality could occur through changes in the existing visual character of the area or loss of scenic vistas. The timeframe for this analysis includes the duration of construction (May 2019 through December 2020) and several months to several years after construction until some vegetation becomes established. Table 4-20 presents a summary of scenic quality impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-20. Summary of Scenic Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water at the Four Facilities could result in water quality impacts that could have long-term impacts on scenic quality.	1, 4	NCFEC	None	NCFEC
Continued existence of the buildings and other man-made structures could have the impact that they would remain inconsistent with the VRM classification of the surrounding area (where such inconsistency is defined as a criterion of significance).	1, 4, 5	NCFEC	None	NCFEC
Ongoing fish habitat restoration actions could result in short-term and long-term impacts on scenic resources.	1	S (short-term from construction); B (long-term)	None	S (short-term from construction); B (long-term)
Dam removal could result in impacts on scenic resources from removal of dams and facilities.	2, 3, 5	B	None	B
The removal of historic properties could result in impacts on scenic resources.	2, 3, 5	S	None	S
Dam removal could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.	2, 3, 5	S	None	S
Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.	2, 3, 5	S (short-term); B (long-term)	None	S (short-term); B (long-term)
Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources.	2, 3, 5	S	None	S
Replacement of the existing wooden Lakeview Bridge just downstream of Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.	2, 3	S (short-term); LTS (long-term)	None	S (short-term); LTS (long-term)
Relocation of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.	2, 3	S (short-term); LTS (long-term)	None	S (short-term); LTS (long-term)

**Table 4-20. Summary of Scenic Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Deconstruction activities could create a new source of light or glare that could adversely affect nighttime views in the area.	2, 3, 4, 5	S	SQ-1: Measures to Reduce Nighttime Light and Glare	LTS
Sediment release during dam and reservoir removal could cause temporary changes in water quality and the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	2, 3, 5	S (short-term)	None	S (short-term)
Removal of the dams and facilities could result in long-term impacts on scenic resources from changes to water quality.	2, 3, 5	B	None	B
Demolition, construction, and restoration activities for the fishways could cause short-term adverse effects on the scenic vistas in the immediate vicinity of the Four Facilities.	4, 5	S	None	S
Construction of fishways could cause changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	4, 5	LTS	None	LTS
Fishways could cause substantial long-term impacts on scenic resources.	4, 5	S	None	S
Construction activities associated with fish collection facilities would introduce new features into the landscape.	4, 5	LTS (short-term); S (long-term)	None	LTS (short-term); S (long-term)
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could affect scenic resources.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Decommissioning of the East and Westside canals and hydropower facilities could affect scenic resources.	2, 3	LTS	None	LTS
<b>KBRA</b>				
Construction activities associated with the Fisheries Restoration Plan-Phase I and Phase II, the WURP, the Fish Entrainment Reduction, and the Klamath Tribes Interim Fish Site could result in impacts on scenic resources.	2, 3	LTS	None	LTS

**Table 4-20. Summary of Scenic Quality Impacts from Chapter 3**

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
The Fisheries Restoration Plan-Phase I and Phase II could result in long-term impacts on scenic resources.	2, 3	B	None	B
Construction activities associated with fish collection facilities would introduce new features into the landscape.	2, 3	LTS (short-term); S (long-term)	None	LTS (short-term); S (long-term)
The Wood River Wetland Restoration Project, the Fish Entrainment Reduction, and the Klamath Tribes Interim Fish Site could result in long-term impacts on scenic resources.	2, 3	LTS	None	LTS
The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in long-term impacts on scenic resources.	2, 3	B/LTS	None	B/LTS

**Key:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

VRM = Visual Resource Management

**4.4.18.1 Alternative 2: Full Facilities Removal of Four Dams Alternative**

*The Proposed Action would result in impacts on scenic resources from removal of the dams and facilities.* Removal of all of four dam facilities would result in a change from a reservoir vista to a river vista. No other known cumulative actions or projects would visibly change the scenic character of the Klamath River at the Four Facilities. **There would be no significant cumulative scenic impacts.**

*The Proposed Action would result in impacts on scenic resources from the removal of some historic properties.* Removal of some properties that are considered historic would occur during dam deconstruction. No other known cumulative actions or projects would remove historic properties along the Klamath River near the Four Facilities. **There would be no significant cumulative scenic impacts associated with removal of historic properties.**

*Removal of the Four Facilities could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.* The Proposed Action would remove the dams' associated reservoirs, and substantial changes would occur in the former reservoir

area during drawdown and until restoration is complete. The Klamath River in the vicinity of the reservoirs would be reduced in breadth to its historic channel width and depth, exposing all previously inundated areas except the historic river channel. The receding water would expose reservoir sediments at the bottom of the reservoir. No other known cumulative actions or projects would affect the scenic resources in the previously inundated areas during this time period. **There would be no significant cumulative scenic impacts associated with the exposed reservoir areas.**

*Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.* Deconstruction activities would have temporary impacts on existing scenic resources around the four facilities because of the presence of construction staging and stockpiling. No other known cumulative actions or projects would affect the scenic vistas at the dam sites during deconstruction because this area would be closed to the public. **There would be no significant cumulative scenic vista impacts associated during deconstruction.**

*Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources. Rerouting of the City of Yreka water supply pipeline along the underside of the Lakeview Bridge just downstream of Iron Gate Dam could result in short and long-term impacts on scenic resources.* The new prefabricated steel pipe bridge would likely be three spans with a center span of 200 feet and two end spans of 100 feet. The spans would be supported on concrete piers. The new pipeline would be connected to the existing buried pipeline at each end of the bridge. No other known actions or projects would affect scenic resources in the location of the proposed bridge. **There would be no significant cumulative scenic effects associated with the City of Yreka's elevated water supply pipeline.**

*Replacement of the existing wooden Lakeview Bridge just downstream of Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.* If the Lakeview Bridge is replaced with a concrete bridge in the same location, there would be short-term significant impacts on scenic quality during construction from the presence of construction equipment, and long-term impacts because the wooden bridge would be replaced with a concrete bridge. No other known actions or projects would affect scenic resources in the location of the existing bridge. **There would be no significant cumulative scenic effects associated with the replacement of the Lakeview Bridge.**

*Relocation of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.* The recreation areas located on the edges of the existing reservoirs would be removed once the reservoirs have been drawn down. Removal activities would include deconstruction and site restoration. No other known cumulative actions or projects would affect visual resources in the locations of the recreational facilities to be demolished. **There would be no significant cumulative scenic effects associated with the deconstruction of the recreational facilities along the reservoirs.**

*Deconstruction could create a new source of light or glare that could adversely affect nighttime views in the area.* Temporary lighting would be erected for nighttime activities, and security lighting might be required during deconstruction. No other known cumulative actions or projects would introduce light or glare at the Four Facilities during deconstruction. **There would be no significant cumulative scenic impacts associated with light or glare.**

*Drawdown and removal of the four reservoirs could cause temporary changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.* In the short-term, water aesthetics (clarity, turbidity (depth of view), and color) in the receding reservoir and downstream river reaches would likely be affected as the sediment behind the dams erodes and washes downstream. Other projects and actions that could occur during reservoir drawdown and could alter the appearance of the Klamath River could include subdivision developments in Siskiyou County, timber harvesting, mining activities, and large storm events. These could contribute sediment and could change the clarity, turbidity (depth of view), and color of the Klamath River. If one or more of these actions occurred at the same time as reservoir drawdown, there could be significant cumulative effects associated with the visual appearance of the river. The Proposed Action's impacts would be temporary and would occur in the winter when the river may already have a changed appearance from runoff and increased turbidity. Because the Proposed Action's contribution would be temporary and would end after the reservoirs were drawn down, **the Proposed Action's incremental contribution to the significant cumulative effect on the appearance of the Klamath River in the short-term would not be cumulatively considerable.**

*Removal of the dams and facilities could result in long-term impacts on scenic resources from changes to water quality.* As described in Section 3.2, Water Quality, removal of the dams at the Four Facilities is expected to improve water quality in the long-term. The changes are expected to reduce the river's summer algae concentrations, resulting in changes in both water clarity and coloration. An improvement in water quality could result in some improvement in scenic resources, such as water clarity or fish viewing opportunities. These improvements would be most noticeable from on-river and riverside viewpoints, and much less noticeable from river canyon roadway and community viewpoints. Other cumulative actions and programs that could also improve water quality on the Klamath River include implementation of TMDLs on the Scott, Salmon, Shasta, and Klamath Rivers as noted in Table 4-3, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, and the Five Counties Road Maintenance Program. Additionally, the Northwest Forest Plan contains provisions for reducing water quality impacts from timber harvesting and road construction. Together these cumulative actions and programs would contribute to improving water quality in the Klamath Basin and could positively affect scenic resources. **The Proposed Action's incremental contribution to the significant cumulative effect on scenic resources would be beneficial.**

### **KBRA**

*Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II, Fish Entrainment Reduction, the Klamath Tribes Interim Fishing Site, and the Fisheries Reintroduction and Management Plan could result in impacts on scenic resources or introduce new features into the landscape.* Many of the KBRA actions and programs would likely require some type of construction. Construction equipment, vehicles, staging areas, and stockpiling areas could have temporary impacts on scenic resources within localized construction areas. No other cumulative actions or projects have been identified that would cause significant cumulative effects on scenic resources. However, when specific locations and construction schedules are available, additional analysis would be completed. **There would be no significant cumulative effects on scenic resources. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**

*The Fisheries Restoration Plan- Phase I and Phase II, Wood River Wetland Restoration Project, Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in long-term impacts on scenic resources.* The Fisheries Restoration Plan is intended to benefit fish populations and therefore increase fish viewing opportunities, which would result in beneficial effects to scenic resources. In addition, actions are anticipated to result in scenery more consistent with the naturally established, characteristic landscape. The Wood River Wetland Restoration Project is intended provide additional water storage which could potentially result in scenery more consistent with the naturally established, characteristic landscape. The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in changes to land uses, including changes from ranchland to water storage areas. These changes have the potential to be beneficial if they result in landscapes (wetlands) that are consistent with the naturally established, characteristic landscape. The only other main cumulative action that would have beneficial effects on scenic resources is the implementation of the KHSA, which would remove reservoirs and restore a portion of the Klamath River to its natural state. Together these actions would have beneficial effects on scenic resources. **The KBRA's incremental contribution to the cumulative effects on scenic resources would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**

*Construction activities associated with fish collection facilities would introduce new features into the landscape.* Trap and haul operations within the Fisheries Reintroduction and Management Plan would require construction of fish collection and handling facilities at Keno and Link River Dams to seasonally move fish around Keno Impoundment and Link River during times of poor water quality. Constructing these facilities would result in temporary impacts on scenic resources at Keno and Link River Dams, and the fish handling facilities would remain in the long term to change the visual landscape. The handling facilities at Keno and Link River Dams would not be in the same visual area as the Four Facilities; therefore, construction of fish handling facilities would not compound the effects of facility removal actions. No other cumulative actions or

projects have been identified that would affect scenic resources at Keno and Link River Dams. **There would be no significant cumulative effects associated with fish collection facilities. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**

*Fish Entrainment Reduction could result in long-term impacts on scenic resources. Construction activities associated with fish collection facilities below Keno Dam and above Klamath Lake would introduce new features into the landscape. Construction activities associated with fish collection facilities below Keno Dam and above Klamath Lake would introduce new features into the landscape.* The impact to scenic resources from the addition of the fish management and entrainment reduction structures would likely be inconsistent with the naturally established, characteristic landscape. No other cumulative actions or projects would introduce structures into the waterway at these locations. **There would be no significant cumulative effects on scenic resources. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**

#### **4.4.18.2 Alternatives 3, 4, and 5**

Alternatives 3 and 5 would have similar cumulative scenic effects as those described above for Alternative 2. Alternative 4 would not have any cumulative scenic effects associated with reservoir drawdown or reservoir removal. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.18.3 Mitigation Measures**

There are no significant cumulative effects; therefore, no mitigation is required.

#### **4.4.19 Recreation**

Cumulative effects on recreation would be associated with changes in the available recreational facilities and/or opportunities adjacent to the Klamath River and within the Klamath Basin. The timeframe for recreation therefore includes the duration of construction (May 2019 through December 2020) and continues indefinitely afterwards because post-construction impacts would be permanent. No cumulative projects were identified that would further reduce reservoir/lake based recreation opportunities including reservoir-based fishing, flat water boating, and camping and day use facilities adjacent to a lake. This analysis does not include effects discussed as part of the Wild and Scenic Rivers analysis in Chapter 3. Table 4-21 presents a summary of the recreation impacts described in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4-21. Summary of Recreation Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued existence of the reservoirs could change existing recreation access and opportunities.	1,4	NCFEC	None	NCFEC
Construction activities associated with ongoing programs could temporarily restrict access to recreational opportunities.	1	LTS	None	LTS
Construction activities associated with ongoing programs could result in short-term water quality impacts which could affect recreational opportunities.	1	LTS	None	LTS
Ongoing actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	1	B	None	B
Construction activities would temporarily restrict recreational access on and in the vicinity of the reservoirs.	1, 4	NCFEC	None	NCFEC
	2, 3, 5	LTS	None	LTS
Construction activities, such as demolition, would generate temporary impacts (i.e., increased noise and dust) and could decrease the quality of recreational experiences in the vicinity of the reservoirs.	2, 3, 5	LTS	None	LTS
Reservoir removal could permanently decrease the availability of reservoir/lake-based recreational opportunities.	1, 4	NCFEC	None	NCFEC
	2, 3, 5	LTS	None	LTS
Removal of recreation facilities could limit access to recreational opportunities along and within the newly formed river channel.	2, 3, 5	S	REC-1: Prepare a plan to develop new recreational facilities and river access points	LTS
Changes in flow and water quality following dam removal could impact developed recreational facilities upstream and downstream of the reservoirs.	2, 3, 5	LTS	None	LTS

**Table 4-21. Summary of Recreation Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Downstream sediment release during reservoir drawdown could decrease the quality of water-contact-based-recreation in the short-term.	2, 3, 5	LTS	None	LTS
Removal of impoundments improves water quality and could impact water-contact-based recreational opportunities.	2, 3, 5	B	None	B
	1, 4	NCFEC	None	NCFEC
Changes to the floodplain or river channel and removal of recreation facilities as a result of dam removal could affect access to whitewater boating opportunities.	2, 3, 5	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)	None	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)
Changes in flows following dam removal could increase the number of days with acceptable flows for various recreational activities in the Klamath River.	2, 3, 5	LTS	None	LTS
Changes in flows could increase the number of days with acceptable flows for whitewater boating and fishing in the J.C. Boyle and Copco 2 Bypass Reaches.	2, 3, 4, 5	LTS	None	LTS
Changes in flows could decrease the number of days with acceptable flows for whitewater boating and fishing in the Hells Corner Reach.	2, 3, 5	S (whitewater boating); LTS (fishing)	None	S (whitewater boating); LTS (fishing)
	4	S (whitewater boating)	None	S (whitewater boating)
Improved habitat for anadromous fish species following dam removal could affect recreational fishing opportunities in the long-term.	2, 3, 5	B	None	B
	4	LTS	None	LTS
Implementation of Mitigation Measure REC-1 could permanently reduce recreational opportunities in the Klamath Basin.	2, 3, 5	LTS	None	LTS
<b>Keno Transfer</b>				
Transfer of the Keno Facility from PacifiCorp to DOI could affect recreational opportunities.	2, 3	NCFEC	None	NCFEC

**Table 4-21. Summary of Recreation Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>East and Westside Facilities</b>				
The decommissioning of the East and West Side Facilities could have adverse effects on recreational resources.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
Construction activities associated with the KBRA could temporarily restrict recreational access.	2,3	LTS	None	LTS
Construction activities associated with KBRA programs could result in short-term water quality impacts which could affect recreational opportunities.	2,3	LTS	None	LTS
Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin.	2,3	B	None	B
KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	2,3	B	None	B
KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin.	2,3	B	None	B
KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin.	2,3	B	None	B

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

There are no known past, present, or future actions or projects that would substantially alter recreation facilities or recreation opportunities along the Klamath River. There are, however, a number of ongoing actions to improve fisheries, including the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. These would benefit recreational fishing.

#### **4.4.19.1 Alternative 2: Full Facilities Removal of Four Dams**

*Demolition activities could temporarily restrict recreational access in the vicinity of the reservoirs.* Short-term demolition activities associated with dam removal would result in temporary loss of access to recreational facilities at the Four Facilities and associated reservoir-based recreational opportunities. No other known actions or projects from May 2019 through December 2020 would occur that would restrict recreation access along the Klamath River. **There would be no significant cumulative impacts associated with restricted recreation access during deconstruction.**

*Temporary impacts from demolition activity (i.e., increased noise and dust) could decrease the quality of recreational experiences in the vicinity of the reservoirs.* No other known actions or projects from May 2019 through December 2020 would occur that would restrict recreation access along the Klamath River. **There would be no significant cumulative impacts associated with a decrease in the quality of recreational experiences due to demolition activities.**

*Dam removal would permanently decrease the availability of reservoir/lake-based recreational opportunities in the area of analysis.* The removal of the dams would eliminate existing opportunities for reservoir-based recreation activities, such as power boating, waterskiing, lake swimming, and flat-water boat angling, provided at J.C. Boyle, Copco 2, and Iron Gate Reservoirs. No other cumulative projects were identified that would further reduce reservoir/lake based recreation opportunities including reservoir-based fishing, flat water boating, and camping and day use facilities adjacent to a lake in the Klamath Basin. **There would be no significant cumulative effects associated with the decrease of reservoir/lake based recreation.**

*Dam removal would permanently remove recreational facilities associated with the reservoirs.* Under the Proposed Action, the recreational facilities constructed to accommodate reservoir recreation, with the exception of Topsy Campground, Fall Creek and Jenny Creek Day Use Areas, and the Iron Gate Fish Hatchery Day Use Area, would be completely removed and the former recreation areas, parking areas, and access trails would be regraded and revegetated (O’Meira et al. 2010). No actions or projects were identified that would further reduce recreation opportunities along the Klamath River. **There would be no significant cumulative effects associated with the removal of the reservoir recreation facilities.**

*Dam removal would not adversely affect developed recreational facilities upstream and downstream of the subject reservoirs.* No actions or projects were identified that would substantially change recreation facilities upstream or downstream of the reservoirs.

**There would be no significant cumulative effects associated with recreation facilities upstream or downstream of the Four Facilities.**

*Sediment release downstream during reservoir drawdown could decrease the quality of water-contact-based recreational opportunities.* The increase in turbidity would reduce visibility and water clarity and this could affect recreation. Other actions that could occur in the Klamath Basin that could increase turbidity include construction of new subdivisions around Iron Gate Dam in Siskiyou County listed in Table 4-4, mining activities, timber harvesting, agricultural activities, road improvements, and large storm events. Together, these could result in high levels of turbidity that could cause significant cumulative water quality effects that could decrease the quality of water-based recreation. The Proposed Action's contribution to this effect would be minimal. The Proposed Action's effects on turbidity would be temporary and almost all the sediment would likely be flushed to the ocean in about two years or less. The Proposed Action would only affect turbidity levels downstream of Iron Gate Dam. **The Proposed Action's incremental contribution to the significant cumulative effect on the quality of water-contact based recreational opportunities in the short-term would not be cumulatively considerable.**

*Changes in water quality associated with dam removal could positively affect water-contact-based recreational opportunities.* Dam removal is expected to result in long-term improvements in water quality that could benefit water-contact-based recreational activities. Many other past, present, and future cumulative actions and programs are taking place or are planned to take place in the Klamath Basin to improve water quality, including the implementation of TMDLs on the Scott, Salmon, Shasta, and Klamath Rivers as noted in Table 4-3, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, and the Five Counties Road Maintenance Program. Additionally, the Northwest Forest Plan contains provisions for reducing water quality impacts from timber harvesting and road construction. Together these cumulative actions and programs would contribute to improving water quality in the Klamath Basin and could positively affect water-contacted based recreation. **The Proposed Action's incremental contribution to the cumulative effects on the quality of water-contact-based recreational opportunities in the long-term would be beneficial.**

*Dam removal could impede access for whitewater boating opportunities.* In the reaches between the existing dams, particularly in the Hell's Corner reach, whitewater boating access would likely be affected due to dam removal activities and sedimentation. No cumulative actions or projects have been identified that would further reduce whitewater boating opportunities along the Klamath River during deconstruction. **There would be no significant cumulative effects associated with access for whitewater boating.**

*Dam removal could increase the number of days with acceptable flows for various recreational activities in the Klamath River. Dam removal could increase the number of days with acceptable flows for whitewater boating in the J.C. Boyle Reach. Dam removal could decrease the number of days with acceptable flows for whitewater boating in the Hell's Corner Reach.* No other known actions or projects would change the number of days with acceptable flows for water-based recreation on the Klamath River. **There would be no significant cumulative effects associated with reducing the number of days with acceptable flows for recreation activities.**

*Dam removal would result in increased fisheries populations and abundance, which would improve recreational fishing along the river.* Removal of the dams would improve habitat conditions for anadromous fish species and is expected to result in increased populations of these species. The increased fisheries populations and abundance would increase the opportunity for recreational fishing. Many other ongoing programs are intended to improve fisheries in the Klamath River and its tributaries, including the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. Together, these actions and the Proposed Action could result in cumulatively beneficial effects on recreational fishing. **The Proposed Action's incremental contribution to the significant cumulative effect on recreational fishing would be beneficial.**

#### **KBRA**

*Construction activities associated with the Phase I Fisheries Restoration Plan could temporarily restrict recreational access.* Although specific plans have not yet been developed, floodplain rehabilitation would likely involve the use of heavy equipment along floodplain and riparian areas and therefore could result in restrictions to public access for recreational activities. No other cumulative actions or projects have been identified that could potentially restrict recreation access on the Klamath River. **There would be no significant cumulative effects associated with restricted recreation access. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Construction activities associated with KBRA programs could result in short-term water quality impacts that could affect recreational opportunities.* Erosion and sedimentation during construction activities has the potential to temporarily decrease water quality and reduce water visibility for boaters, swimmers, and fisherman. These short-term water quality impacts would be anticipated to occur throughout the basin where construction activities take place. Specific sections of the river could be affected for a period of time throughout implementation of the KBRA programs. BMPs would be implemented to reduce erosion and sedimentation during construction. Following implementation and related construction activities for KBRA programs including the Wood River Wetland Restoration, and the Interim Flow and Lake Level Program, WURP, water quality and clarity would be expected to improve.

Other actions that could occur in the Klamath Basin that could increase turbidity include reservoir drawdown associated with the KHSA, construction of new subdivisions noted

in Table 4-4, mining, timber harvesting, road improvements, recreation, and agricultural activities. Together, these could result in high levels of turbidity that could cause significant cumulative water quality effects that could decrease the quality of water-based recreation. The KBRA's contribution to this effect would be minimal. The KBRA's effects on turbidity would be temporary and would be controlled with best management practices. **The KBRA's incremental contribution to the significant cumulative effect on water quality that could decrease the quality of water-contact based recreational opportunities would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**

*Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin.* Implementation of the Fisheries Restoration Plan would likely include some sort of fire treatment throughout the basin. It is expected that large or severe burn treatments would result in a short-term adverse effect of the visual quality of the burned area, which could directly affect the number of recreational visitors to the area (i.e., depending on the size and intensity of the burn, recreationalists may be less likely to visit an area immediately after a prescribed burn than an unburned area). However, long-term visual quality benefits typically result from burn treatments that are consistent with the historic range of the ecosystem. No other cumulative actions are projects have been identified that would substantially alter the visual setting of the basin through proscribed burning that could decrease recreational visitors to the basin. **There would be no significant cumulative impacts associated with altering the visual setting and decreasing recreational visitors to the Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.* It is expected that correction of fish passage issues throughout the basin would restore fish access to new and historic habitats and result in increased fish populations. The increased fish populations and abundance would beneficially affect recreational fishing opportunities. More specifically, the increased abundance would allow for increased catch limits and fewer catch and release requirements, as well as decrease the potential of closures of entire fishing seasons as those that occurred on the Klamath River in the recent past. Many other ongoing actions or programs are intended to improve fisheries in the Klamath River and its tributaries, including the removal of the Four Facilities as part of the KHSR, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. The Northwest Forest Plan contains provisions to reduce impacts from timber harvesting on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) would also improve fisheries. Together, these actions and the Proposed Action could result in cumulatively beneficial effects on recreational fishing. **The Proposed Action's incremental contribution to the significant cumulative effect on recreational fishing would be beneficial. Implementation of**

**specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin.* KBRA programs including the Fisheries Restoration Plans Phase I and II, Fisheries Reintroduction and Management Plan Phase I and II, Wood River Wetland Restoration, WURP, and Interim Flow and Lake Level Program would result in long-term benefits to water quality throughout the Klamath Basin. No other cumulative actions or projects have been identified that would increase recreational opportunities in the Klamath Basin. **There would be no significant cumulative effects associated with increased recreational opportunities in the Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin.* KBRA programs would result in long-term benefits to terrestrial species as a result of restored floodplain and riparian vegetation and habitat areas. It is anticipated that improvements and increases in terrestrial wildlife habitat would benefit recreational wildlife viewing and recreational hunting opportunities in the Klamath Basin. Other cumulative actions and programs identified in the Klamath Basin that would also contribute to enhancing wildlife and plant resources include California Wildlife: Conservation Challenges (CDFG 2005), which is California's Wildlife Action Plan and outlines measures for conservation of wildlife and habitat, the Riparian Bird Conservation Plan (Riparian Habitat Joint Venture 2004), which provides conservation guidance and implements various programs for riparian bird species in California, and the California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California (CDFG and Caltrans 2004), which provides information on wildlife corridors that will be used to help implement the Wildlife Action Plan, and will encourage consideration of wildlife corridors for transportation and land use planning projects. Together, these would have beneficial cumulative impacts on terrestrial vegetation and wildlife. **The KBRA's incremental contribution to the cumulative effects on terrestrial and wildlife species that could increase recreational opportunities throughout the Klamath Basin would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.19.2 Alternatives 3, 4, and 5**

Alternative 3 would have similar cumulative recreation effects as Alternative 2. Alternative 4 would not have any cumulative recreation effects, beyond potentially improving fish passage and therefore improving recreational fishing. Alternative 5 would have similar cumulative effects as Alternative 2 but because two dams would remain in place, cumulative benefits to water quality and fisheries would be less. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

**4.4.19.3 Mitigation Measures**

There are no cumulatively considerable recreation effects; therefore, no mitigation measures are required.

**4.4.20 Toxic/Hazardous Materials**

Cumulative toxic and hazardous materials impacts could occur from future projects in the vicinity of the Four Facilities that could require the use, transport, or disposal of hazardous materials, or that could involve the accidental release of hazardous materials around the dam sites. The timeframe for cumulative effects associated with toxic and hazardous materials includes the duration of construction (May 2019 through December 2020). No permanent toxic or hazardous materials would occur after construction is complete. Table 4-22 presents a summary of the toxic and hazardous materials impacts presented in Chapter 3. These impacts are analyzed for cumulative effects.

**Table 4.22. Summary of Toxic/Hazardous Materials Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued operation of the Four Facilities could create a hazard to the public or the environment through the transport, use, or disposal of hazardous materials.	1, 4, 5	NCFEC	None	NCFEC
Construction activities could create a significant hazard to the public or the environment if they are located on a site which is included on a list of hazardous materials sites.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could create a hazard to the public or the environment through the transport, use, or disposal of HTRW.	2, 3, 4, 5	LTS	None	LTS
Construction activities could create a hazard to the public or the environment through the abatement and disposal of asbestos and lead-based paint.	2, 3, 5	LTS	None	LTS
Construction activities could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 4, 5	LTS	None	LTS
Construction activities required to relocate the Yreka water supply pipeline could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment	2, 3, 5	LTS	None	LTS
Removal of various recreation facilities could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 5	LTS	None	LTS

**Table 4.22. Summary of Toxic/Hazardous Materials Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Keno Transfer</b>				
The transfer of the Keno Facility to DOI could result in affects to HTRW.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
The decommissioning of the East and West Side Facilities could have adverse effects in terms of toxics and hazards.	2, 3	LTS	None	LTS
<b>KBRA</b>				
Construction activities associated with the KBRA programs could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered during construction.	2,3	LTS	None	LTS
Construction activities associated with the KBRA programs could create a significant hazard to the public or the environment through the accidental release of hazardous materials during construction activities.	2,3	LTS	None	LTS

**Key:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

There are no known actions or projects that would occur directly at the Four Facilities that could contribute to cumulative hazardous or toxic materials impacts. There are several new subdivisions proposed around Iron Gate Dam and several road improvements proposed for Siskiyou County. If these actions occur at the same time as dam removal, they could contribute to cumulative hazardous and toxic materials impacts through the use, storage, disposal, and accidental release of hazardous materials.

**4.4.20.1 Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)**

*The Proposed Action could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials during construction. The Proposed Action would create a significant hazard to the public or the environment through the abatement and disposal of asbestos and lead-based paint during construction. The Proposed Action would create a significant hazard to the public or the environment through the handling, transport and disposal of hazardous, toxic, or radiological waste during construction. Under the Proposed Action, recreational*

*facilities currently located on the banks of the existing reservoirs would be removed following drawdown.* The Proposed Action would involve the use, transport, and disposal of hazardous materials during deconstruction. In addition, deconstruction activities may uncover hazardous materials. Future development such as the proposed subdivisions near Iron Gate Dam or road improvements, mining, or agricultural activities could also involve the use, transport, or disposal of hazardous materials in and around the dam sites. Together these projects and the Proposed Action could result in significant cumulative effects on the public or the environment if they occurred simultaneously. The Proposed Action's incremental contribution to the cumulative effect would not be cumulatively considerable. The Proposed Action's contribution to any toxic and hazardous materials cumulative effects would be minimized by a hazardous materials management plan that would contain measures for proper handling and transport to prevent hazardous materials effects on the public and environment. No schools exist within 3 miles of the project site; therefore, no schools would be exposed to hazardous materials. **The Proposed Action's incremental contribution to significant cumulative effects associated with toxic and hazardous materials would not be cumulatively considerable.**

*The Proposed Action could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction. The Proposed Action includes the relocation of the Yreka water supply pipeline, which could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction.* Some equipment and deconstruction activities may require the use and storage of hazardous materials on-site. An accidental release of these materials could pose a threat to the public and the environment. Future development such as the proposed subdivisions near Iron Gate Dam or road improvements could also accidentally uncover or release hazardous materials in and around the dam sites. Together these projects and the Proposed Action could result in significant cumulative effects on the public or the environment. The Proposed Action's incremental contribution to the cumulative effect would not be cumulatively considerable. The Proposed Action's contribution to any toxic and hazardous materials cumulative effects would be minimized by a health and safety plan and a hazardous materials management plan that would contain measures for proper handling, storage, and transport of hazardous materials, as well as spill prevention measures to be implemented on-site. Proper clean up equipment would be required to be kept on-site in the case of accidental spills or releases. **The Proposed Action's incremental contribution to the significant cumulative effects associated with the accidental release of toxic and hazardous materials would not be cumulatively considerable.**

#### **KBRA**

*Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II and Fish Entrainment Reduction could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered or through the accidental release of hazardous materials during construction.* The KBRA could require the transport, use, and disposal of hazardous

materials and has the potential to result in accidental releases of such materials during construction. While the specific locations and schedules for KBRA actions are currently unknown, the KBRA actions could combine with other actions requiring the transport, use, or disposal of hazardous materials, such as road construction, mining, or agricultural activities, and could result in significant cumulative hazardous impacts. The KBRA's contribution to the significant cumulative effect would be minimal. A health and safety plan and a hazardous materials management plan that would contain measures for proper handling, storage, and transport of hazardous materials, as well as spill prevention measures to be implemented on-site. Proper clean up equipment would be required to be kept on-site in the case of accidental spills or releases. **The KBRA's incremental contribution to the cumulative effect on hazardous materials would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### ***4.4.20.2 Alternatives 3, 4, and 5***

Alternatives 3, 4 and 5 would have similar cumulative hazardous effects as those described for Alternative 2; however, Alternative 4 would not require the removal of any dams and would therefore not contribute to cumulative effects associated with handling and disposal of hazardous materials from hydroelectric facilities and infrastructure. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### ***4.4.20.3 Mitigation Measures***

There would be no cumulatively considerable effects; therefore, no mitigation measures are required.

#### **4.4.21 Traffic and Transportation**

Cumulative effects on transportation would be associated with the cumulative ambient background growth in traffic volumes that would result from traffic associated with the dam removal and future actions or projects that may temporarily or permanently increase traffic levels in the area of analysis. The traffic analysis presented in Section 3.22, Traffic and Transportation, in Chapter 3 already considers the dam removal traffic impacts and those of background growth in traffic volumes for the years of construction. For the transportation analysis in Chapter 3, ambient background growth was calculated and superimposed on baseline traffic volumes before applying additional "project related" traffic volumes to the roadways for analysis. This method ensures the accounting of traffic growth out to the planning timeframe.

Therefore, this cumulative analysis focuses on future projects or actions that could occur that might increase traffic levels in the area. This analysis is performed on a qualitative level rather than a quantitative level because the future timeframe for implementation of the Proposed Action and alternatives makes it difficult to accurately predict all actions or projects that could be implemented and contribute cumulative traffic impacts. The timeframe for this cumulative effects analysis includes the duration of construction as no

permanent traffic impacts would occur from the Proposed Action or alternatives. Table 4-23 presents a summary of the traffic and transportation impacts described in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Traffic Flow Effects</b>				
Construction vehicle trips could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 4, 5	LTS	None	LTS
	1	S	Traffic Management BMPs	LTS
Construction vehicle trips could result in temporary traffic flow effects on on-site roads.	2, 3, 4, 5	LTS	None	LTS
	1	NCFEC	None	NCFEC
Construction vehicle trips during removal of recreation facilities associated with dam removal could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 5	LTS	None	LTS
Construction vehicle trips during the relocation of the Yreka water supply pipeline could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 5	LTS	None	LTS
Implementation of the interim measures (IM's) 8 J.C. Boyle Bypass Barrier Removal and IM 16 Water Diversions could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2	LTS	None	LTS
<b>Traffic Safety Effects</b>				
Construction vehicle trips could cause traffic safety effects associated with the creation of dust along gravel roads.	2, 3, 5	LTS	None	LTS
Construction vehicle trips could cause traffic safety effects associated with vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road and OR66.	2, 3, 4, 5	LTS	None	LTS
Construction vehicle trips could cause traffic safety effects associated with sharp curves along Copco Road and OR66.	2, 3, 5	LTS	None	LTS

**Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3**

<b>Potential Impact</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Construction vehicle trips during the relocation of the Yreka water supply pipeline and removal of recreation facilities could cause traffic safety effects associated with sharp curves along Copco Road. The installation of signage at sharp corners would help to reduce this risk (See Appendix B).	2, 3, 5	LTS	None	LTS
The relocation of existing recreation facilities from the banks of the existing reservoirs down slope to the new river bed could result in traffic impacts along adjacent roadways.	2	LTS	None	LTS
Implementation of the interim measures (IM's) 7 J.C. Boyle Gravel Placement could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	1,2,3	LTS	None	LTS
Implementation of the interim measures (IM's) 8 J.C. Boyle Bypass Barrier Removal could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	1,2,3	LTS	None	LTS
Implementation of the interim measures (IM's) 16 Water Diversions could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	2,3	LTS	None	LTS
<b>Trap and Haul</b>				
Traffic associated with the implementation of the prescriptions and trap and haul operations would cause traffic safety effects on OR66 and US97, access roads, and onsite roads	4,5	LTS	None	LTS
<b>Road Condition Effects</b>				
Increased traffic volumes from heavy construction vehicles during construction activities could degrade road conditions and exceed bridge weight capacities. As part of the development of the construction plan, an in depth analysis of bridge and road capacity and state of repair will be conducted by the dam removal entity (DRE), with remedial actions taken prior to the commencement of facility deconstruction.	2, 3, 4, 5	S	TR-1: Relocate Jenny Creek Bridge and Culverts	LTS

**Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Public Transit Effects</b>				
Construction vehicle trip volumes and material hauling routes could affect regional transit service.	2, 3, 4, 5	LTS	None	LTS
<b>Non-Motorized Transportation Effects</b>				
The presence of construction vehicles along Copco and Topsy Grade/Ager-Beswick Roads could affect non-motorized transportation (i.e., bicyclists and pedestrians) due to high speeds and dust generation.	2, 3, 4, 5	LTS	None	LTS
<b>Keno Transfer</b>				
The transfer of the Keno Facility could impact traffic and transportation.	2, 3	NCFEC	None	NCFEC
<b>East and Westside Facilities</b>				
Activities associated with the decommissioning of the East and Westside Facilities could affect traffic and transportation.	2, 3	LTS	None	LTS
<b>KBRA</b>				
Activities associated with the KBRA programs involving construction could cause temporary traffic effects	2,3	LTS	None	LTS
Operational activities associated with the Fisheries Reintroduction and Management Plans could result in temporary traffic effects associated with trap-and-haul activities.	2,3	LTS	None	LTS

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Actions or projects that could contribute to cumulative traffic impacts include construction of new subdivisions in Siskiyou County, and road improvement projects planned by Siskiyou County Public Works, Klamath County, and Jackson County, as noted in Table 4-3 above. Ongoing mining, timber harvesting, recreation, and agricultural activities could also contribute to cumulative traffic impacts and are considered.

#### **4.4.21.1 Alternative 2: Full Facilities Removal of Four Dams Traffic Flow Effects**

*Deconstruction activities associated with the Proposed Action would result in temporary traffic flow effects on Interstate-5 (I-5), OR66, US97, and access roads.* Deconstruction activities would increase traffic on I-5, OR66, US97, and access roads to the Four Facilities. Several projects or actions in the area of analysis that would also likely increase traffic include various approved subdivisions in Siskiyou County noted in Table 4-4 and mining operations in Siskiyou County. Road improvement projects planned by Siskiyou County Public Works, Klamath County, and Jackson County could also affect traffic on access roads or highways by increasing the number of construction vehicles or diverting traffic onto other roads. However, current traffic does not exceed the existing Level of Service (LOS) or volume to capacity (v/c) ratios and future traffic with planned growth is not expected to exceed these. The Proposed Action's contribution to this cumulative effect would be minimal. None of the main roads in the area of analysis would experience volumes in excess of their planned LOS or volume to capacity (v/c) ratio due to traffic resulting from implementation of the Proposed Action. Additionally, the traffic impacts would only occur for the duration of deconstruction. No permanent traffic effects would occur. **There would be no significant cumulative traffic flow effects on I-5, OR66, US97, or access roads.**

*Deconstruction activities associated with the Proposed Action would result in temporary traffic flow effects on on-site roads. Construction activities associated with the demolition of recreation facilities would result in temporary traffic flow effects on I-5, OR66, US97, and access roads. Construction activities related to the relocation of the Yreka water supply pipeline would result in temporary traffic flow effects on I-5, OR66, US97, and access roads. The Proposed Action would require the relocation of existing recreation facilities from the banks of the existing reservoirs down slope to the new river bed.* The short but frequent heavy vehicle trips anticipated as part of dam deconstruction along on-site gravel roads could cause traffic flow concerns. Removal of recreation facilities and relocation of the Yreka water supply pipeline would also increase traffic levels and could have construction traffic safety concerns associated with sharp curves. Cumulative projects that could also cause traffic flow and safety concerns include the widening of Copco Road by Siskiyou County Public Works, which currently does not have a date of implementation. The Proposed Action and the planned road widening could create significant cumulative traffic flow effects. The Proposed Action's incremental contribution to this significant cumulative effect would not be cumulatively considerable. The Lead Agencies would incorporate measures into the project to minimize such cumulative effects. Signage and construction traffic management would be implemented to maintain traffic flow. The Lead Agencies would coordinate with Siskiyou County Public Works to provide updates on the proposed deconstruction schedule and this could allow the planned Copco Road widening and other road improvements to be scheduled so as to help avoid cumulative effects. **The Proposed Action's incremental contribution to the significant cumulative traffic effects on on-site roads would not be cumulatively considerable.**

### **Traffic Safety Effects**

*Activities associated with the Proposed Action, would cause traffic safety effects associated with dust along gravel roads.* High trip volumes would create a substantial amount of dust in dry conditions on Copco Road, Lakeview Road, Topsy Grade/Ager-Beswick Road, and the roads leading to and surrounding each dam. The dust could create a substantial visibility hazard for vehicles on the deconstruction sites throughout the area. Other future projects such as the planned subdivisions around Iron Gate Dam, mining activities, road improvements, and recreation could also increase dust along these roads and create significant cumulative dust impacts. The Proposed Action's contribution to the significant cumulative effects associated with dust would not be cumulatively considerable. The Proposed Action's dust impacts would be minimized with the incorporation of dust abatement measures. Additionally, the dust impacts would only last the duration of construction; no long term dust impacts would occur. **The Proposed Action's incremental contribution to the significant cumulative effects associated with dust from construction traffic would not be cumulatively considerable.**

*Activities associated with the Proposed Action, would cause traffic safety effects associated with vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road and OR66.* Slow moving construction traffic associated with the Proposed Action could have safety impacts when turning onto roads or merging onto freeways. A significant cumulative effect could occur if additional construction traffic was also present for roadway improvements, or if mining or other activities required the use of large construction vehicles in the same vicinity as the Proposed Action. The Proposed Action's incremental contribution to the cumulative effects would not be cumulatively considerable. The Proposed Action would implement appropriate signage and would coordinate with local agencies regarding road use during deconstruction to minimize cumulative effects. If conflicts are identified, the Lead Agencies would work with local agencies to re-route traffic, whenever feasible. **The Proposed Action's incremental contribution to the significant cumulative traffic effects associated with vehicle turnouts would not be cumulatively considerable.**

*Activities associated with the Proposed Action would cause traffic safety effects associated with sharp curves along Copco Road and OR66. Activities associated with relocation of the City of Yreka's water supply pipeline, implementation of the IMs, and relocation or demolition of recreation facilities would cause traffic safety effects associated with sharp curves along Copco Road and OR66.* Sharp curves along Copco Road and OR66 could pose a safety risk for deconstruction traffic. All other projects using Copco Road or OR66 would be responsible for ensuring their own traffic safety; **therefore no significant cumulative effects are expected.**

### **Road Condition Effects**

*Under the Proposed Action, further analysis of road conditions and bridge weight capacities would be necessary.* Bridges used for the Proposed Action deconstruction activities may not be capable of handling the heavy deconstruction vehicles. This impact is related solely to the Proposed Action; no other actions could contribute to this effect.

**There would be no significant cumulative effects on road conditions and bridge weight capacities.**

#### **Public Transit Effects**

*Under the Proposed Action, the trip volumes and routes of material hauling and worker trips could affect regional transit service.* There are small overlaps between minor haul routes and public transit routes during deconstruction. No other known projects/actions in the area of analysis would affect regional transit service. **There would be no significant cumulative effects on regional transit service.**

#### **Non-motorized Transportation Effects**

*Under the Proposed Action, heavy vehicle traffic could cause non-motorized transportation effects.* Cyclists and pedestrians could travel along Copco and Topsy Grade/Ager-Beswick Roads because of the recreational nature of the area. These pedestrians and cyclists would have to travel along the road itself, and could encounter safety hazards when sharing the road with large hauling vehicles, which could occupy much of the available road width, generate dust, or vary speeds around corners. This impact is related solely to the Proposed Action; no other actions could contribute to this effect. **There would be no significant cumulative effect on non-motorized transportation.**

#### **KBRA**

*Construction activities associated with the KBRA programs involving construction could cause temporary traffic effects.* While several of the KBRA actions and programs would likely generate construction traffic, specific locations and construction, operation, and maintenance details are not available. For the purposes of this analysis, it is assumed that significant cumulative traffic impacts would occur. The KBRA would implement best management practices and would coordinate with local agencies to minimize or reduce traffic impacts. **Therefore, the KBRA's incremental contribution to the cumulative effects on traffic would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

*Operational activities associated with the Fisheries Reintroduction and Management Plans could result in temporary traffic effects associated with trap-and-haul activities.* Haul trucks would be required to relocate anadromous fish species around Keno Impoundment and Link River. Haul trucks may travel on OR66, US97, access roads, and on-site roads. Seasonal trap and haul operations would occur during periods of poor water quality. Hauling activities would occur after the peak traffic-generating period of facility removal because fish cannot access Keno Dam until after removal of the Four Facilities; however, some construction traffic associated with completing removal activities and reservoir restoration may occur at the same time as hauling operations.

Other general cumulative actions or projects that could also contribute to increased traffic on these roads include the new residential subdivisions approved for Siskiyou County, mining, agricultural activities, recreation, and road improvements such as those planned

in Siskiyou County. Together, these actions could increase the amount of traffic on existing roads and could cause temporary significant cumulative traffic impacts.

The KBRA's contribution to any cumulative traffic effects would be temporary and minimal. Seasonal trap and haul operations would occur at Keno Dam, but only until water quality conditions no longer require it. While construction traffic related to dam removal and hauling operations, taken together, could increase the severity of the traffic effects, the combined traffic would likely still be less than the peak traffic during dam deconstruction. **The KBRA's incremental contribution to the significant cumulative effects associated with traffic would not be cumulatively considerable.**

**Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

#### **4.4.21.2 Alternatives 3, 4, and 5**

Alternatives 3, 4, and 5 would have similar cumulative traffic effects as those described for Alternative 2 because they would require construction vehicles and equipment. Alternative 5 may contribute to fewer cumulative traffic effects because it would require the removal of only two dams and therefore less roads would be used by construction vehicles and equipment. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.21.3 Mitigation Measures**

There would be no cumulatively considerable effects; therefore, no mitigation measures are required.

#### **4.4.22 Noise and Vibration**

Cumulative noise impacts could occur from a variety of sources near the Four Facilities. Traffic, recreational activities, mining, agricultural activities, firefighting activities, and timber harvesting could all contribute to the cumulative background noise. The timeframe for noise and vibration impacts is during construction (May 2019 to December 2020).

Table 4-24 presents a summary of the noise and vibration impacts described in Chapter 3. These impacts are then analyzed for cumulative effects.

**Table 4-24. Summary of Noise and Vibration Impacts from Chapter 3**

<b>Potential Impact</b>	<b>Alternatives</b>	<b>Significance Pursuant to CEQA</b>	<b>Proposed Mitigation</b>	<b>Significance After Mitigation Pursuant to CEQA</b>
Construction and deconstruction activities at the dam sites could cause a temporary increase in noise levels at Copco 1 Dam that could affect residents in the area.	1	NCFEC	None	NCFEC
	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
	4	S	NV-1: Noise and Vibration Control Plan	LTS
Construction and deconstruction activities at the dam sites could cause a temporary increase in nighttime noise levels at Iron Gate Dam.	1	NCFEC	None	NCFEC
	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
	4	LTS	None	LTS
Reservoir restoration activities could result in short-term increases in noise levels in the project vicinity.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Blasting activities at Copco 1 Dam could increase vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction activities at the dam sites could increase short-term vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
	4	LTS	None	LTS
Construction activities at the dam sites could require the transport of waste to off-site landfills and construction worker commutes which would cause increases in noise along haul routes.	2, 3, 4, 5	LTS	None	LTS
Trap and Haul operations could result in temporary increases in noise and vibration levels from vehicles used to relocate fish.	4, 5	S	NV-1: Noise and Vibration Control Plan	LTS
<b>Keno Transfer</b>				
The transfer of Keno dam to the DOI could have adverse effects on noise and vibration.	2,3	NCFEC	None	NCFEC
<b>East and West Side Facility Decommissioning</b>				
The decommissioning of the East and West Side Facilities could have adverse effects on noise and vibration.	2.3	LTS	None	LTS

**Table 4-24. Summary of Noise and Vibration Impacts from Chapter 3**

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Klamath Basin Restoration Agreement</b>				
Construction activities associated with the KBRA could cause temporary increases in noise and vibration levels.	2,3	S	NV-1: Noise and Vibration Control Plan	LTS
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in noise and vibration levels from vehicles associated with trap-and-haul activities.	2,3	S	NV-1: Noise and Vibration Control Plan	LTS

**Key:**

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant
- N/A = Not Applicable

Actions or projects that could contribute to cumulative noise effects include construction of the approved new subdivisions around Iron Gate Dam in Siskiyou County (see Table 4-4). Other more general activities that could contribute cumulative noise effects include road improvement projects, increases in traffic from population growth, and recreation activities.

**4.4.22.1 Alternative 2: Full Facilities Removal of Four Dams**

**Construction Equipment Noise and Vibration**

*Deconstruction activities associated with the Proposed Action could cause a temporary increase in noise levels at Copco 1 that could affect residents in the area. Reservoir restoration activities could result in short-term increases in noise levels in the project vicinity.* Construction activities would result in significant noise impacts at Copco 1 during daytime construction activities and nighttime construction activities after 10:00 p.m. Helicopters and other equipment noise from embankment restoration would cause a temporary significant noise impact on the residential areas near Copco Lake. Mitigation measures would be implemented to reduce noise levels, but these would not reduce levels below significance criteria and noise would still be noticeable. At this time, there are no other known projects or actions are would be implemented in 2020 near Copco 1 reservoir that would result in a new source of noise and could contribute to cumulative noise effects. However, future residential development, mining, agricultural or recreation activities, firefighting practices, road improvements, and increased traffic levels from population increases could contribute to increased noise levels at Copco 1. If

these activities occurred around Copco 1, they could result in significant cumulative noise effects. The Proposed Action's incremental contribution to the significant cumulative noise effects would be cumulatively considerable. The Proposed Action would implement all feasible mitigation measures to reduce noise levels (Mitigation Measure NV-1); however, noise would remain high for the duration of deconstruction. **Therefore, the Proposed Action's incremental contribution to significant cumulative noise effects would be cumulatively considerable around Copco 1 for the duration of deconstruction. No other feasible mitigation measures are available to reduce these impacts; therefore they would remain cumulatively considerable.**

*Deconstruction activities associated with the Proposed Action would cause a temporary increase in nighttime noise levels at Iron Gate Dam.* Deconstruction noise would cause a temporary significant noise impact on the residential area near Iron Gate Dam at night. Helicopters and other equipment noise from embankment restoration would cause a temporary significant noise impact on the residential areas near Iron Gate Reservoir. Mitigation Measure NV-1 would be implemented but would not reduce nighttime outdoor noise impacts to less than significant levels at sensitive receptors. Several subdivisions have been approved around Iron Gate Dam in Siskiyou County, as noted above in Table 4-4. However, it is assumed that these construction activities associated with new subdivisions would not occur at night. No other cumulative actions have been identified that would result in increased nighttime noises around Iron Gate Dam. **There would be no significant cumulative nighttime noise effects at Iron Gate Dam during deconstruction.**

*Blasting activities could increase vibration levels.* Deconstruction activities could require some blasting to remove portions of the dams and associated infrastructure. Blasting would result in increased vibration levels around the Four Facilities.

Residential developments, increased traffic, mining, and recreation activities in the area around the dam sites could also cause increases in vibration. This could result in significant cumulative vibration impacts. However, the Proposed Action would implement measures to minimize or avoid vibration impacts (Mitigation Measure NV-1) and address potential vibration complaints. With these mitigation measures, the Proposed Action's **incremental contribution to the significant cumulative effect associated with vibration would not be cumulatively considerable.**

#### **Deconstruction-Related Traffic Noise**

*Transporting waste to off-site landfills and construction worker commutes could cause increases in noise along haul routes.* Under the Proposed Action, transporting waste to off-site landfills and construction worker commutes could cause increases in noise along haul routes. The transporting of construction wastes, as well as the construction workers commuting to and from the deconstruction sites would increase traffic-related noise levels. Construction of new residential developments, traffic, mining, timber harvesting, agricultural activities, and recreation activities in the area around the dam sites could also cause increases in traffic-related noise. Traffic-related noise would therefore be a significant cumulative effect. The Proposed Action would have minor increases in noise

levels 50 feet from all haul roads, and would be barely noticeable 500 feet away from haul roads. Additionally, the traffic-related noise would only last the duration of construction; no long-term noise would occur after dam removal and restoration actions are complete. **The Proposed Action's incremental contribution to the significant cumulative effect associated with traffic-related noise would not be cumulatively considerable.**

#### **KBRA**

*Construction activities associated with the KBRA could cause temporary increases in noise and vibration levels.* Several KBRA elements may cause noise and vibration impacts from the use of heavy equipment, including channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. These KBRA actions would take place in different locations around the Klamath Basin, and could occur at different times. While the locations, equipment, and schedules for the KBRA actions are currently not known, it is reasonable to assume that significant short-term cumulative noise and vibration effects could occur from implementation of the KBRA actions and other on-going activities such as traffic, timber harvesting, agricultural activities, mining, and recreation. The KBRA's incremental contribution to the significant cumulative noise and vibration impacts could be cumulatively considerable. Mitigation Measure NV-1 would be implemented, when appropriate, to reduce or avoid noise and vibration impacts. **Because the noise and vibration impacts would be temporary and would be reduced or avoided with mitigation, the KBRA's contribution to the significant short-term cumulative noise and vibration impacts would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

#### **4.4.22.2 Alternatives 3, 4, and 5**

Cumulative noise and vibration effects under Alternatives 3 and 5 would be similar to those described for Alternative 2 as they would require dam removal, blasting, and hauling of waste for disposal. Alternative 4 would not involve any dam removal or restoration activities and therefore would not contribute to any cumulative noise or vibration impacts associated with those activities. Alternative 4 would still contribute construction-related noise and vibration impacts from equipment and blasting during creation of fish passage facilities. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

#### **4.4.22.3 Mitigation Measures**

Noise impacts at Copco 1 and Iron Gate Dam would be cumulatively considerable under all alternatives with the exception of Iron Gate Dam under the Fish Passage at Four Dams Alternative. All feasible noise mitigation (Mitigation Measure NV-1) would be implemented to reduce noise during deconstruction; however, noise impacts would remain cumulatively considerable at these locations for the duration of deconstruction and no further mitigation is possible.

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# Chapter 5

## Other Required Disclosures

Other required disclosures of environmental documents include irreversible and irretrievable commitment of resources; the relationship between short-term uses and long-term productivity; growth inducing impacts; summary of environmental impacts by alternative; significant and unavoidable impacts; and the environmentally superior alternative.

### 5.1 Irreversible and Irretrievable Commitment of Resources

According to the National Environmental Policy Act (NEPA), an environmental impact statement (EIS) must contain a discussion of irreversible and irretrievable commitment of resources that would result from the Proposed Action if it was implemented (40 CFR Section 1502.16). The irreversible commitment of resources generally refers to the use or destruction of a resource that cannot be replaced or restored over a long period of time. The irretrievable commitment of resources refers to the loss of production or use of natural resources and represents lost opportunities for the period when the resource cannot be used. The California Environmental Quality Act (CEQA) also requires a discussion of any significant effect on the environment that would be irreversible if the project were implemented or would result in an irretrievable commitment of resources (CEQA Guidelines Section 15126(c)).

Dam removal, deconstruction, construction, and restoration activities under the Proposed Action and the Klamath Basin Restoration Agreement (KBRA) programs and plans would involve the consumption of nonrenewable natural resources. These nonrenewable natural resources would consist of petroleum for fuels necessary to operate equipment used during deconstruction activities. The Proposed Action would include removal of four dams and all power generation facilities. This would result in the generation of waste from the concrete, mechanical, and electrical items at the dams and power facilities. Petroleum fuels would be used to haul these materials to disposal sites in the project area. In addition to fuels used in transportation, the use of the disposal sites would constitute an irreversible and irretrievable commitment of resources. Concrete and earthen materials would be used as backfill to bury dam structures, backfill the excavated tailrace channels, and restore the river to its pre-dam appearance. These materials would be permanently committed during implementation of the proposed action. Construction activities necessary for implementation of KBRA programs and plans would require the use of nonrenewable natural resources including petroleum for fuels and other construction materials.

## **5.2 Relationship Between Short-Term Uses and Long-Term Productivity**

As required by NEPA (40 CFR Section 1502.16), this section describes the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.

### **5.2.1 Klamath Hydroelectric Settlement Agreement**

All four action alternatives involve demolition and/or construction activities including removing the dams and power generation facilities or constructing fish passage facilities. Dam removal (Under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative) and the construction of fish passage facilities (under the Fish Passage at Four Dams and Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternatives) would require short-term uses of capital, labor, fuels, and construction materials, as well as the creation of temporary new access roads and storage pads needed during deconstruction activities.

Removal of reservoirs at the Four Facilities under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would benefit water quality by converting existing reservoir areas to a free-flowing river. Klamath Hydroelectric Project reservoirs have been shown to create higher water temperatures than those that would occur under natural conditions. Therefore, removal of the dams and return of the reservoirs to a natural flowing river would result in long-term beneficial effects on water temperature and overall water quality. In turn, improvements in water quality could result in improvements in scenic resources, such as water clarity or fish viewing opportunities. Further, removal of the reservoirs could result in beneficial impacts on dissolved oxygen and pH levels in the water, thus increasing the likelihood of the free-flowing river consistently supporting beneficial uses. Other benefits to long-term productivity could result from decreases in the levels of microcystin and chlorophyll-a concentrations.

As described above, implementation of the Proposed Action would result in the drawdown and removal of reservoirs at the Four Facilities and would eliminate reservoir recreational opportunities at these sites. However, improved water quality as well as the return of the Klamath River to free-flowing river conditions would also result in benefits for other water-contact-based recreational opportunities, including recreational fishing and some whitewater boating.

Long-term beneficial impacts would also occur for aquatic resources under the Proposed Action, the Partial Facilities Removal Alternative, the Fish Passage at Four Dams Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. Changed habitat conditions resulting from dam removal would reduce impacts on salmonids from fish disease and parasites. Long-term changes to the flow regime of the Klamath River (under the Proposed Action and the Partial Facilities

Removal Alternative) would benefit fall-run Chinook using the Lower Klamath River Reach. In addition, the absence of the dams would provide access to 420 miles of additional habitat upstream of Iron Gate Dam, including at least 30 miles in tributaries such as Fall, Jenny, Shovel, and Spencer creeks, among others. Under the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, flow increases would provide more habitat than under existing conditions for redband/rainbow trout and other resident riverine species, as well as any anadromous fish or lamprey that reestablish in the Hydroelectric Reach, but habitat gains would be less than under the Proposed Action. While removal of the two dams would eliminate existing habitat in Copco 1 and Iron Gate Reservoirs for adult shortnose and Lost River suckers, habitat within J.C. Boyle Reservoir would remain and higher flow releases would be made through the J.C. Boyle bypass reach than under existing conditions. Higher baseflows would also be provided in the Copco 2 bypass reach. These modifications would provide a benefit for fish living in this reach, including redband trout and anadromous fish. Dam removal would also restore habitat connectivity on the mainstem Klamath River and create additional habitat within the Hydroelectric Reach, thus increasing long-term productivity of coho and Chinook salmon, steelhead, and Pacific lamprey. Increases in fish populations would also result in beneficial impacts for scenic fish viewing, recreational fishing, and conditions for species traditionally and culturally important to American Indian tribes.

Under the Fish Passage at Four Dams Alternative, long-term fishery productivity would increase in the basin due to water quality improvements from implementation of Oregon and California Total Maximum Daily Loads (TMDLs). Under this alternative, the hydrology of the Klamath River from Iron Gate Dam to the Klamath River Estuary would generally remain the same as existing conditions; however, fish would be able to migrate past the dams and would gain access to substantial areas of additional habitat. This access could still be delayed or impaired at the ladders, and continuing adverse water quality conditions in the reservoirs could also impair access to additional habitat. However, United States Department of the Interior (DOI) and United States Department of Commerce (DOC) prescriptions include elements to limit delays through reservoirs and fish ladders due to water quality issues. Implementation of fish passage at the dams under the Fish Passage at Four Dams Alternative would benefit anadromous fisheries in the Klamath River, thus resulting in long-term beneficial impacts on recreational fishing.

Removal of dams and reservoirs under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in gains in riparian habitat and wildlife corridors. The dams and reservoirs act as a barrier to terrestrial wildlife movement and migration. Elimination of the dams and reservoirs will remove these artificial barriers and allow for more natural gene-flow and population interactions.

Long-term beneficial impacts on environmental justice populations would occur under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. The tribes' heavy reliance on social services and food subsidies is a direct result of long standing environmental injustices that have stripped tribal people of their ability to engage in

long-standing traditions and subsistence and commercial harvest activities. Increases in the populations of fall- and spring-run Chinook Salmon, coho salmon, and summer and winter steelhead would allow tribes to increase subsistence fishing and make fish a larger part of their diet and ceremonies. These effects would have long-term benefits on tribal health.

### **5.2.2 Klamath Basin Restoration Agreement**

Implementation of some elements of the KBRA, including the Phase I Fisheries Restoration Plan, could result in short-term use of resources associated with standard construction activities. Implementation of KBRA actions would require short-term uses of capital, labor, fuels, and construction materials. Construction activities related to full implementation of the KBRA could result in short term greenhouse gas emissions. The Drought Plan and the Climate Change Assessment and Adaptive Management Plan under the KBRA would assess and address potential climate change impacts in the region. The plans will assist the region in planning and responding to the climate change impacts identified in the EIS/EIR. The following paragraphs describe the long-term increases in fisheries productivity that would result from KBRA actions.

The Phase I and Phase II Fisheries Restoration Plan under the KBRA would accelerate long-term improvements to fine sediment, water temperature, nutrients, and dissolved oxygen, thus increasing long-term productivity of the Klamath River Basin. Long-term productivity in the Klamath River Basin would also occur due to the continuation of the Williamson River Delta Project, the Agency Lake and Barnes Ranches Projects, the Wood River Wetland Restoration, the Water Use Retirement Program, and the Interim Flow and Lake Level Program. In addition to long-term benefits to water quality, the KBRA elements would expand the habitats available to fish and terrestrial species throughout the basin and would increase their viability and resilience.

In addition, KBRA implementation would result in the establishment of limitations on specific diversions for Reclamation's Klamath Project to protect flows on the mainstem and provide specific allocations of water from Klamath Reclamation Project diversions to the wildlife refuges. These actions would result in long-term benefits to water quality and habitats in the project area. The groundwater monitoring plan and pumping limits under the KBRA would also protect flows on the mainstem, thus providing stable habitat conditions to support the species of the basin. Additional aspects of the KBRA that would benefit aquatic resources include the Water Use Retirement Plan (WURP) and the Fish Entrainment Reduction actions.

The Fisheries Restoration Plan phases I and II would result in long-term benefits to fisheries populations and abundance, and terrestrial wildlife. Wetland habitats would benefit over the long term due to increased supplies of water delivered to wildlife refuges in the basin.

Plans and programs in the KBRA including Wood River Wetland Restoration, Future Storage Opportunities, Water Management on Reclamation's Klamath Project, and

WURP could result in long-term beneficial impacts on water supply and water rights. KBRA actions would improve water supply reliability and help ensure against impacts on water supply delivery. In addition, KBRA implementation would result in long-term benefits to surface water hydrology and flood protection related to new surface and groundwater storage options. The WURP is intended to permanently increase the flow of water into Upper Klamath Lake by 30,000 acre feet per year (KBRA Section 16.2.2), and could include actions to increase inflow (including upland vegetation management) that would result in beneficial impacts on groundwater resources. The Interim Flow and Lake Level Program (KBRA Section 20.4) would result in similar beneficial impacts on groundwater.

Under the Power for Water Management Program of the KBRA, irrigators participating in the program would be eligible for adjusted power rates, which would continue to allow area farmers to pump water at electricity rates that would maintain profitability of their operations. This effect would benefit farm workers as it would help farm operators stay in business. Implementation of the Power for Water Management Program could also involve the development of renewable energy sources, which would provide green energy. This would be a beneficial impact. In addition, several elements of the KBRA are intended to restore fisheries and improve water quality. These programs, combined with the Klamath County Economic Development Plan (KBRA Section 27.3) and the Tribal Programs Economic Revitalization (KBRA Section 31) could improve social services for county residents and tribal members. The Mazama Forest Project (KBRA Section 33.2) would result in the acquisition of 90,000 acres of timberland to be managed by the Klamath Tribes' Forest Management Plan, thus benefitting the Klamath Tribes.

KBRA programs including the Phase I Fisheries Restoration Plan, Fisheries Restoration Plan – Phase II, Williamson River Delta Project, Agency Lake and Barnes Ranches, Wood River Wetland Restoration, Flood Storage Opportunities, On-Project Plan, Water Use Retirement Plan, Fish Entrainment Reduction, and the Klamath Tribes Fishing Site would have long-term beneficial impacts.

### **5.2.3 Keno Transfer**

The Proposed Action and the Partial Facilities Removal Alternative include the transfer of Keno Dam from PacifiCorp to the DOI. The Proposed Action and Description of Alternatives, Chapter 2, describes that PacifiCorp would transfer ownership and operational responsibility of the Keno Facility to the DOI. Operations under DOI would be consistent with the historic operations of the facility in place since the existing contract was signed on January 4, 1968; therefore, there would be no changes to operations or the surrounding areas as a result of the transfer. Future upgrades at the Keno facility by DOI would be subject to additional NEPA compliance.

Transfer of the Keno Facility may involve the use of vehicles and the commitment of vehicle fuel. The transfer would be undertaken as a connected action to dam removal because the facility would no longer be useful to PacifiCorp.

### **5.2.4 East and West Side Facilities**

The Proposed Action and the Partial Facilities Removal Alternative include the decommissioning of PacifiCorp's East and West Side Facilities. In the event of an affirmative Secretarial Determination, under a plan outlined in the KHSA, PacifiCorp would apply to FERC for a partial surrender of its license of the East and West Side facilities in order to decommission the generating facilities (KHSA 6.4.1(A)). PacifiCorp would be responsible for the decommissioning and for recovering its costs through "standard ratemaking procedures" (KHSA 6.4.1(B)). Once the decommissioning was completed, the lands associated with the East and West Side facilities would be transferred to DOI.

Removing the two facilities would result in the loss of 3.8 megawatts of generating capacity and the removal of the generating infrastructure. Decommissioning may involve the use of vehicles and construction equipment. This would require short-term uses of capital, labor, fuels, and construction materials. Decommissioning of the facilities would be undertaken as a connected action to dam removal because the facility would no longer be useful to PacifiCorp.

## **5.3 Growth Inducing Impacts**

CEQA Guidelines Section 15126.2(d) requires an environmental document to:

*"Discuss the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth...."*

NEPA requires that an EIS analyze direct and indirect impacts of growth-inducing effects. Growth-inducing effects under NEPA are a subset of indirect effects, which are defined as effects that "are caused by the action and occur later in time or are farther removed in distance, but are still reasonably foreseeable" (40 CFR 1508.8(b)).

Direct growth-inducing impacts generally stem from the construction of new housing, businesses, or infrastructure. Indirect growth inducement could result if a project establishes substantial new permanent employment opportunities or if it would remove obstacles hindering population growth, such as the expansion or the provision of urban services and infrastructure in an undeveloped area. Under CEQA, growth inducement may not necessarily be considered detrimental, beneficial, or of insignificant consequence. Induced growth is considered a significant impact only if it directly (or indirectly) affects the ability of agencies to provide needed public services, or if it can be demonstrated that the potential growth significantly affects the environment.

The Proposed Action and alternatives would not result in the construction of new housing either directly or indirectly. The Proposed Action and alternatives would not provide new water, wastewater, sewer, electricity, or natural gas infrastructure or facilities and

would not require or create any new public services such as schools, public services, or public roads that could support increased growth in the Klamath Basin.

The Proposed Action and alternatives would require construction workers to perform the necessary construction work. Any employment required for the alternatives would be temporary and would be needed only during a 20-month period which includes an 8-month period of site preparation and partial drawdown at Copco 1 and a 12-month period for full drawdown and removal of facilities. Construction workers would likely commute to the sites from the surrounding local communities or find temporary accommodations for the duration of construction. Section 3.17, Population and Housing, analyzed all potential impacts from non-local workers as being less than significant as counties in the region have sufficient housing supply to accommodate the estimated number of non-local workers. Thus, there would be no need for the construction of new housing. Implementation of the Proposed Action or alternatives would not generate any permanent employment opportunities that would attract a substantial number of people to the region.

Restoration of the Klamath River fisheries is one of the main objectives of this project. If the fish populations were to rebound back to pre-dam levels, this could result in an increase in recreational fishing in the region, and possibly an increase in overall tourism. Such a change in visitor numbers would likely occur slowly as fish populations rebound, but would be unlikely to result in permanent population growth.

Neither the Proposed Action nor any of the alternatives would result in new housing, utilities, services, or permanent employment that could induce growth in the region, nor would the project result in any impacts that would require the provision of new housing, utilities, services, or permanent employment. The Proposed Action and alternatives would not induce growth.

## **5.4 Summary of Environmental Impacts**

“A summary of the environmental impacts identified for each alternative (including beneficial effects) is presented in Table 5-1. Table 5-2 presents a subset of the impacts presented in Table 5.1 which, even after mitigation measures are implemented, may remain significant and unavoidable for the No Action/No Project and the action alternatives. The purpose of Table 5-1 and Table 5-2 is to consolidate and disclose the significance determinations made throughout the EIS/R and does not include particular information which are pursuant only to NEPA. Table 5-3 presents a summary of the environmental impacts of the resources analyzed in this EIS/EIR specific to NEPA for Tribal Trust, Socioeconomics, and Environmental Justice. While Table 5-4 presents a summary of the Wild and Scenic River (WSR) resource effects that will be utilized to complete a WSR assessment.”

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.2 Water Quality</b>				
<b>Water Temperature</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable Oregon DEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the Hydroelectric Reach.	1, 4,5	NCFEC	None	NCFEC
Dam removal and/or elimination of hydropower peaking operations at J.C. Boyle Powerhouse could cause short-term and long-term alterations in daily water temperatures and fluctuations in the J.C. Boyle bypass and peaking reaches.	2, 3, 5	S for J.C. Boyle bypass reach B for J.C. Boyle peaking reach	None	S for J.C. Boyle bypass reach B for J.C. Boyle peaking reach
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term increases in spring time water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir.	2, 3, 5	S for springtime B for late summer/fall	None	S for springtime B for late summer/fall
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term and long-term increases in sediment deposition in the Klamath River or Estuary that could alter morphological characteristics and indirectly affect seasonal water temperatures.	2, 3, 5	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable California North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free flowing river could result in short-term and long-term increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River.	2, 3, 5	S – Iron Gate Dam to Salmon River for springtime	None	S – Iron Gate Dam to Salmon River for springtime
<b><i>Suspended Sediments</i></b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could result in short-term and long-term interception and retention of mineral (inorganic) suspended material by the KHP dams.	1, 4	NCFEC	None	NCFEC
Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach.	1 ,2 ,3	LTS	None	LTS
Implementation of IM 8, J.C. Boyle Bypass Barrier Removal, could result in short-term increases in mineral suspended material in the Hydroelectric Reach due to deconstruction activities.	1	LTS	None	LTS
Implementation of IM 16, Water Diversions, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach due to diversion screening deconstruction and construction activities.	2 ,3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued impoundment of water in the reservoirs could cause short- term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the Hydroelectric Reach due to in-reservoir algal blooms.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam.	2, 3, 5	S	None	S
Construction/deconstruction activities could cause short-term increases in suspended material in the Hydroelectric Reach due to stormwater runoff from construction/deconstruction areas.	2, 3, 4, 5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities would include the demolition of various recreation facilities which could cause short-term increases in suspended material in the Hydroelectric Reach from stormwater runoff from the demolition areas.	2, 3, 5	LTS	None	LTS
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the lower Klamath River and the Klamath Estuary.	2, 3	S	None	S
Draining the reservoirs and release of sediment could cause short-term increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material and rates of deposition in the marine nearshore environment.	2, 3, 5	LTS	None	LTS
Continued impoundment of water in the reservoirs could cause short-term and long-term interception and retention of mineral (inorganic) sediments by the dams and correspondingly low levels of suspended material immediately downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could result in short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the KHP reservoirs and subsequent transport into the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Construction/deconstruction activities could cause short-term increases in suspended material in the lower Klamath River, Klamath Estuary, and marine nearshore environment due to stormwater runoff from construction/deconstruction areas.	2, 3, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces into the lower Klamath River and Klamath Estuary.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
<b>Nutrients</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could result in long-term interception and retention of TP and TN in the Hydroelectric Reach on an annual basis but release (export) of TP and TN from reservoir sediments on a seasonal basis.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in sediment- associated nutrients in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term interception and retention of TP and TN on an annual basis but release (export) of TP and TN on a seasonal basis.	1, 4	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Draining the reservoirs and release of sediment to the lower Klamath River could cause short-term increases in sediment-associated nutrients in the river and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
<b><i>Dissolved Oxygen</i></b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term <sup>1</sup> seasonal and daily variability in dissolved oxygen concentrations in the Hydroelectric Reach, such that levels do not meet Oregon DEQ and California North Coast Basin Plan water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term <sup>2</sup> increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir.	2, 3, 5	S	None	S
Dam removal and conversion of reservoir areas to free-flowing river conditions could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach.	2, 3, 5	B	None	B

<sup>1</sup> Long-term is defined as 2-50 years.

<sup>2</sup> Short-term is defined as <2 years.

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term seasonal and daily variability in dissolved oxygen concentrations in the Klamath River downstream of Iron Gate Dam, such that levels do not meet California North Coast Basin Plan and Hoopa Valley Tribe water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC
Dam removal and sediment release could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	S (lower Klamath River from Iron Gate Dam to Clear Creek) NCFEC (Klamath Estuary or Marine Nearshore Environment)	None	S (lower Klamath River from Iron Gate Dam to Clear Creek) NCFEC (Klamath Estuary or Marine Nearshore Environment)
Dam removal and conversion of reservoir areas to a free-flowing river could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the lower Klamath River, particularly for the reach immediately downstream of Iron Gate Dam.	2, 3, 5	B	None	B
<b>pH</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in summertime pH in the Hydroelectric Reach.	2, 3, 5	B	None	B
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the lower Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in summertime pH in the lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term summertime increases in pH in the lower Klamath River downstream of Iron Gate Dam.	2, 3, 5	LTS (from Iron Gate Dam to confluence with the Scott River) NCFEC (Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the Marine Nearshore Environment)	None	LTS (from Iron Gate Dam to confluence with the Scott River) NCFEC (Klamath River just downstream of Seiad Valley, the Klamath Estuary, and the Marine Nearshore Environment)
<b><i>Chlorophyll-a and Algal Toxins</i></b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as <i>M. aeruginosa</i> , resulting in high seasonal concentrations of chlorophyll-a and algal toxins in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and algal toxins in the Hydroelectric Reach.	2, 3, 5	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Lower Klamath Basin</b>				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as <i>M. aeruginosa</i> , resulting in high seasonal concentrations of chlorophyll-a and algal toxins transported into the Klamath River from downstream of Iron Gate Dam to the Klamath Estuary, and potentially to the marine nearshore environment.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and algal toxins in the lower Klamath River and the Klamath Estuary.	2, 3, 5	B	None	B
<b>Inorganic and Organic Contaminants</b>				
<b>Upper Klamath Basin</b>				
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants for freshwater aquatic species in the Hydroelectric Reach.	1, 4, 5	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants in the Hydroelectric Reach through human consumption of resident fish tissue.	1, 4, 5	NCFEC	None	NCFEC
Draining the reservoirs and sediment release could cause short-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed reservoir terraces and river banks within the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction/deconstruction activities could cause short-term increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation equipment in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Reservoir area restoration activities could include herbicide application which could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
<b>Lower Klamath Basin</b>				
Dam removal and sediment release could cause short-term and long-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the lower Klamath River and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed downstream river terraces and downstream river banks following reservoir drawdown.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities could cause short-term increases in suspended sediments and the potential for inorganic and organic contaminants from hazardous materials associated with construction equipment to be transported into the lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 4, 5	LTS	None	LTS
<b>Trap and Haul Operations</b>				
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction.	4, 5	LTS	None	LTS
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of the Phase I Fisheries Restoration Plan could result in short-term construction-related increases in suspended materials and long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction.	2, 3,	LTS	None	LTS
Implementation of Wood River Wetland Restoration could result in short-term construction-related increases in suspended materials and long-term warmer spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake.	2, 3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of Water Diversion Limitations could result in decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)
Implementation of the Water Use Retirement Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short-term) B (long-term)	None	NCFEC (short-term) B (long-term)
<b>3.3 Aquatic Resources</b>				
<b>Critical Habitat</b>				
Continued impoundment of water within the reservoirs could alter the water quality and habitat suitability within critical habitat.	1,4	NCFEC (coho) NCFEC (Bull Trout and Southern Resident Killer Whale)	None	NCFEC (coho) NCFEC (Bull Trout, Southern Resident Killer Whale)
Reservoir drawdown associated with dam removal could alter the quality of critical habitat.	2, 3, 5	S (short-term for coho) LTS (Bull Trout and Southern Resident Killer Whale)	None	S (short-term for coho) LTS (Bull Trout and Southern Resident Killer Whale)
The removal of dams and reservoirs could alter the availability and quality of critical habitat.	2,3,5	B (coho) LTS (Bull Trout and Southern Resident Killer Whale)	None	B (coho) LTS (Bull Trout, Southern Resident Killer Whale)
<b>Essential Fish Habitat</b>				
Continued impoundment of water within the reservoirs could alter the availability and suitability of Essential Fish Habitat (EFH).	1, 4	NCFEC (Chinook and coho salmon EFH) NCFEC (Groundfish EFH, Pelagic Fish)	None	NCFEC (Chinook and coho salmon EFH) NCFEC (Groundfish EFH, Pelagic Fish)
Reservoir drawdown associated with dam removal could alter the quality of EFH.	2, 3, 5	S (short-term for Chinook and coho) LTS (groundfish and pelagic fish)	None	S (short-term for Chinook and coho) LTS (groundfish and pelagic fish)
The removal of dams and reservoirs could alter the availability and quality of EFH.	2, 3, 5	B (Chinook and coho) LTS (groundfish and pelagic fish)	None	B (Chinook and coho) LTS (groundfish and pelagic fish)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Species Impacts</b>				
<b>Fall-run Chinook Salmon</b>				
Continued impoundment of water within the reservoirs alter habitat suitability affecting Fall-run Chinook salmon.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting Fall-Run Chinook salmon.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect Fall-run Chinook salmon.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	LTS
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect Fall-run Chinook salmon.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect Fall-run Chinook salmon.	4	B	None	B
<b>Spring-run Chinook Salmon</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting Spring-run Chinook salmon.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting Spring-run Chinook salmon.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect spring-run Chinook salmon.	2, 3, 5	LTS	AR-2: Protection of outmigrating juveniles	LTS
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect Spring-run Chinook salmon.	2, 3, 5	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Fish passage provisions could result in alterations in habitat availability which could affect Spring-run Chinook salmon.	4	B	None	B
<b><i>Coho Salmon</i></b>				
Continued impoundment of water within reservoirs at the Four Facilities could alter habitat suitability affecting coho salmon.	1	NCFEC (for all population units)	None	NCFEC (for all population units)
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting coho salmon.	1	NCFEC (for all population units)	None	NCFEC (for all population units)
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect coho salmon.	2, 3, 5	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units) LTS (Trinity River, Salmon River, and Lower Klamath River population units)	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units) LTS (Trinity River, Salmon River, and Lower Klamath River population units)
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect coho salmon.	2, 3, 5	B (Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River population units) LTS (Trinity River population units)	None	B (Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River population units) LTS (Trinity River population units)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Fish passage provisions could result in alterations in habitat availability which could affect coho salmon.	4	B (Upper Klamath River population unit) NCFEC (Mid-Klamath River, Shasta River, Scott River, Salmon River, Trinity River, and Lower Klamath River population units)	None	B (Upper Klamath River population unit) NCFEC (Mid-Klamath River, Shasta River, Scott River, Salmon River, Trinity River, and Lower Klamath River population units)
<b><i>Steelhead</i></b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting steelhead.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting steelhead.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect steelhead in the short-term.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect steelhead.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect steelhead.	4	B	None	B
<b><i>Pacific Lamprey</i></b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting Pacific lamprey.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs, bedload sediment transport, and deposition which could affect Pacific lamprey in the short-term.	2, 3, 5	S	AR-2: Protection of outmigrating juveniles; AR-5: Pacific lamprey capture and relocation	S

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect Pacific lamprey.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect Pacific lamprey.	4	B	None	B
<b><i>Green Sturgeon</i></b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting green sturgeon.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting green sturgeon.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect green sturgeon.	2, 3, 5	S	AR-3: Fall flow pulses	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect green sturgeon.	2, 3, 5	LTS	None	LTS
Fish passage provisions could result in alterations in habitat availability which could affect green sturgeon.	4	NCFEC	None	NCFEC
<b><i>Shortnose Sucker and Lost River</i></b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting Lost River and shortnose suckers.	1	NCFEC	None	NCFEC
	4	LTS	None	LTS
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting Lost River and shortnose suckers.	1	NCFEC	None	NCFEC
Reservoir removal associated with dam removal could alter habitat availability and affect Lost River and shortnose suckers	2, 3, 5	S	AR-6: Sucker rescue and relocation	LTS
Restoration action associated with KBRA implementation could alter habitat availability and suitability and affect Lost River and shortnose suckers.	2	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Fish passage provisions could affect shortnose and Lost River Sucker populations by continuing poor water quality and high rates of predation.	4, 5	LTS	None	LTS
<b>Redband Trout</b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting redband trout.	1,5	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting redband trout.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect redband trout.	2, 3, 5	LTS	None	LTS
Removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, which could affect redband trout.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect redband trout.	4	B	None	B
<b>Bull Trout</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting bull trout.	1	NCFEC	None	NCFEC
Dam removal and/or fish passage could alter habitat access for anadromous fish, which could affect bull trout.	2, 3, 4, 5	LTS	None	LTS
<b>Eulachon</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting eulachon.	1, 4	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect eulachon.	2, 3, 5	LTS	None	LTS
<b>Longfin Smelt</b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting longfin smelt.	1, 4	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect longfin smelt.	2, 3, 5	LTS	None	LTS
<b><i>Introduced Resident Species</i></b>				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting introduced resident species.	1, 4	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting introduced resident species.	1	NCFEC	None	NCFEC
Fish passage provisions could result in alterations in habitat availability which could affect introduced resident species.	4	NCFEC	None	NCFEC
Mandatory conditions and provisions for continued hydroelectric operations could alter habitat suitability affecting introduced resident species.	4	LTS	None	LTS
<b><i>Freshwater mussels</i></b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting freshwater mussels.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect freshwater mussels in the short-term.	2, 3, 5	S	AR-7: Freshwater mussel relocation	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect freshwater mussels in the long-term.	2, 3, 5	B	None	B
Dam removal would increase connectivity between Upper Klamath Basin and the Hydroelectric Reach and would create additional riverine habitat within the Hydroelectric Reach.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect freshwater mussels.	4	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Benthic Macroinvertebrates</i></b>				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting macroinvertebrates.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect macroinvertebrates.	2, 3, 5	S	None	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect macroinvertebrates.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect macroinvertebrates.	4	NCFEC	None	NCFEC
<b><i>Interim Measures</i></b>				
IM 7, implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement could result in alterations to habitat quality and affect aquatic species.	1,2,3	B – Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units NCFEC – green sturgeon, eulachon, southern Resident Killer Whales	None	B – Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. Coho Salmon (Upper Klamath River population units. LTS – all other Coho population units NCFEC – green sturgeon, eulachon, Southern Resident Killer Whales

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
IM 8, implementation of J.C. Boyle Bypass Barrier removal could result in alterations to habitat availability, and affect aquatic species.	1, 2	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units NCFEC – macroinvertebrates, freshwater muscles, green sturgeon, eulachon, southern Resident Killer Whales	None	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units NCFEC – macroinvertebrates, freshwater muscles, green sturgeon, eulachon, southern Resident Killer Whales
IM 16, implementation of the interim measure Water Diversions could result in alterations to habitat availability and habitat quality and affect aquatic species.	3	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, southern Resident Killer Whales	None	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. Coho Salmon (Upper Klamath River population units) LTS – all other Coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, southern Resident Killer Whales

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Trap and Haul Operations</i></b>				
Implementation of trap and haul measures could affect aquatic species.	4, 5	B (fall-run Chinook)	None	B (fall-run Chinook)
<b><i>Construction-Related Impacts</i></b>				
The removal of dams and reservoirs and the construction of fish passage facilities could disturb the river channel during construction which could affect aquatic species.	2, 3, 4, 5	LTS	None	LTS
Removal of the dams will require the new construction to relocate of the City of Yreka water supply pipeline. Relocation of the City of Yreka water supply pipeline could disturb the river channel during construction and affect aquatic resources.	2, 3, 5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Implementation of Phases 1 and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could result in alterations to water quantity, water quality, habitat availability and habitat quality, and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers, coho salmon except for the Trinity River Populations); NCFEC (green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels); LTS (coho Trinity River)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers, coho salmon except for the Trinity River Populations); NCFEC (green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels); LTS (coho Trinity River)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of Phase I of the Fisheries Reintroduction and Management Plan could result in alterations to habitat availability (fish access), and could affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, benthic macroinvertebrates, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, and freshwater mussels); LTS (redband trout, shortnose and Lost River suckers)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, benthic macroinvertebrates, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, and freshwater mussels); LTS (redband trout, shortnose and Lost River suckers)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<p>Implementation of Water Diversion Limitations could result in reducing uncertainties associated with maintaining adequate ecological flows for aquatic species and their habitats, especially in low-flow years, and could alter water quality, and water temperatures in certain seasons and affect aquatic species.</p>	<p>2, 3</p>	<p>B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)</p>	<p>None</p>	<p>B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)</p>

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of On-Project Plan could result in alterations to water quantity and water quality and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
The Water Use Retirement Program could alter water quantity and water quality, and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Fish Entrainment Reduction could result in alterations to potential alterations to mortality risk and affect aquatic species.	2, 3	B (shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey, coho salmon from the Upper Klamath River population unit); NCFEC (all other coho salmon population units, green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey, coho salmon from the Upper Klamath River population unit); NCFEC (all other coho salmon population units, green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)
Implementation of the Klamath River Tribes Interim Fishing Site could result in alterations to managed harvest mortality of fish species that are culturally important to the Klamath River Tribes.	2, 3	NCFEC	None	NCFEC
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	B	None	B
<b>3.4 Algae</b>				
<b><i>Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir</i></b>				
Dam removal activities could decrease the spatial extent, temporal duration, toxicity, or concentration of nuisance and/or noxious phytoplankton in the area of analysis.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities could decrease the spatial extent, temporal duration, or biomass of nuisance periphyton in the area of analysis	2, 3, 5	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Hydroelectric Reach</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms in the Hydroelectric Reach.	2, 3, 5	B	None	B
Dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton in low-gradient channel margin areas within the Hydroelectric Reach.	2, 3	S	None	S
	5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could impact algae.	2, 3, 5	NCFEC	None	NCFEC
Construction and deconstruction activities would include the demolition of various recreation facilities that could affect algae.	2, 3, 5	NCFEC	None	NCFEC
<b><i>Klamath River Downstream of Iron Gate Dam</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach and subsequent transport into the Klamath River downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities could support long-term growth of nuisance periphyton such as <i>Cladophora</i> spp. Downstream of Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream of Iron Gate Dam.	2, 3, 5	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath River downstream of Iron Gate Dam.	2, 3, 5	LTS	None	LST
<b><i>Klamath Estuary</i></b>				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as <i>M. aeruginosa</i> in the Hydroelectric Reach and subsequent transport into the Klamath Estuary.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams could substantially reduce or eliminate the transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath Estuary.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath Estuary.	2, 3, 5	LTS	None	LTS
<b><i>Marine Nearshore Environment</i></b>				
Dam removal and conversion of the reservoir areas could cause long-term increases in freshwater phytoplankton and periphyton species of concern.	2, 3, 5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of restoration actions, programs, and/or plans presented in the KBRA would accelerate restoration actions currently underway throughout the Klamath Basin and reduce nuisance and/or noxious phytoplankton blooms through their beneficial effects on flow and water quality.	2, 3	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms.	2, 3	B	None	B
<b>3.5 Terrestrial Resources</b>				
Construction activities could result in the loss of wetland and riparian vegetation communities and culturally important species including willows.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in direct mortality or harm to special-status amphibian and reptile species during construction.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in nest abandonment by birds, including special-status bird species, during construction.	2, 3, 4, 5	LTS	TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle Surveys	LTS
Construction activities could result in on the loss of special-status plants.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan TER-4: Surveys for Special Status Plants	LTS
Construction activities could result in adverse impacts on wildlife from riparian habitat loss.	2, 3, 4, 5	LTS	None	LTS
Removal of reservoirs and associated loss of habitat could result in impacts on wildlife.	2, 3, 5	LTS	None	LTS
Dam removal and the flushing of sediments could result in long-term impacts on riparian habitat from sedimentation in downstream reaches.	2, 3, 5	LTS	None	LTS
Removal of reservoirs could result in loss of reservoir wetlands.	2, 3, 5	S	TER-5: Permanent Loss of Wetlands at Reservoirs	LTS
Construction activities could result in the removal of trees and other vegetation and could result in long-term impacts on wildlife habitat, particularly for nesting birds.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle Surveys	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Removal of dam facilities could result in long-term impacts on bats from loss of roosting habitat.	2, 3, 5	S	TER-6: Impacts on Special-Status Bats from Loss of Roosting Habitat	LTS
Dam removal and the flushing of sediments could result in long-term impacts on amphibians from changes in habitat due to sedimentation in downstream reaches.	2, 3, 5	LTS	None	LTS
Removal of the reservoirs could result in long-term impacts on special-status species from loss of aquatic habitat at reservoirs.	2, 3, 5	LTS (Special Status Birds)	TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle	LTS
Dam removal and associated sedimentation in downstream reaches could result in impacts on culturally important species.	2, 3, 5	LTS	None	LTS
Removal of reservoirs and associated facilities could result in long-term impacts on wildlife corridors.	2	B	None	B
Continued existence of the reservoirs and/or other facilities could present a barrier to movement of some terrestrial species.	1, 3, 4, 5	NCFEC	None	NCFEC
Exposed reservoir bottoms and other areas of construction disturbance could result in impacts from invasive plants.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan	LTS
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could result in impacts on terrestrial resources from construction activities and pipe alignment.	2, 3, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special Status Plants	LTS
Removal of various recreation facilities could result in impacts to terrestrial resources during construction.	2, 3, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special Status Plants	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause impacts to terrestrial resources.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse effects to terrestrial resources.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II could result in impacts on terrestrial wildlife and/or habitat.	2,3	S	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special-Status Plants TER-4: Permanent Loss of Wetlands at Reservoirs	LTS
Construction activities associated with Fish Entrainment Reduction could result in impacts on terrestrial wildlife and/or habitat	2,3	S	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special-Status Plants TER-4: Permanent Loss of Wetlands at Reservoirs	LTS
Modification of aquatic habitat from the Wood River Wetland Restoration project could result in impacts on terrestrial wildlife and/or habitat.	2,3	LTS	None	LTS
The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat.	2,3	LTS	TER-2: Nesting Bird Surveys	LTS
The Mazama Forest Project could result in adverse impacts on terrestrial resources.	2,3	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.6 Flood Hydrology</b>				
Continued operation of the Klamath Hydroelectric Project and Reclamation's Klamath Project could alter river flows and result in changes to flood risks.	1	NCFEC	None	NCFEC
Ongoing restoration actions could affect flood hydrology.	1	NCFEC	None	NCFEC
Drawdown of reservoirs could result in short-term increases in downstream surface water flows and could result in changes to flood risk.	2, 3, 5	LTS	None	LTS
Reservoir drawdown and resulting downstream sediment deposition could change flood risk.	2, 3, 5	LTS	None	LTS
Changes in flows following dam removal could result in changes to the 100-year floodplain downstream of Iron Gate Dam between River Mile 190 and 105.	2, 3, 5	S	H-1: Emergency Response Plan H -2: Move or Relocate Structures	LTS
Removing the Four Facilities could reduce the risks associated with a dam failure.	2	B	None	B
Removing Copco 1 and Iron Gate Dams could reduce the risks associated with a dam failure.	5	B	None	B
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect flood risk.	2, 3, 5	NCFEC	None	NCFEC
Removal of recreation facilities located on the banks of the existing reservoirs which could affect flood hydrology.	2, 3, 5	NCFEC	None	NCFEC
Changes in flows in the Hydroelectric Reach including the J.C. Boyle and Copco 2 Bypass Reaches could affect flood hydrology.	4, 5	LTS	None	LTS
Construction of a new gage within the 100-year floodplain at Copco 2 Dam or J.C. Boyle Dam to measure flows could affect flood hydrology.	5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause changes to operations affecting flows downstream of Keno Dam, which could cause changes to flood risks.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause changes in flood risk downstream of the facilities.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of the Fisheries Restoration Plans could change flows downstream of Upper Klamath Lake, which could result in changes to flood risks	2, 3	LTS	None	LTS
Implementation of Wood River Wetland Restoration by the Bureau of Land Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks.	2, 3	B	None	B
Implementation of Future Storage Opportunities by Reclamation may cause changes to flows upstream and down downstream of Upper Klamath Lake, which could result in changes to flood risks	2, 3	B	None	B
Implementation of the On-Project Plan may change flows downstream of Upper Klamath Lake during dry years, which could result in changes to flood risks.	2, 3	NCFEC	None	NCFEC
Implementation of the WURP would change flows upstream of Upper Klamath Lake, which could result in changes to flood risks.	2, 3	NCFEC	None	NCFEC
Implementation of an Emergency Response Plan could result in changes to flood risks in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2, 3	NCFEC	None	NCFEC
Implementation of Climate Change Assessment and Adaptive Management may change flows upstream and downstream of Upper Klamath Lake, which could result in changes to flood risks.	2, 3	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of Interim Flow and Lake Program during the interim period would change river flows, which could result in changes to flood risks.	2, 3	NCFEC	None	NCFEC
<b>3.7 Groundwater</b>				
Continued impoundment of water in the reservoirs with no changes in facility operations could result in impacts on groundwater resources.	1, 4	NCFEC	None	NCFEC
Implementation of ongoing restoration activities in the Klamath Basin could impact groundwater levels in the Upper Basin.	1, 4, 5	NCFEC	None	NCFEC
Continued impoundment of the water in the reservoirs could lead to increased groundwater storage.	1, 4, 5	B	None	B
Draining of the reservoirs could lower groundwater levels in the aquifer adjacent to the reservoirs, which could impact existing wells.	2, 3, 5	S	GW-1: Deepening or Replacement of an Existing Affected Groundwater Well	LTS
Removing the dams and eliminating the reservoirs could reduce recharge to groundwater.	2, 3, 5	LTS	None	LTS
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect groundwater.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities would include the demolition of various recreation facilities which could affect groundwater.	2, 3, 5	NCFEC	None	NCFEC
<b>Keno Transfer</b>				
Implementation of the Keno Transfer could cause adverse effects to local groundwater.	2, 3	NCFEC	None	NCFEC
<b>East and West Side Facilities</b>				
Decommissioning the East and West Side Facilities could have adverse effects to groundwater resources.	2, 3	NCFEC	None	NCFEC
<b>KBRA</b>				
The Water Diversion Limitations program could reduce irrigation water in the driest years.	2,3	B (long-term)	None	B (long-term)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Upland vegetation management under the WURP would increase inflow to Upper Klamath Lake.	2,3	B (long-term)	None	B (long-term)
The purchase and lease of water under the Interim Flow and Lake Level Program would increase water for fisheries.	2,3	LTS (short-term) B (long-term)	None	LTS (short-term) B (long-term)
Implementation of an Emergency Response Plan could result in changes to groundwater following the failure of a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	NCFEC	None	NCFEC
<b>3.8 Water Supply/Water Rights</b>				
Continued operation of the Four Facilities could affect water supply operations.	1, 4	NCFEC	None	NCFEC
Ongoing restoration actions would continue to be implemented and could affect water supply availability.	1	NCFEC	None	NCFEC
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect water supply.	2, 3, 5	NCFEC	None	NCFEC
Removal of various recreation facilities located on the banks of the existing reservoirs which could affect water supply or water rights.	2, 3, 5	NCFEC	None	NCFEC
Flow changes downstream of Iron Gate Dam could affect water supply downstream of Seiad Valley.	2, 3, 5	LTS	None	LTS
Changes in flow downstream of Iron Gate Dam could affect water rights holders.	2, 3, 5	LTS	None	LTS
Sediment release during reservoir drawdown could affect Klamath River geomorphology and water intake pumps downstream of Iron Gate Dam.	2, 3, 5	S	WRWS-1: Modifications to Intake Points	LTS
<b>Trap and Haul – Programmatic Measure</b>				
Implementation of the trap and haul measures could require water rights to divert water for the fish handling facilities	4, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could cause changes to operations affecting water levels upstream of Keno Dam, which could cause changes to water supply or water rights.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning of the East and Westside Facilities and redirecting of water flows could affect water users reliant on a diversion from the West Canal.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of the trap and haul element of the Fisheries Reintroduction and Management would require water rights to divert water for the fish handling facilities.	2, 3	LTS	None	LTS
Implementation of Wood River Wetland Restoration by the Bureau of Land Management would result in changes to storage opportunities at Agency Lake, which could affect water supply.	2, 3	LTS	None	LTS
The study of additional off-stream storage opportunities in the Upper Klamath Basin to identify new storage opportunities, could affect water supply.	2, 3	NCFEC	None	NCFEC
Implementation of Water Diversion Limitations to Reclamation's Klamath Project could result in changes to water diversions, which may affect water rights and water supply.	2, 3	LTS	None	LTS
Implementation of the On-Project Plan to allow for full implementation of Water Diversion Limitations to Reclamation's Klamath Project would result in changes to water diversions for irrigation in dry years, which could affect water rights or adjudicated rights.	2, 3	B	None	B
Implementation of the Water Use Retirement Program increases instream flow to Upper Klamath Lake which could affect water rights upstream of Upper Klamath Lake.	2, 3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Water Use Retirement Program increases instream flow to Upper Klamath Lake which could affect water supply upstream of Upper Klamath Lake.	2, 3	NCFEC	None	NCFEC
Implementation of Off-Project Water Settlement negotiations could affect water rights and adjudicated rights upstream of Upper Klamath Lake.	2, 3	B (resolved water rights)	None	B (resolved water rights)
	2, 3	LTS (unresolved water rights)	None	LTS (unresolved water rights)
Implementation of Off-Project Reliance Program could change water deliveries for irrigation downstream of Upper Klamath Lake to Off-Project water users affecting water rights.	2, 3	LTS	None	LTS
Implementation of Drought Plan water and resource management actions could result in changes to water supply deliveries for Klamath Basin interests during drought years.	2, 3	B	None	B
Implementation of an Emergency Response Plan could result in a change to water supply deliveries in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2, 3	B	None	B
Implementation of Climate Change Assessment and Adaptive Management could result in changes to water deliveries depending on climatic changes	2, 3	B	None	B
Implementation of Interim Flow and Lake Program during the interim period could change water deliveries affecting water supply	2, 3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.9 Air Quality</b>				
Vehicle exhaust and fugitive dust emissions from dam removal activities and construction of fish passage could increase emissions of VOC, Nox, CO, SO2, PM10, and PM2.5 to levels that could exceed Siskiyou County's thresholds of significance.	2, 3,5	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks AQ-4: Dust control measures during blasting operations	S
	4	LTS	None	LTS
Relocation of the City of Yreka water supply pipeline could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
Reservoir restoration actions could result in short-term and temporary increases in criteria pollutant emissions from the use of helicopters, trucks, and barges that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	S	None	S
Relocation and demolition of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from the operation of construction equipment that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas.	2, 3, 4, 5	LTS	None	LTS
<b>Interim Measures (IM's)</b>				
Activities associated with interim measure (IM) 7 J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	1,2,3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Activities associated with interim measure (IM) 8 J.C. Boyle Bypass Barrier Removal could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	1	LTS	None	LTS
Activities associated with interim measure (IM) 16 Water Diversions could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	2,3	LTS	None	LTS
<b><i>Trap and Haul Operations</i></b>				
Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.	4, 5	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ-3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	LTS
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could have adverse effects on air quality.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse air quality effects.	2, 3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.	2, 3	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	S <sup>3</sup>
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap and haul activities.	2, 3	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	S <sup>3</sup>
<b>3.10 Greenhouse Gases/Global Climate Change</b>				
Vehicle exhaust from dam removal activities and construction of fish passage could increase GHG emissions in the short-term to levels that could exceed the designated significance criteria.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	LTS	None	LTS
Relocation of the City of Yreka water supply pipeline could result in short-term increases in GHG emissions from vehicle exhaust.	2, 3, 5	LTS	None	LTS

<sup>3</sup> While Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce impacts to LTS, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Reservoir restoration actions could result in short-term increases in GHG emissions from the use of helicopters, trucks, and barges.	1, 2, 3, 5	LTS	None	LTS
The demolition of various recreation facilities which could result in short-term increases in GHG emissions from vehicle exhaust.	2, 3, 5	LTS	None	LTS
Removing or reducing a renewable source of power by removing the dams or developing fish passage could result in increased GHG emissions from possible non-renewable alternate sources of power.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	S	CC-1 (market mechanisms); CC-2 (energy audit program); and CC-3 (energy conservation plan)	S
<b><i>Interim Measures (IM's)</i></b>				
Activities associated with interim measures (IM) 7 J.C. Boyle Gravel Placement and/or Habitat could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	1,2,3	LTS	None	LTS
Activities associated with interim measures (IM) 8 J.C. Boyle Bypass Barrier Removal Enhancement could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	1	LTS	None	LTS
Activities associated with interim measures (IM) 16 Water Divisions could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	2,3	LTS	None	LTS
<b><i>Trap and Haul Operations</i></b>				
Implementation of trap and haul measures could result in temporary increases in GHG emissions from vehicle exhaust	4,5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could have adverse effects on greenhouse gases and climate change.	2, 3	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>East and Westside Facilities</i></b>				
Decommissioning the East and West Side Facilities could cause adverse greenhouse gas and climate change effects.	2, 3	LTS	None	LTS
<b><i>KBRA</i></b>				
Construction activities associated with the KBRA programs involving construction could cause temporary increases in GHG emissions and climate change.	2, 3	LTS	None	LTS
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in GHG emissions from vehicle exhaust associated with trap and haul activities.	2, 3	LTS	None	LTS
Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources which would provide affordable electricity to allow efficient use, distribution, and management of water.	2, 3	B	None	B
Implementation of the Drought Plan and the Climate Change Assessment and Adaptive Management Plan could affect climate change-related impacts.	2, 3	B	None	B
<b>3.11 Geology, Soils, and Geologic Hazards</b>				
Continued impoundment of water in the reservoirs could continue to trap sediment at rates similar to historical rates.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could continue to prevent access to the diatomite beds at Copco 1 Reservoir.	1, 4	NCFEC	None	NCFEC
Draining of the reservoirs could uncover diatomite beds at Copco 1 Reservoir; however the land would be transferred to a State agency which would not allow commercial use, access to the mineral resource would not be changed.	2, 3, 5	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction and deconstruction activities could change erosion patterns through heavy vehicle use, excavation, and grading which could result in soil erosion.	2, 3, 4, 5	LTS	None	LTS
Draining of the reservoirs could cause instability along the banks of the reservoirs.	2, 3, 5	LTS	None	LTS
Draining of Copco 1 Reservoir could eliminate wave induced erosion thereby improving stability for upland hillsides and reducing the potential for erosion.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could cause river bank erosion downstream.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in short-term increases in sedimentation in slow-moving eddies and pools downstream from the reservoirs to the Klamath River estuary.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in changes to seismic or volcanic activity.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in long-term changes in the amount of erosion of the exposed reservoir bottom sediment remaining in the river channel.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in long-term changes to downstream sediment deposition from the erosion of remaining reservoir sediments.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could leave sediments that would dry out and could affect restoration activities and/or future road construction activities.	2, 3, 5	S	GEO-1: Geotechnical Analysis	LTS
Removal of Iron Gate Dam would require relocation of the Yreka water supply pipeline which could affect geology and soils.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities would include the removal of various recreation facilities which could affect geology and soils.	2, 3, 5	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Keno Transfer</i></b>				
The Keno Transfer could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and West Side Facilities could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Implementation of the Phase I Fisheries Restoration Plan could result in construction related sediment erosion.	2, 3	LTS (short term) B (long term)	None	LTS (short term) B (long term)
<b>3.13 Cultural and Historic Resources</b>				
Under the No Action/No Project Alternative current effects/impacts on historic properties/ historical resources, other cultural resources, and human remains will continue to occur.	1	NCFEC	None	NCFEC
The Proposed Action could result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD, which is considered eligible for inclusion on the National Register and California Register.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	S

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Reservoir drawdown associated with the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
Installation of the Yreka Water Supply Pipeline could affect/impact archaeological and historic sites that are eligible for inclusion on the National Register or California Register.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction activities including use of haul roads and disposal sites for demolition debris under the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register or California Register.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
Removal of the recreational facilities after reservoir drawdown may affect archaeological or historic sites that could be eligible for inclusion on the National Register or California Register or human remains.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
The Fish Passage at Four Dams Alternative could affect/impact the four dams and the KHHD, other historic properties/historical resources, TCPs, cultural landscapes, or human burials.	4, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
<b><i>Keno Transfer</i></b>				
The Transfer of Keno Dam to the DOI could have adverse effects to historic properties or historic resources.	2, 3	B	None	B
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and West Side Facilities could have adverse effects on historic resources or historic properties.	2, 3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Implementation of the KBRA fisheries restoration program could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	S <sup>4</sup>
Establishment of the Klamath Tribes Interim Fishing Site and implementation of the Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	LTS
<b>3.14 Land Use, Agricultural and Forest Resources</b>				
The continued operation of and impoundment of water at the Four Facilities could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	1	NCFEC	None	NCFEC

<sup>4</sup> Studies will be conducted to identify cultural resources and reduce significant impacts to these resources. Implementation of specific plans and projects associated with the KBRA will require future environmental compliance as appropriate.

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
The exposure of the currently inundated lands from the removal of the Four Facilities could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	2, 3	NCFEC	None	NCFEC
The construction of fish passage infrastructure at the Four Facilities, or the construction activities associated with the removal of Copco 1 and Iron Gate dams and the construction of fish passage infrastructure at J.C. Boyle and Copco 2 could conflict with applicable land use plans, policies, or regulations adopted for the purpose of mitigating an environmental effect.	4, 5	NCFEC	None	NCFEC
The continued impoundment of water at the Four Facilities could result in the indirect conversion of farmland to non-agricultural use or conflict with the Williamson Act or agricultural zoning in the upper Klamath Basin due to uncertain water supplies.	1	NCFEC	None	NCFEC
Construction activities from the full or partial removal of the Four Facilities could result in the indirect conversion of farmland to non-agricultural use or conflict with the Williamson Act or agricultural zoning in the upper Klamath Basin due to uncertain water supplies.	2, 3	NCFEC	None	NCFEC
The construction of fish passage infrastructure at the Four Facilities, or the construction activities associated with the removal of Copco 1 and Iron Gate dams and the construction of fish passage infrastructure at J.C. Boyle and Copco 2, could result in the indirect conversion of farmland to non-agricultural use or conflict with the Williamson Act or agricultural zoning in the upper Klamath Basin due to uncertain water supplies.	4, 5	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction activities associated with full or partial dam removal, the construction of fish passage infrastructure, or the continued impoundment of water at Copco 2 and J.C. Boyle dams could result in the conversion of forest lands to non-forest use or conflict with forest zoning.	2, 3, 4, 5	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities and construction activities associated with the development of fish passage could indirectly convert farmland to non-agricultural use or forest land to non-forest use.	1, 4	NCFEC	None	NCFEC
Construction activities associated with dam removal and the draining of the reservoirs could result in changes in the existing physical environment that could convert farmland to non agricultural use or convert forest land to non forest use.	2, 3, 5	LTS	None	LTS
Construction activities associated with dam removal could require new, permanent roads to be constructed to provide access to new recreation areas, which could constitute a change in the existing environment.	2, 3, 5	LTS	None	LTS
Dam removal would require the relocation of the Yreka water supply line and could result in a change in the existing environment and surrounding environment.	2, 3, 5	NCFEC	None	NCFEC
Construction and restoration activities associated with dam removal would include the demolition of various recreation facilities which could affect land use.	2, 3, 5	NCFEC	None	NCFEC
The construction and development of fish passage facilities would require new permanent roads to be created to provide access to the Klamath Hydroelectric Project facilities which could create conflicts with applicable plans and policies or otherwise cause a significant land use impact due to existing zoning and land uses.	4, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>Keno Transfer</i></b>				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could result in a change in land use.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and West Side facilities could impact land use.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
The KBRA could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	2,3	LTS	None	LTS
The implementation of the Water Diversion Limitation Program could convert farmland to non-agricultural uses, a potentially significant effect.	2,3	LTS	None	LTS
The Water Use Retirement Program could result in the fallowing or conversion of agricultural land to non agricultural uses, such as open space or wetland restoration areas	2,3	B	None	B
The Power for Water Management Program could affect Land Use in the Klamath Project area.	2,3	LTS	None	LTS
The KBRA's Mazama Forest Project could result in the conversion of forest land to non-forest use or conflict with forest zoning.	2,3	NCFEC	None	NCFEC
<b>3.17 Population and Housing</b>				
Construction activities could employ non-local workers, who would need housing for the duration of their employment.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	LTS	None	LTS
Construction, restoration, and monitoring activities associated with new programs could create new jobs and could employ non-local workers, who would need housing for the duration of their employment.	1	LTS	None	LTS
Dam removal would require relocation of the Yreka water supply pipeline and could result in an increase in construction workers requiring housing.	2, 3,5	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Removal of recreation facilities and related construction activities could result in an increase in construction workers requiring housing.	2, 3, 5	NCFEC	None	NCFEC
<b><i>Keno Transfer</i></b>				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could affect population and housing.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and Westside Facilities could impact population and housing.	2, 3	NCFEC	None	NCFEC
<b><i>KBRA</i></b>				
Construction and monitoring activities associated with the KBRA programs could employ non-local workers who would need housing for the duration of their employment.	2,3	LTS	None	LTS
<b>3.18 Public Health and Safety, Utilities and Public Services, Solid Waste, Power</b>				
Continued impoundment of water at the reservoirs under annual license renewals would allow hydropower generation to continue subject to the conditions of the Reclamation Biological Opinions, which would have the potential to decrease hydropower production.	1	NCFEC	None	NCFEC
Construction activities related to the ongoing restoration and management activities could impact public health and safety	1	NCFEC	None	NCFEC
Construction activities from dam removal could result in public health and safety risks.	2, 3, 4, 5	S	PHS-1: Public Safety Management Plan	LTS
Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities.	2, 3, 4, 5	S	PHS-1: Public Safety Management Plan PHS-2: Fire Management Plan	LTS
Construction activities could increase the risk of wildfires.	2, 3, 4, 5	S	PHS-2: Fire Management Plan	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal would eliminate a water source for wildfire services and could increase response times.	2, 3, 5	LTS	None	LTS
Dam removal would eliminate a water source for residential firefighting in and around Copco Village, and could increase the risk to homes from fire.	2, 3, 5	LTS	None	LTS
Construction activities could affect police services by temporarily increasing the population of construction workers, lengthening response times due to construction traffic on area roads, and exposing construction areas to theft and/or vandalism.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could require the use of electricity and natural gas supplies in the study area.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could affect the City of Yreka's municipal water supply by damaging or exposing the Yreka water supply pipeline prior to its relocation.	2, 3, 5	LTS	None	LTS
The removal of recreational facilities currently located on the banks of the existing reservoirs could affect public health and safety	2, 3, 5	S	PS-1: Public Safety Management Plan PHS-2: Fire Management Plan	LTS
Construction activities could affect public services and utilities in the counties and cities in the study area.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in the need for new construction and access roads.	2, 3, 4, 5	LTS	None	LTS
Construction activities (including Signage and Construction Traffic Management BMP) could affect road conditions by increasing traffic from heavy construction vehicles which could affect public health and safety.	2, 3, 4, 5	LTS	None	LTS
Construction activities could generate a substantial amount of solid waste which could affect public services and utilities.	2, 3, 4, 5	LTS	None	LTS
Dam removal would remove existing hydropower facilities, resulting in a loss of hydropower generation which could affect the supply of electricity.	2, 3, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Development of fish passage would reduce power generation at the existing hydropower facilities due to bypass stream flow requirements which could affect the supply of electricity.	4, 5	LTS	None	LTS
Dam removal could increase available mosquito habitat and could increase the risk of disease transmission in the short-term.	2, 3, 5	LTS	None	LTS
Leaving dam facilities and infrastructure in place which could have the potential to result in public health and safety risks.	4	NCFEC	None	NCFEC
	3, 5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Under the Proposed Action, the Keno Facility will be transferred to the DOI, which could cause adverse effects to Public Health and Safety.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Under the Proposed Action, the East and West Side Facilities will be decommissioned, resulting in the loss of generated power.	2, 3	LTS	None	LTS
<b><i>KBRA</i></b>				
Prescribed burning and mechanical thinning under the Phase I and II Fisheries Restoration Plans could affect Public Services and Utilities.	2, 3	S (short-term); B (long-term)	PHS-2: Fire Management Plan	LTS (short-term); B (long-term)
Construction activities associated with the KBRA programs could result in public health and safety impacts.	2, 3	B (long-term)	None	B (long-term)
Implementation of the Power for Water Management Program could create new renewable energy sources.	2, 3	B	None	B
Completing the Emergency Response Plan could have beneficial effects on Public Services and Public Safety.	2, 3	B	None	B

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.19 Scenic Quality</b>				
Continued impoundment of water at the Four Facilities could result in water quality impacts that could have long-term impacts on scenic quality.	1, 4	NCFEC	None	NCFEC
Continued existence of the buildings and other man-made structures could have the impact that they would remain inconsistent with the VRM classification of the surrounding area (where such inconsistency is defined as a criterion of significance).	1, 4, 5	NCFEC	None	NCFEC
Ongoing fish habitat restoration actions could result in short-term and long-term impacts on scenic resources.	1	S (short-term from construction); B (long-term)	None	S (short-term from construction); B (long-term)
Activities related to the Agency Lake and Barnes Ranches ongoing projects could result in long-term impacts to scenic resources.	1	B	None	B
Dam removal could result in impacts on scenic resources from removal of dams and facilities.	2, 3, 5	B	None	B
The removal of historic properties could result in impacts on scenic resources.	2, 3, 5	S	None	S
Dam removal could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.	2, 3, 5	S	None	S
Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.	2, 3, 5	S (short-term); B (long-term)	None	S (short-term); B (long-term)
Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources.	2, 3, 5	S	None	S
Replacement of the existing wooden Lakeview Bridge just downstream of Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.	2, 3	S (short-term); LTS (long-term)	None	S (short-term); LTS (long-term)

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Relocation of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.	2, 3	S (short-term); LTS (long-term)	None	S (short-term); LTS (long-term)
Deconstruction activities could create a new source of light or glare that could adversely affect nighttime views in the area.	2, 3, 4, 5	S	SQ-1: Measures to Reduce Nighttime Light and Glare	LTS
Sediment release during dam and reservoir removal could cause temporary changes in water quality and the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	2, 3, 5	S (short-term)	None	S (short-term)
Removal of the dams and facilities could result in long-term impacts on scenic resources from changes to water quality.	2, 3, 5	B	None	B
Demolition, construction, and restoration activities for the fishways could cause short-term adverse effects on the scenic vistas in the immediate vicinity of the Four Facilities.	4, 5	S	None	S
Construction of fishways could cause changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	4, 5	LTS	None	LTS
Fishways could cause substantial long-term impacts on scenic resources.	4, 5	S	None	S
Construction activities associated with fish collection facilities would introduce new features into the landscape.	4, 5	LTS (short-term); S (long-term)	None	LTS (short-term); S (long-term)
<b><i>Keno Transfer</i></b>				
Implementation of the Keno Transfer could affect scenic resources.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
Decommissioning of the East and Westside canals and hydropower facilities could affect scenic resources.	2, 3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II could result in impacts on scenic resources.	2, 3	LTS	None	LTS
The Fisheries Restoration Plan- Phase I and Phase II could result in long-term impacts on scenic resources.	2, 3	B	None	B
Construction activities associated with fish collection facilities would introduce new features into the landscape.	2, 3	LTS (short-term); S (long-term)	None	LTS (short-term); S (long-term)
The Wood River Wetland Restoration Project could result in long-term impacts on scenic resources.	2, 3	LTS	None	LTS
Construction activities associated with the WURP could result in impacts on scenic resources.	2, 3	LTS	None	LTS
The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in long-term impacts on scenic resources.	2, 3	B/LTS	None	B/LTS
Construction activities associated with Fish Entrainment Reduction could result in impacts on scenic resources.	2, 3	LTS (short-term)	None	LTS
Fish Entrainment Reduction could result in long-term impacts on scenic resources.	2, 3	LTS	None	LTS
Construction activities associated with the Klamath Tribes Interim Fish Site could result in impacts on scenic resources.	2, 3	LTS	None	LTS
The Klamath Tribes Interim Fish Site could result in long-term impacts on scenic resources.	2, 3	LTS	None	LTS
<b>3.20 Recreation</b>				
Continued existence of the reservoirs could change existing recreation access and opportunities.	1,4	NCFEC	None	NCFEC
Construction activities associated with ongoing programs could temporarily restrict access to recreational opportunities.	1	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction activities associated with ongoing programs could result in short-term water quality impacts which could affect recreational opportunities.	1	LTS	None	LTS
Ongoing actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	1	B	None	B
Construction activities could temporarily restrict recreational access on and in the vicinity of the reservoirs.	1, 4	NCFEC	None	NCFEC
	2, 3, 5	LTS	None	LTS
Construction activities, such as demolition, would generate temporary impacts (i.e., increased noise and dust) and could decrease the quality of recreational experiences in the vicinity of the reservoirs.	2, 3, 5	LTS	None	LTS
Reservoir removal could permanently decrease the availability of reservoir/lake-based recreational opportunities.	1, 4	NCFEC	None	NCFEC
	2, 3, 5	LTS	None	LTS
Removal of recreation facilities could limit access to recreational opportunities along and within the newly formed river channel.	2, 3, 5	S	REC-1: Prepare a plan to develop new recreational facilities and river access points	LTS
Changes in flow and water quality following dam removal could impact developed recreational facilities upstream and downstream of the reservoirs.	2, 3, 5	LTS	None	LTS
Downstream sediment release during reservoir drawdown could decrease the quality of water-contact-based-recreation in the short-term.	2, 3, 5	LTS	None	LTS
Removal of impoundments improves water quality and could impact water-contact-based recreational opportunities.	2, 3, 5	B	None	B
	1, 4	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Changes to the floodplain or river channel and removal of recreation facilities as a result of dam removal could affect access to whitewater boating opportunities.	2, 3, 5	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)	None	NCFEC (downstream of Iron Gate); LTS (Hydroelectric Reach)
Changes in flows following dam removal could increase the number of days with acceptable flows for various recreational activities in the Klamath River.	2, 3, 5	LTS	None	LTS
Changes in flows could increase the number of days with acceptable flows for whitewater boating and fishing in the J.C. Boyle and Copco 2 Bypass Reaches.	2, 3, 4, 5	LTS	None	LTS
Changes in flows could decrease the number of days with acceptable flows for whitewater boating and fishing in the Hells Corner Reach.	4	S (whitewater boating)	None	S (whitewater boating)
	2, 3, 5	S (whitewater boating); LTS (fishing)	None	S (whitewater boating); LTS (fishing)
Improved habitat for anadromous fish species following dam removal could affect recreational fishing opportunities in the long-term.	2, 3, 5	B	None	B
	4	LTS	None	LTS
Implementation of Mitigation Measure REC-1 could permanently reduce recreational opportunities in the Klamath Basin.	2, 3, 5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
Transfer of the Keno Facility from PacifiCorp to DOI could affect recreational opportunities.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and West Side Facilities could have adverse effects on recreational resources.	2, 3	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Construction activities associated with the KBRA could temporarily restrict recreational access.	2,3	LTS	None	LTS
Construction activities associated with KBRA programs could result in short-term water quality impacts which could affect recreational opportunities.	2,3	LTS	None	LTS
Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin.	2,3	B (long-term)	None	B (long-term)
KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	2,3	B	None	B
KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin.	2,3	B	None	B
KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin.	2,3	B	None	B
<b>3.21 Toxic/Hazardous Materials</b>				
Continued operation of the Four Facilities could create a hazard to the public or the environment through the transport, use, or disposal of hazardous, toxic, or radiological waste (HTRW).	1, 4, 5	NCFEC	None	NCFEC
Construction activities could create a significant hazard to the public or the environment if they are located on a site which is included on a list of hazardous materials sites.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could create a hazard to the public or the environment through the transport, use, or disposal of HTRW.	2, 3, 4, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction activities could create a hazard to the public or the environment through the abatement and disposal of asbestos and lead-based paint.	2, 3, 5	LTS	None	LTS
Construction activities could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 4, 5	LTS	None	LTS
Construction activities required to relocate the Yreka water supply pipeline could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 5	LTS	None	LTS
Removal of various recreation facilities could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 5	LTS	None	LTS
<b><i>Keno Transfer</i></b>				
The transfer of the Keno Facility to DOI could result in affects to HTRW.	2, 3	NCFEC	None	NCFEC
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and West Side Facilities could have adverse effects in terms of toxics and hazards.	2, 3	LTS	None	LTS
<b><i>KBRA</i></b>				
Construction activities associated with the KBRA programs could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered during construction.	2,3	LTS	None	LTS
Construction activities associated with the KBRA programs could create a significant hazard to the public or the environment through the accidental release of hazardous materials during construction activities.	2,3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.22 Traffic and Transportation</b>				
<b><i>Traffic Flow Effects</i></b>				
Changes in traffic volumes could affect traffic flow.	1	NCFEC	None	NCFEC
Construction activities associated with the continued implementation of ongoing restoration actions could cause temporary effects to traffic and transportation.	1	S	Traffic best management practices	LTS
Construction vehicle trips could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 4, 5	LTS	None	LTS
Construction vehicle trips could result in temporary traffic flow effects on on-site roads.	2, 3, 4, 5	LTS	None	LTS
Construction vehicle trips during removal of recreation facilities associated with dam removal could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 5	LTS	None	LTS
Construction vehicle trips during the relocation of the Yreka water supply pipeline could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 5	LTS	None	LTS
Implementation of the interim measures (IM's) 8 J.C. Boyle Bypass Barrier Removal and IM 16 Water Diversions could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2	LTS	None	LTS
<b><i>Traffic Safety Effects</i></b>				
Changes in traffic safety could occur.	1	NCFEC	None	NCFEC
Construction vehicle trips could cause traffic safety effects associated with the creation of dust along gravel roads.	2, 3, 5	LTS	None	LTS
Construction vehicle trips could cause traffic safety effects associated with vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road and OR66.	2, 3, 4, 5	LTS	None	LTS
Construction vehicle trips could cause traffic safety effects associated with sharp curves along Copco Road and OR66.	2, 3, 5	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction vehicle trips during the relocation of the Yreka water supply pipeline and removal of recreation facilities could cause traffic safety effects associated with sharp curves along Copco Road. The installation of signage at sharp corners would help to reduce this risk (See Appendix B).	2, 3, 5	LTS	None	LTS
The relocation of existing recreation facilities from the banks of the existing reservoirs down slope to the new river bed could result in traffic impacts along adjacent roadways.	2	LTS	None	LTS
Implementation of the interim measures (IM's) 7 J.C. Boyle Gravel Placement could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	1,2,3	LTS	None	LTS
Implementation of the interim measures (IM's) 8 J.C. Boyle Bypass Barrier Removal could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	1,2,3	LTS	None	LTS
Implementation of the interim measures (IM's) 16 Water Diversions could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	2,3	LTS	None	LTS
<b><i>Trap and Haul Operations</i></b>				
Traffic associated with the implementation of the prescriptions and trap and haul operations would cause traffic safety effects on OR66 and US97, access roads, and onsite roads	4,5	LTS	None	LTS
<b><i>Road Condition Effects</i></b>				
Changes in road conditions could occur.	1	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Increased traffic volumes from heavy construction vehicles during construction activities could degrade road conditions and exceed bridge weight capacities. As part of the development of the construction plan, an in depth analysis of bridge and road capacity and state of repair will be conducted by the dam removal entity (DRE), with remedial actions taken prior to the commencement of facility deconstruction.	2, 3, 4, 5	S	TR-1: Relocate Jenny Creek Bridge and Culverts	LTS
<b>Public Transit Effects</b>				
Changes in public transit could occur.	1	NCFEC	None	NCFEC
Construction vehicle trip volumes and material hauling routes could affect regional transit service.	2, 3, 4, 5	LTS	None	LTS
<b>Non-motorized Transportation Effects</b>				
Changes in non-motorized transportation could occur.	1	NCFEC	None	NCFEC
The presence of construction vehicles along Copco and Topsy Grade/Ager-Beswick Roads could affect non-motorized transportation (i.e., bicyclists and pedestrians) due to high speeds and dust generation.	2, 3, 4, 5	LTS	None	LTS
<b>Keno Transfer</b>				
The transfer of the Keno Facility could impact traffic and transportation.	2, 3	NCFEC	None	NCFEC
<b>East and West Side Facilities</b>				
Activities associated with the decommissioning of the East and Westside Facilities could affect traffic and transportation.	2, 3	LTS	None	LTS
<b>KBRA</b>				
Activities associated with the KBRA actions that involve construction could cause temporary traffic effects.	2,3	LTS	None	LTS
Operational activities associated with the Fisheries Reintroduction and Management Plans could result in temporary traffic effects associated with trap-and-haul activities.	2, 3	LTS	None	LTS

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.23 Noise and Vibration</b>				
Construction and deconstruction activities at the dam sites could cause a temporary increase in noise levels at Copco 1 Dam that could affect residents in the area.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction and deconstruction activities at the dam sites could cause a temporary increase in nighttime noise levels at Iron Gate Dam.	1	NCFEC	None	NCFEC
	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
	4	LTS	None	LTS
Reservoir restoration activities could result in short-term increases in noise levels in the project vicinity.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Blasting activities at Copco 1 Dam could increase vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction activities at the dam sites could require the transport of waste to off-site landfills and construction worker commutes which would cause increases in noise along haul routes.	2, 3, 4, 5	LTS	None	LTS
Construction activities at the dam sites could increase short-term vibration levels.	2, 3,5	S	NV-1: Noise and Vibration Control Plan	S
	4	LTS	None	LTS
<b>Trap and Haul – Programmatic Measure</b>				
Trap and Haul operations could result in temporary increases in noise and vibration levels from vehicles used to relocate fish.	4, 5	S	NV-1: Noise and Vibration Control Plan	LTS
<b>Keno Transfer</b>				
The transfer of Keno dam to the DOI could have adverse effects on noise and vibration.	2, 3	NCFEC	None	NCFEC

**Table 5-1. Summary of Environmental Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><i>East and West Side Facilities</i></b>				
The decommissioning of the East and West Side Facilities could have adverse effects on Noise and Vibration.	2, 3	LTS	None	LTS
<b><i>KBRA</i></b>				
Construction activities associated with the KBRA could cause temporary increases in noise and vibration levels.	2,3	S	NV-1: Noise and Vibration Control Plan	LTS
Operational activities associated with the Fisheries Reintroduction Management Plan could result in temporary increases in noise and vibration levels from vehicles associated with trap-and-haul activities.	2, 3	S	NV-1: Noise and Vibration Control Plan	LTS

**KEY:**

**Significance:**

NCFEC = No Change From Existing Conditions

B = Beneficial

LTS = Less than Significant

S = Significant

N/A = Not Applicable

**Alternatives:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.2 Water Quality</b>				
<b><i>Water Temperature</i></b>				
<b>Upper Klamath Basin</b>				
Dam removal and/or elimination of hydropower peaking operations at J.C. Boyle Powerhouse could cause short-term <sup>5</sup> and long-term <sup>6</sup> alterations in daily water temperatures and fluctuations in the J.C. Boyle bypass and peaking reaches.	2, 3, 5	S for J.C. Boyle bypass reach	None	S for J.C. Boyle bypass reach
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term increases in spring time water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir.	2, 3, 5	S for springtime	None	S for springtime
<b><i>Lower Klamath Basin</i></b>				
Dam removal and conversion of the reservoir areas to a free flowing river could result in short-term and long-term increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River	2, 3, 5	S – Iron Gate Dam to Salmon River for springtime	None	S – Iron Gate Dam to Salmon River for springtime
<b><i>Suspended Sediments</i></b>				
<b>Upper Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Hydroelectric Reach downstream of J.C. Boyle Dam.	2, 3, 5	S	None	S

<sup>5</sup> Short-term is defined as <2 years following dam removal.

<sup>6</sup> Long-term is defined as 2-50 years following dam removal.

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>Lower Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the lower Klamath River and the Klamath Estuary.	2, 3, 5	S	None	S
<b><i>Dissolved Oxygen</i></b>				
<b>Upper Klamath Basin</b>				
Draining the reservoirs and release of sediment could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir.	2, 3, 5	S	None	S
<b>Lower Klamath Basin</b>				
Dam removal and sediment release could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	S (lower Klamath River from Iron Gate Dam to Clear Creek)	None	S (lower Klamath River from Iron Gate Dam to Clear Creek)
<b>3.3 Aquatic Resources</b>				
<b><i>Critical Habitat</i></b>				
Reservoir drawdown associated with dam removal could alter the quality of critical habitat.	2, 3, 5	S (short-term for coho)	None	S (short-term for coho)
<b><i>Essential Fish Habitat</i></b>				
Reservoir drawdown associated with dam removal could alter the quality of EFH.	2, 3, 5	S (short-term for Chinook and coho)	None	S (short-term for Chinook and coho)

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><u>Species Impacts</u></b>				
<b><u>Coho Salmon</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect coho salmon.	2, 3, 5 (would only remove Copco 1 and Iron Gate)	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units)
<b><u>Steelhead</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect steelhead in the short-term.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S
<b><u>Pacific Lamprey</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect Pacific lamprey in the short-term.	2, 3, 5	S	(Alternative 2 only) AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S
<b><u>Green Sturgeon</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect green sturgeon.	2, 3, 5	S	AR-3: Fall flow pulses;	S
<b><u>Freshwater mussels</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect freshwater mussels in the short-term.	2, 3, 5	S	AR-7: Freshwater mussel relocation	S

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b><u>Benthic Macroinvertebrates</u></b>				
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect macroinvertebrates.	2, 3, 5	S	None	S
<b>3.4 Algae</b>				
<b><i>Hydroelectric Reach</i></b>				
Dam removal and the elimination of hydropower peaking operations could result in long-term increased biomass of nuisance periphyton in low-gradient channel margin areas within the Hydroelectric Reach.	2, 3, 5	S	None	S
<b>3.9 Air Quality</b>				
Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of VOC, NOx, CO, SO <sub>2</sub> , PM <sub>10</sub> , and PM <sub>2.5</sub> to levels that could exceed Siskiyou County's thresholds of significance.	2, 3	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S
Reservoir restoration actions could result in short-term and temporary increases in criteria pollutant emissions from the use of helicopters, trucks, and barges that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	S	None	S
<b><i>Trap and Haul Operations</i></b>				
Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.	4, 5	S	None	S

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>KBRA</b>				
Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.	2, 3	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S <sup>7</sup>
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap-and-haul activities.	2, 3	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks	S
<b>3.10 Greenhouse Gases/Global Climate Change</b>				
Removing or reducing a renewable source of power by removing the dams or developing fish passage could result in increased GHG emissions from possible non-renewable alternate sources of power.	2, 3, 4, 5	S	CC-1: Market Mechanisms); CC-2: Energy Audit Program; and CC-3: Energy Conservation Plan	S

<sup>7</sup> While Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce impacts to LTS, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
<b>3.13 Cultural and Historic Resources</b>				
The Proposed Action could result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD, which is considered eligible for inclusion on the National Register and California Register.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4: Treatment of Indian Human Remains	S
<b>KBRA</b>				
Implementation of the KBRA programs including the Phase 1 and 2 Fisheries Restoration Plans, Fisheries Reintroduction and Management Plan, Wood River Wetland Restoration Project, On-Project Plan, Water Use Retirement Program, Fish Entrainment Reduction, Klamath Tribes Interim Fishing Site, and Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3	S	None	S <sup>8</sup>
Establishment of the Klamath Tribes Interim Fishing Site could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3	S	None	S <sup>8</sup>

<sup>8</sup> Studies will be conducted to identify cultural resources and reduce significant impacts to these resources. Implementation of specific plans and projects associated with the KBRA will require future environmental compliance as appropriate.

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2, 3	S	None	S <sup>8</sup>
<b>3.19 Scenic Quality</b>				
Ongoing fish habitat restoration actions could result in short-term and long-term impacts on scenic resources.	1	S (short-term from construction)	None	S (short-term from construction)
The removal of historic properties could result in impacts on scenic resources.	2, 3, 5	S	None	S
Dam removal could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.	2, 3, 5	S	None	S
Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.	2, 3, 5	S (short-term)	None	S (short-term)
Construction of a new, elevated City of Yreka water supply pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources.	2, 3, 5	S (short-term)	None	S (short-term)
Replacement of the existing wooden Lakeview Bridge just downstream of Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.	2, 3	S (short-term)	None	S (short-term)
Relocation of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.	2, 3	S (short-term)	None	S (short-term)
Sediment release during dam and reservoir removal could cause temporary changes in water quality and the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	2, 3, 5	S	None	S

**Table 5-2. Summary of Significant and Unavoidable Impacts**

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Demolition, construction, and restoration activities for the fishways could cause short-term adverse effects on the scenic vistas in the immediate vicinity of the Four Facilities.	4, 5	S	None	S
Fishways could cause substantial long-term impacts on scenic resources.	4, 5	S	None	S
<b>Trap and Haul Operations</b>				
Construction activities associated with fish collection facilities would introduce new features into the landscape.	4, 5	S (long-term)	None	S (long-term)
<b>KBRA</b>				
Construction activities associated with fish collection facilities would introduce new features into the landscape.	2, 3	S (long-term)	None	S (long-term)
<b>3.20 Recreation</b>				
Changes in flows could decrease the number of days with acceptable flows for whitewater boating and fishing in the Hells Corner Reach.	2, 3, 4, 5	S (whitewater boating)	None	S (whitewater boating)
<b>3.23 Noise and Vibration</b>				
Construction and deconstruction activities at the dam sites could cause a temporary increase in noise levels at Copco 1 Dam that could affect residents in the area.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction and deconstruction activities at the dam sites could cause a temporary increase in nighttime noise levels at Iron Gate Dam.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Reservoir restoration activities could result in short-term increases in noise levels in the project vicinity.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Blasting activities at Copco 1 Dam could increase vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction activities at the dam sites could increase short-term vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S

**KEY:**

**Significance:**

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N/A = Not Applicable

**Alternatives:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
<b>3.12 Tribal Trust</b>			
<b><i>The Klamath Tribes</i></b>			
Continued operation of the four Klamath River dams would result in no change from existing conditions to the trust resources of The Klamath Tribes and other resources traditionally used by The Klamath Tribes.	1, 4	NCFEC	None
Removal of the Four Facilities and implementation of KBRA plans and programs, would address most of the water quality and aquatic resources issues related to The Klamath Tribes' trust resources and other resources traditionally used by the Tribes (see Sections 3.2, 3.3, and 3.5).	2, 3	B	None
	5 (at Copco and Iron Gate Reservoirs only)	B	None
Construction of fishways at the four dams would address a portion of the critical issues related to migratory fish that were identified by The Klamath Tribes, however the remaining critical issues affecting their trust resources and other resources traditionally used by the Klamath Tribes would persist.	4	B	None
<b><u>KBRA</u></b>			
Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources.	2, 3	B	None
Implementation of the Mazama Forest Project could result in impacts/effects to Trust Resources and other traditionally used resources.	2, 3	B	None
<b><i>Quartz Valley Tribe</i></b>			
The Quartz Valley Reservation is not along the Klamath River and the Tribe does not have a reserved Klamath River fishery or reserved water rights; thus there would be no impact from dam removal or construction of fish passage facilities.	1, 2, 3, 4, 5	NCFEC	None
<b><i>Karuk</i></b>			
Continued operation of the four Klamath River dams would result in no change from existing conditions to the trust resources of the Karuk and other resources traditionally used by the Karuk.	1, 4	NCFEC	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Removal of the Four Facilities and implementation of KBRA plans and programs, would address most of the water quality and aquatic resources issues related to the Karuk trust resources and other resources traditionally used by the Tribes (see Sections 3.2, 3.3, and 3.5).	2, 3	B	None
	5 (at Copco and Iron Gate Reservoirs only)	B	None
Construction of fishways at the four dams would address a portion of the critical issues related to migratory fish that were identified by the Karuk, however the remaining critical issues affecting their trust resources and other resources traditionally used by the Karuk would persist.	4	B	None
<b><u>KBRA</u></b>			
Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to traditionally used resources.	2, 3	B	None
<b><u>Hoopa Valley Indian Tribe</u></b>			
Continued operation of the four Klamath River dams would result in no change from existing conditions to the trust resources of the Hoopa Valley Indian Tribe and other resources traditionally used by the Hoopa Valley Indian Tribe.	1, 4	NCFEC	None
Removal of the Four Facilities and implementation of KBRA plans and programs, would address most of the water quality and aquatic resources issues related to the Hoopa Valley Indian Tribe trust resources and other resources traditionally used by the Tribes (see Sections 3.2, 3.3, and 3.5).	2, 3	B	None
	5 (at Copco and Iron Gate Reservoirs only)	B	None
Construction of fishways at the four dams would address a portion of the critical issues related to migratory fish that were identified by the Hoopa Valley Indian Tribe, however the remaining critical issues affecting their trust resources and other resources traditionally used by the Hoopa Valley Indian Tribe would persist.	4	B	None
<b><u>KBRA</u></b>			
Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources.	2, 3	B	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
<b><i>Yurok</i></b>			
Continued operation of the four Klamath River dams would result in no change from existing conditions to the trust resources of the Yurok Tribe and other resources traditionally used by the Yurok.	1, 4	NCFEC	None
Removal of the Four Facilities and implementation of KBRA plans and programs, would address most of the water quality, terrestrial, and aquatic resources issues related to the Yurok Tribe trust resources and other resources traditionally used by the Yurok (see Sections 3.2, 3.3, and 3.5).	2, 3	B	None
	5 (at Copco and Iron Gate Reservoirs only)	B	B
Construction of fishways at the four dams would address a portion of the critical issues related to migratory fish that were identified by the Yurok Tribe, however the remaining critical issues affecting their trust resources and other resources traditionally used by the Yurok would persist (see Sections 3.2 and 3.3).	4	B	None
<b><i>KBRA</i></b>			
Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources.	2, 3	B	None
<b><i>Resighini Rancheria</i></b>			
Continued operation of the four Klamath River dams would result in no change from existing conditions to the trust resources of the Resighini Rancheria and other resources traditionally used by the Resighini Rancheria.	1, 4	NCFEC	None
Removal of the Four Facilities and implementation of KBRA plans and programs, would address most of the water quality, terrestrial, and aquatic resources issues related to the Resighini Rancheria trust resources and other resources traditionally used by the Resighini Rancheria (see Sections 3.2, 3.3, and 3.5).	2, 3	B	None
	5 (at Copco and Iron Gate Reservoirs only)	B	None
Construction of fishways at the four dams would address a portion of the critical issues related to migratory fish that were identified by the Resighini Rancheria, however the remaining critical issues affecting their trust resources and other resources traditionally used by the Resighini Rancheria would persist (see Sections 3.2 and 3.3).	4	B	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
<b>3.15 Socioeconomics</b>			
<b>Four Facilities</b>			
Changes in annual O&M expenditures required to continue the operation of the existing facilities could affect employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
	2, 3, 5	Adverse	None
Construction activities associated with dam removal and fish passage facilities would increase economic output, employment, and labor income during the construction period in Klamath and Siskiyou Counties.	2, 3, 4, 5	B (short-term)	None
Mitigation spending after the deconstruction period could increase economic output, employment, and labor income in the regional economy.	2, 3, 4, 5	B (short-term)	None
<b>Commercial Fishing</b>			
Changes in commercial fishing harvests could change fishing revenues and affect employment, labor income, and output in the regional economy.	1	NCFEC	None
	2, 3, 4, 5	B (long-term)	None
<b>Recreation</b>			
Changes to reservoir recreation expenditures could affect employment, labor income, and output in the regional economy.	1, 5 (due to continued use of J.C. Boyle Reservoir)	NCFEC	None
	2, 3, 5 (due to removal of Copco and Iron Gate Reservoirs)	Adverse	None
Changes to in-river sport fishing opportunities could affect recreational expenditures and employment, labor income, and output in the regional economy.	1	NCFEC	None
	2, 3, 4, 5	B (long-term)	None
Changes to ocean sport fishing could affect recreational expenditures in the regional economy.	1	NCFEC	None
	2, 3, 4, 5	B (long-term)	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Changes to whitewater boating opportunities could affect recreational expenditures and employment, labor income, and output in the regional economy.	1	NCFEC	None
	2, 3, 4, 5	Adverse (from reduced whitewater boating expenditures in the Upper Klamath River and Hell's Corner Reach)	None
<b>Indian Tribes</b>			
The continuation of dam operations could affect existing economic conditions of Indian Tribes in the area of analysis.	1	NCFEC	None
Dam removal and the construction of fish passage could increase fish harvest for subsistence, cultural practices and commercial uses and provide economically beneficial opportunities for Indian Tribes residing on the Klamath River (excluding the Hoopa Valley Tribe, who reside on the Trinity River).	2, 3, 4, 5	B	None
<b>PacifiCorp Hydroelectric Service</b>			
Energy rates for PacifiCorp customers could change.	1, 4, 5	UKN	None
Removal of the Four Facilities could result in increased energy rates for PacifiCorp customers.	2, 3	NCFEC	None
<b>Property Values and Local Government Revenues</b>			
Property values surrounding Iron Gate and Copco Reservoirs could change.	1, 4, 5 (around Copco 2 Reservoir)	NCFEC	None
	2, 3, 5 (around Copco 1 and Iron Gate Reservoirs)	Adverse (short-term); UKN (long-term)	None
Changes in real estate values around Copco 1 and Iron Gate Reservoirs could affect property tax revenues to Siskiyou County.	2, 3, 5	Adverse (short-term); UKN (long-term)	None
	4	NCFEC	None
Removal of the Four Facilities could affect property tax revenues to Siskiyou and Klamath Counties from PacifiCorp.	2, 3, 5	NCFEC	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Construction worker spending could increase sales and use tax receipts in Siskiyou and Klamath Counties.	2, 3	B (short-term)	None
Changes in visitation for recreation activities could affect sales tax revenues.	2, 3	UKN	None
<b><i>PacifiCorps Property Taxes</i></b>			
PacifiCorp's property tax payments to Siskiyou and Klamath Counties could change.	1, 4	NCFEC	None
<b><i>Ongoing Restoration Activities</i></b>			
Ongoing restoration activities could generate employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
<b><i>Irrigated Agriculture</i></b>			
Changes in Reclamation's Klamath Project hydrology could affect farm revenues, employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
Changes in on-farm pumping costs could affect farm revenues, employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
Water acquisitions could affect farm revenues, employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
<b><i>Refuge Recreation</i></b>			
Changes in water supply could affect visitor spending for refuge recreation and affect employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
<b><i>Tribal Program</i></b>			
Ongoing fisheries and conservation management by The Klamath Tribes, Karuk Tribe, and Yurok Tribe could generate employment, labor income, and output in the regional economy.	1, 4	NCFEC	None
<b><i>KBRA</i></b>			
Fish habitat restoration for the Fisheries Program could affect employment, labor income, and output in the regional economy.	2, 3	B (during project implementation)	None
In the long-term, the Fisheries Program could support increased fish abundance in the Klamath River and tributaries.	2, 3	B (long-term)	None
Construction, analysis, and monitoring activities under the Water Resources Program could affect employment, labor income, and output in the regional economy.	2, 3	B (during project implementation)	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Changes in the Reclamation Klamath Project hydrology could affect gross farm revenue and the regional economy.	2, 3	B (long-term)	None
Increases in on-farm pumping costs could affect household income and reduce employment, labor income, and output in the regional economy.	2, 3	Adverse	None
Water acquisitions via permanent, voluntary water rights sales could affect farm revenues and employment, labor income, and output in the regional economy.	2, 3	B	None
Water acquisitions via short-term water leasing could decrease farm revenues and reduce employment, labor income, and output in the regional economy.	2, 3	Adverse (short-term)	None
Changes in water supply could affect refuge recreation expenditures and employment, labor income, and output in the regional economy.	2, 3	B	None
Implementation of regulatory assurances under the KBRA could support employment, labor income, and output in the regional economy.	2, 3	B/NCFEC	None
Implementation of the Klamath County Economic Development Plan could support long-term economic growth in Klamath County.	2, 3	B	None
Funds from the California Water Bond Legislation could be used by Siskiyou County to improve economic conditions in the county and to support future economic growth.	2, 3	B	None
Construction and monitoring activities associated with Tribal Program actions would increase jobs, labor income, and output for The Klamath Tribes, Karuk Tribe, and Yurok Tribe.	2, 3	B	None
<b>3.16 Environmental Justice</b>			
Changes to fisheries could disproportionately affect tribal people.	1	NCFEC	None
	2, 3, 4, 5	B	None
Increased traffic, air quality emissions, and noise associated with construction activities could disproportionately affect county residents and tribal people.	1	NCFEC	None
	2, 3, 4, 5	Disproportionate Effects (short-term)	Air Quality (Section 3.9) and Noise and Vibration (Section 3.23) mitigation measures

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
Release of sediment from reservoirs could cause disproportionate short term impacts on county residents and tribal people.	1	NCFEC	None
	2, 3	NCFEC (short-term, inorganic and organic contaminants); Disproportionate Effect (short-term, reduced mussel populations)	None
Changes to water quality could cause disproportionate long term water quality impacts on county residents and tribal people.	1, 4, 5	NCFEC	None
	2, 3	B	None
Changes in county revenues could decrease county funding of social programs used by county residents.	1, 4	NCFEC	None
	2, 3, 5	Disproportionate Effects	None
Changes to water quality and fish populations could disproportionately impact tribal health and social wellbeing in the long term.	1, 4, 5	NCFEC	None
	2, 3	B	None
Traffic on associated haul roads could disproportionately affect county residents and tribal people.	2, 3, 4, 5	Disproportionate Effects (short-term); NCFEC (long-term)	Traffic and Transportation (Section 3.22) mitigation measures
Dam removal activities and construction of fish passage could provide jobs for county residents and tribal people that are low income and minority.	2, 3, 4, 5	B (short-term)	None
The installation of the Yreka water supply pipeline could disproportionately affect county residents or tribal people.	2, 3	NCFEC	None
Relocation of existing recreation facilities from the banks of the existing reservoirs down slope to the new river bed could disproportionately affect county residents or tribal people.	2, 3	NCFEC	None

**Table 5-3: Summary of Environmental Effects Relative to NEPA**

Potential Impact	Alternative(s)	Effect Pursuant to NEPA	Mitigation
<b>Keno Transfer</b>			
The Keno Transfer could have adverse effects on environmental justice issues.	2, 3	NCFEC	None
<b>East and Westside Facilities</b>			
The East and West Side Facilities decommissioning could have adverse effects on environmental justice issues.	2, 3	NCFEC	None
<b>KBRA</b>			
Implementation of the Phases I and II Fisheries Restoration Plans, the Fisheries Monitoring Plan, the Fisheries Reintroduction and Management Plan, and the Klamath River Tribes Interim Fishing Site could disproportionately affect tribal populations.	2, 3	B	None
Implementation of the Water Use Retirement Program, Off-Project Reliance Program, and Interim Flow and Lake Level Program could disproportionately affect low income and minority farm workers.	2, 3	Disproportionate Effects (short-term); NCFEC (long-term)	None
Implementation of the Tribal Fisheries and Conservation Management Program could disproportionately affect the tribes.	2, 3	B	None
Implementation of the Tribal Programs Economic Revitalization could disproportionately affect the tribes.	2, 3	B	None
Implementation of the Mazama Forest Project could disproportionately affect the tribes.	2, 3	B	None
Implementation of the Klamath County Economic Development Plan could disproportionately affect low income and minority people in Klamath County.	2, 3	B	None
Implementation of the California Water Bond Legislation could disproportionately affect low income and minority people in Siskiyou County.	2, 3	B	None

**KEY:**

**Significance:**

NCFEC = No Change From Existing Conditions

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LTS = Less than Significant

S = Significant

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**Alternatives:**

1 = No Action/No Project

2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)

3 = Partial Facilities Removal of Four Dams Alternative

4 = Fish Passage at Four Dams Alternative

5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

**Table 5-4. Wild and Scenic River Resource Effects**

Potential Impact	Alternatives	Effect	Proposed Mitigation	Effect After Mitigation
<b><i>Wild and Scenic River Assessment – Scenic Evaluation</i></b>				
Dam removal could result in changes to water flow character (river flows and accompanying river width, depth, and channel inundation or exposure) compared with conditions present when the Oregon component was designated as a National WSR.	2, 3, 5	B	None	B
Dam removal could result in changes to water flow character (river flows and accompanying river width, depth, and channel inundation or exposure) compared with conditions present when the California component was designated as a National WSR.	2, 3, 5	B	None	B
Dam removal could result in changes to water appearance (clarity, turbidity, depth of view, color, and prominence of algae) compared with conditions present when the California and Oregon components were designated as National WSRs.	2, 3, 5	B	None	B
Increases in anadromous fish habitat and improvements in water quality following dam removal could result in increases in the population of large anadromous fish species and resulting changes in opportunities for fish and wildlife viewing compared with conditions present when the California and Oregon components were designated as National WSRs.	2, 3, 5	B	None	B
Improvements to riparian habitat in the California and Oregon WSR components following dam removal could affect opportunities for river-dependent wildlife viewing compared with conditions present when the California and Oregon components were designated as National WSRs.	2, 3	B	None	B
Dam removal and restoration of the riverine corridor could result in changes to riparian vegetation compared with conditions present when the Oregon Klamath River component was designated as National WSRs.	2, 3, 5	B	None	B

**Table 5-4. Wild and Scenic River Resource Effects**

Potential Impact	Alternatives	Effect	Proposed Mitigation	Effect After Mitigation
Dam removal and restoration of the riverine corridor could result in changes to riparian vegetation compared with conditions present when the California Klamath River component was designated as National WSRs.	2, 3	B	None	B
Dam removal and the resulting presence of a more natural setting and character could result in changes to the natural appearing landscape character as compared with conditions present when the Oregon Klamath River component was designated as National WSRs.	2, 3, 5	B	None	B
Dam removal and the resulting presence of a more natural setting and character could result in changes to the natural appearing landscape character as compared with conditions present when the California Klamath River component was designated as National WSRs.	2, 3	B	None	B
<b><i>Wild and Scenic River Assessment – Recreation Evaluation</i></b>				
Flow changes following dam removal could affect opportunities for whitewater boating compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	S, short-term (Oregon WSR component); NE, short-term (California WSR component); B (long-term)	None	S, short-term (Oregon WSR component); NE, short-term (California WSR component); B (long-term)
Changes to flows and fish habitat could result in long-term effects to recreational fishing compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B

**Table 5-4. Wild and Scenic River Resource Effects**

Potential Impact	Alternatives	Effect	Proposed Mitigation	Effect After Mitigation
Removal of reservoirs could result in changes to opportunities for other recreational activities (water play, swimming, camping) compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	S	REC-1: Prepare a plan to develop new recreational facilities and river access points	LTS
Dam removal could improve the recreational setting (water-quality related aesthetics, odors, tastes, contacts, and public health and safety aspects) compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B
<b><i>Wild and Scenic River Assessment – Fisheries Evaluation</i></b>				
Dam removal could alter stream flow regime compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B
A more natural flow regime following dam removal could decrease fall water temperatures compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B (California WSR component); NE (Oregon WSR component)	None	B (California WSR component); NE (Oregon WSR component)
Dam removal would improve water quality characteristics (physical, biological, and chemical) and reduce fish crowding compared to conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B
The release of sediment during reservoir drawdown would alter geomorphic conditions, sediment transport regime, and substrate quality compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B

**Table 5-4. Wild and Scenic River Resource Effects**

Potential Impact	Alternatives	Effect	Proposed Mitigation	Effect After Mitigation
Improved water quality, decreased fish disease, and more natural habitat conditions following dam removal could affect conditions for anadromous fish species compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B
Restored connectivity between the lower and upper Klamath River, a natural flow regime in place of existing reservoirs, and water quality improvements following dam removal could affect conditions for resident fish species compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B
Restored connectivity between the lower and upper Klamath River, a natural flow regime in place of existing reservoirs, and water quality improvements following dam removal could affect conditions for species traditionally used and culturally important to Indian Tribes compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B
<b><i>Wild and Scenic River Assessment – Wildlife Evaluation</i></b>				
Removal of reservoirs and creation of riparian habitat could affect habitat for special status species compared with conditions present when the California and Oregon Klamath River components were designated as National WSRs.	2, 3, 5	B	None	B

**Table 5-4. Wild and Scenic River Resource Effects**

Potential Impact	Alternatives	Effect	Proposed Mitigation	Effect After Mitigation
Implementation of the prescriptions provided by the USFWS, DOI, and DOC in the FERC 2007 EIS could change whitewater boating opportunities in the Hell's Corner reach.	4	S	None	S

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## 5.5 Significant and Unavoidable Impacts

Significant and unavoidable adverse effects refer to the environmental consequences of an action that cannot be avoided by redesigning the project, changing the nature of the project, or implementing mitigation measures. NEPA requires a discussion of any adverse impacts that cannot be avoided (40 CFR Section 1502.15). The CEQA Guidelines require a discussion on significant environmental effects that cannot be avoided as well as those that can be mitigated but not reduced to an insignificant level (Section 15126.2 (b) and Section 15126.2(a)). This section discusses the significant and unavoidable impacts of the Klamath River dam removal alternatives presented in Chapter 2, Project Description.

### 5.5.1 Water Quality

Implementation of the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in short-term (<2 years following dam removal) and long-term (2-50 years following dam removal) increases in summer/fall water temperatures and daily fluctuations in the J.C. Boyle Bypass Reach due to the elimination of hydropower peaking operations. This would be a significant and unavoidable impact for the J.C. Boyle Bypass Reach. Similarly, implementation of these alternatives would result in potentially significant increases in springtime water temperatures in the Hydroelectric Reach downstream of Copco 1 Reservoir.

Short-term significant and unavoidable impacts would result from sediment release (and corresponding increases in suspended sediment concentrations [SSCs]) associated with dam removal under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. These short-term (<2 years following dam removal) increases in SSCs would result in a significant impact in the Hydroelectric Reach. In the Lower Klamath Basin, sediment release from dam removal under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would exceed applicable North Coast Basin Plan water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary and would substantially adversely affect the cold freshwater habitat (COLD) beneficial use. Thus, these short-term increases in SSCs would be significant and unavoidable in the lower Klamath River and the Klamath Estuary.

Dissolved oxygen impacts are anticipated to be secondary impacts of the sediment release during reservoir drawdown. Under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, elevated SSCs during reservoir drawdown and dam removal would result in decreases in dissolved oxygen in the Hydroelectric Reach downstream of J.C. Boyle Reservoir and in the lower Klamath River from Iron Gate Dam to Clear Creek. These decreases in dissolved oxygen would be significant and unavoidable impacts.

### **5.5.2 Aquatic Resources**

Under the Proposed Action, elevated levels of SSCs during the 2 to 3 month reservoir drawdown period would result in short-term significant and unavoidable impacts on critical habitat for coho salmon as well as essential fish habitat for Chinook and coho salmon. SSCs and bedload sediment transport and deposition under the Proposed Action would result in the loss of coho and fall-run Chinook salmon, Pacific Lamprey, green sturgeon and summer and winter steelhead individuals present in the mainstem after drawdown in January 2020. Based on the substantial reduction in the abundance of a year class in the short-term, the loss of these individuals during short-term increases in SSCs and bedload movement would be significant and unavoidable. For coho, this significant and unavoidable impact applies to the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

The Proposed Action and changes in bed substrate from the erosion of accumulated sediments and changed substrate characteristics in the Klamath River during reservoir drawdown would affect mussels. Given the substantial reduction in the abundance of multiple year classes in the short term and the slow recovery time of freshwater mussels, the effects would be significant for mussels in the short term. Similar significant and unavoidable impacts would occur for benthic macroinvertebrates.

The Partial Facilities Removal Alternative and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in similar short-term significant and unavoidable impacts related to suspended sediment concentrations and bedload movement. These impacts would occur for fall-run Chinook, coho, steelhead, Pacific Lamprey, green sturgeon, freshwater mussels, and benthic macroinvertebrates.

### **5.5.3 Algae**

The Proposed Action and Partial Facilities Removal Alternative would result in increases in nutrient inputs from the Upper Klamath Basin that could increase periphyton biomass in low-gradient channel areas in the Hydroelectric Reach; this impact would be significant and unavoidable.

Development of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in increased nutrient transport to downstream reaches and result in changes to the periphyton community composition. This impact would be significant and unavoidable in the Hydroelectric Reach downstream of J.C. Boyle Dam.

### **5.5.4 Air Quality**

Under the Proposed Action and Partial Facilities Removal Alternatives, total emissions of Particulate Matter <10 microns (PM<sub>10</sub>) from construction equipment exhaust, on-road haul trucks, commuting vehicles, and fugitive dust emissions from unpaved roads and general earth moving activities would exceed Siskiyou County's thresholds of significance. This impact could not be mitigated to less than significant with implementation of the mitigation measures in Section 3.9, Air Quality, and would remain a significant and unavoidable impact. Reservoir restoration activities under the Proposed

Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in short-term and temporary increases in criteria pollutant emissions from the use of helicopters, trucks, and barges. These impacts would be significant and unavoidable.

Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust. These short-term impacts would be significant and unavoidable and implementation of mitigation measures in Section 3.9, Air Quality, would not reduce these to less than significant. Additionally, operational activities associated with the Fisheries Reintroduction and Management Plan could result in short-term increases in air quality pollutant emissions from vehicle exhaust associated with trap-and-haul activities. Implementation of the mitigation measures in Section 3.9, Air Quality, would not reduce these impacts to less than significant, thus they would remain significant and unavoidable impacts.

### **5.5.5 Greenhouse Gases/Global Climate Change**

Implementation of the Proposed Action and decommissioning and removal of Iron Gate, Copco 1, and Copco 2 dams (which are California Renewable Portfolio Standard [RPS]-eligible facilities) is contrary to implementation of AB 32 but the significance would diminish as new renewable sources are developed. Although it is expected that PacifiCorp would add new sources of renewable power that would replace the removed dams, the analysis in Section 3.10, Greenhouse Gases/Global Climate Change, provides a conservative assumption that emissions could still occur when the dams are removed.

Section 3.10, Greenhouse Gases/Global Climate Change, describes that the California Air Resources Board expects that implementation of its Scoping Plan (2008) would reduce 21.3 million metric tons carbon dioxide equivalent by 2020 (from 2005 baseline) from California's RPS; therefore, the possible increase in emissions from removing the dams would account for three percent of the expected emissions reduction. Under a business-as-usual scenario, which assumes that the Scoping Plan would not be implemented, this would impede California's ability to meet its emission reduction goal. While mitigation measures in Section 3.10, Greenhouse Gases/Global Climate Change, would be implemented to reduce emissions from power replacement, it is expected that greenhouse gas emissions would remain significant and unavoidable in the short-term until PacifiCorp adds new sources of renewable power that would replace the removed dams. Implementation of the Partial Facilities Removal Alternative, the Fish Passage at Four Dams Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would also result in the reduced operation or decommissioning of the power generating facilities of the dams; thus, electricity generation capacity would require replacement with other sources of power.

### **5.5.6 Cultural and Historic Resources**

Under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative some, if

not all, of the Four Facilities and their associated hydroelectric facilities would be removed. These facilities are part of the Klamath Hydroelectric Historic District (KHHD), which is eligible for the NRHP. Removal of these structures constitutes a significant and unavoidable impact.

Implementation of the following KBRA programs would include ground disturbing activities that are likely to have a significant impact on cultural and historic resources that are eligible for inclusion on the National Register and/or California Register. These KBRA programs include:

- Phases 1 and 2 Fisheries Restoration Plans
- Fisheries Reintroduction and Management Plan
- Wood River Wetland Restoration Project
- On-Project Plan
- Water Use Retirement Program
- Fish Entrainment Reduction
- Klamath Tribes Interim Fishing Site
- Mazama Forest Project

Studies will be conducted to identify cultural resources and measures to reduce significant impacts to those resources. As described in Section 3.13, Cultural and Historic Resources, implementation of specific plans and projects associated with Phase 1 and 2 Fisheries Restoration will require future environmental compliance as appropriate.

Additional KBRA programs that would likely have significant impacts on archaeological and historic sites; traditional cultural properties (TCPs); cultural landscapes that are eligible for inclusion on the National Register and/or California Register; and, possibly, on Indian human remains include the establishment of the Klamath Tribes Interim Fishing Site and the Mazama Forest Project. While construction-related BMPs would be implemented to reduce impacts from ground disturbing activities related to the establishment of the Klamath Tribes interim fishing site, actual implementation of specific plans associated with this will require future environmental compliance as appropriate. Under the Mazama Forest Project, the 90,000 acres identified in the Mazama Forest Project are likely to include cultural and historic resources that are eligible for inclusion on the National Register and/or California Register. While implementation of specific forest management plans are likely to have significant impacts on cultural and historic resources eligible for inclusion on the National Register and/or California Register, these specific plans and projects associated with the Mazama Forest Project will require future environmental compliance as appropriate.

### **5.5.7 Socioeconomics**

Under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, reduced annual operations and maintenance (O&M) expenditures required to continue the operation of the dams and existing facilities could affect employment, labor income, and

output in the regional economy. These reductions in O&M expenditures would result in long-term adverse effects in the regional economy.

The Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in reduced reservoir recreation opportunities associated with dam and reservoir removal and could reduce recreational expenditures in the regional economy. If visitors prefer to recreate in a reservoir setting rather than the new river setting, they may choose to recreate outside of the region. Losses in recreation spending would directly affect several industries in the region and would result in secondary impacts on support industries. In addition, implementation of any of these three dam removal alternatives would result in loss of jobs and incomes for PacifiCorp workers employed in Siskiyou and Klamath Counties.

Another adverse effect would result from losses in whitewater boating opportunities under the Proposed Action and the Partial Facilities Removal Alternative. Specifically, flow decreases in the Hell's Corner Reach would result in losses of commercial trips and corresponding losses in recreation expenditures in the local economy.

Dam removal and the removal of Copco 1 and Iron Gate Reservoirs under the Proposed Action, Partial Facilities Removal Alternative, and Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would affect private parcels with partial reservoir views, frontage/access or with river views subsequent to the action. While a majority of the applicable private parcels are vacant residential land and single-family residential, changes caused by dam removal would have adverse effects on property values in the short-term. However, the net magnitude of these changes is difficult to forecast. In the long-term, land values of parcels downstream of Iron Gate Dam with river views could increase because of restoration of the river, including improved water quality and more robust anadromous fish runs. Along the same lines, if some land values are reduced and there are no offsetting increases in other property values, Siskiyou County property tax revenues might decline relative to the No Action/No Project Alternative, assuming nothing else changes that might impact property tax revenues, (e.g., tax rates). This would result in a short-term adverse impact.

Under the KBRA, increases in on-farm pumping costs would affect household income and reduce employment, labor income, and output in the regional economy. Under the Proposed Action and the Partial Facilities Removal Alternative, irrigators are pumping more groundwater compared to the No Action/No Project Alternative and therefore are paying more for electricity under the Proposed Action and Partial Facilities Removal even with a decrease in electricity rates assumed in the Proposed Action (Reclamation 2011 and Reclamation 2011b). Thus, a reduced household income due to increased pumping costs would have a relatively small adverse impact on the regional economy.

Water acquisitions via short-term water leasing, which could occur as part of KBRA programs like the Off-Project Reliance Program and the Interim Flow and Lake Level Program, could decrease farm revenues and reduce employment, labor income, and output in the regional economy. These programs allow farmers to sell or lease their water

for fisheries programs on a short term basis when sufficient water is unavailable for fish. The regional economy would be affected by the loss in gross farm revenue generated on the land idled by farmers who voluntarily lease water. While some of these regional effects would be offset by household induced effects when farmers spend a portion of the compensation in the local area, short-term water leasing proposed in the KBRA is expected to have a short term, adverse effect on the regional economy.

### **5.5.8 Environmental Justice**

Implementation of the action alternatives would result in short-term construction-related impacts to air quality, traffic (including traffic on associated haul roads used during construction), and noise. These effects would likely result in short-term disproportionate effects to county residents and tribal people. Sediment release during reservoir drawdown would result in reduced freshwater mussel populations which would disproportionately affect tribes that rely on the mussels as a food source. This would be a short-term disproportionate effect to tribal people.

Section 3.15, Socioeconomics, describes that the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would cause short-term and long-term declines in tax revenues to the counties in the area of analysis stemming from a discontinuation of tax revenue from PacifiCorp and a short-term decrease in property values near the reservoirs. Reductions in the counties' budgets and resulting reductions or eliminations in social programs would disproportionately affect low income and minority county residents and tribal people.

Under the KBRA, implementation of the WURP, Off-Project Reliance Program, and Interim Flow and Lake Level Program could result in voluntary land fallowing and permanent water right sales. In turn, farm labor jobs could be lost which could disproportionately affect low-income, minority farm workers, who could lose a portion of their income if farms no longer required their labor. These would be short-term disproportionate effects.

### **5.5.9 Scenic Quality**

Ongoing fish habitat restoration actions would occur under the No Action/No Project Alternative throughout the entire basin with the exception of the Trinity River Basin. Activities related to these actions including floodplain rehabilitation, large woody debris replacement, fish passage correction, and cattle exclusion fencing, among others would include construction activities which could result in short-term significant impacts on scenic resources. These impacts would be significant and unavoidable in the short-term.

Implementation of the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in the removal of some historic properties. While the removal of buildings in and return to a natural landscape is preferable under the BLM's Visual Resource Management (VRM) process, some historic scenery elements may be considered socially

valued and their elimination from the scenic character would be considered a significant and unavoidable scenery impact of the project.

In addition to the removal of historic properties, removal of dams and reservoirs would result in substantial changes in the former reservoir areas during drawdown and until restoration is complete. Receding water in the current reservoirs would expose reservoir sediment. It is expected that the river channel would appear very similar to conditions before the river was impounded (with exception of vegetation not yet being established). The alternatives would involve stabilizing and revegetating the newly exposed reservoir areas with herbaceous and woody vegetation. Until the restoration was complete, however, the area would appear barren and/or sparsely vegetated. Additionally, Section 3.19, Scenic Quality, describes that studies estimate that it will take 30 years for the river corridor habitats to fully recover from the dam removals (Phillip Williams and Associates [PWA] 2009). Thus, these impacts on scenic resources would be significant and unavoidable in both the short and long-term.

Sediment release during reservoir drawdown would also result in temporary significant and unavoidable impacts to water aesthetics (clarity, turbidity (depth of view), and color). The impact on the appearance of the Klamath River would be temporary; however, as no mitigation measures could be implemented to reduce the impact on scenic resources, it would be significant and unavoidable.

Deconstruction, restoration, and construction activities associated with the Proposed Action, the Partial Facilities Removal Alternative, the Fish Passage at Four Dams Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would result in areas around the dams and in the vicinity of construction being inconsistent with the surrounding natural landscape and the VRM classification. Specifically, scenic quality changes during deconstruction, restoration, and construction activities would be caused by the temporary presence of large construction vehicles and equipment, temporary structures, temporary access roads, equipment storage areas, material stockpiles, piles of demolition materials, and other common construction items that would detract from the natural surroundings. These temporary impacts on scenic resources would be significant and unavoidable.

The addition of the fishways, under the Fish Passage at Four Dams Alternative and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, would change the scenic character in the vicinity of the dams by adding hardscape elements that would blend with the facility features but would not blend with the natural landscape and could dominate views due to their size. At Copco 1 and Iron Gate Dams, the fishway structures would be particularly large (see Table 3.19-3 in Section 3.19, Scenic Quality). Although the fishways have not yet been designed, they likely could display angular geometry, continuous straight lines, and flat surfaces that may moderately contrast with the colors, forms, and textures of the surrounding characteristic landscape, or may be insignificant compared to scenery impacts of the existing dam facilities. Thus, the addition of fishways could be a significant, permanent impact. No mitigation measures could be implemented to lessen the impact on scenic quality.

### **5.5.10 Recreation**

Under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative, the Hell's Corner Reach of the Klamath River, which currently provides whitewater boating opportunities, would lose acceptable and predictable flows necessary for whitewater boating. Less predictability would inhibit the ability of commercial outfitters to provide whitewater boating opportunities on a regular scheduled basis. This water flow impact on whitewater boating opportunities would be a significant and unavoidable impact.

### **5.5.11 Noise and Vibration**

Construction activities at the Copco 1 Development associated with the Proposed Action, the Partial Facilities Removal Alternative, the Fish Passage at Four Dams Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would produce noise and vibration levels resulting in significant and unavoidable impacts that could affect sensitive receptors in the area. Noise impacts would be significant and unavoidable for outdoor receptors during construction.

Construction activities at Iron Gate Dam would cause temporary increases in nighttime noise levels for the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative resulting in a significant and unavoidable impact. Reservoir restoration activities in the vicinity of the dams and reservoirs would also result in short-term increases in noise levels. Impacts related to vibration produced during construction activities under the Proposed Action, the Partial Facilities Removal Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would be significant and unavoidable. These short-term noise and vibration impacts would remain significant and unavoidable even after implementation of the mitigation measure in Section 3.23, Noise and Vibration.

## **5.6 Environmentally Preferable/Superior Alternative**

NEPA requires the Lead Agency to identify the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR Part 1505.2(b)). The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources. Although this alternative must be identified in the ROD, it need not be selected for implementation.

Section 15126.6(e)(2) of the CEQA Guidelines requires agencies to identify the environmentally superior alternative in a draft EIR. If the No Project Alternative is the environmentally superior alternative, an additional environmentally superior alternative must be identified among the other alternatives.

CDFG has identified Alternative 3 (Partial Facilities Removal of Four Dams) as the environmentally superior alternative. All of the alternatives evaluated in the EIS/EIR, including the No Action/No Project Alternative, have significant unavoidable environmental impacts as identified in Section 5.5. Alternative 2 (Full Facilities Removal of Four Dams, the Proposed Action), Alternative 3, and Alternative 5 (Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate) would have the most short-term significant and unavoidable impacts among the alternatives. These impacts would largely be limited to the time frame of direct dam deconstruction actions and sediment release. After dam deconstruction, impacts would include the loss of reservoir recreation and local economic impacts. Alternatives 2, 3, and 5 would significantly improve water temperature, dissolved oxygen, and algal toxins for aquatic resources and reduce the incidence of fish disease in juvenile salmon by removing the two largest reservoirs—Copco I and Iron Gate. Alternatives 4 and 5 would maintain some power production and recreational benefits thereby reducing local economic impacts.

Although the No Action/No Project Alternative will have no change from existing conditions resulting from construction, this alternative is not the environmentally superior alternative when compared to the Proposed Action, which is intended to improve environmental conditions. Alternative 3 is the environmentally superior alternative when compared with the Proposed Action because it would:

- Reduce the air quality impacts from emissions of volatile organic compounds (VOCs), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), particulate matter < 10 microns (PM<sub>10</sub>), and particulate matter < 2.5 microns (PM<sub>2.5</sub>) from reduced construction activities;
- Reduce the contribution to greenhouse gases from reduced construction activities;
- Reduce noise and vibration from reduced construction activities;
- Reduce impacts to terrestrial plants and wildlife from fewer truck trips;
- Reduce disturbance to archaeological and historic sites from fewer truck trips;
- Retain structures for roosting bats; and
- Retain historically significant structures at Copco 1.

Alternative 3 would provide similar long-term benefits when compared with Alternative 2, but would reduce short-term impacts because it involves less construction. Alternative 3 would result in superior long-term beneficial environmental effects. In summary, Alternative 3 is considered the environmentally superior alternative among all the alternatives because it provides long-term beneficial environmental effects, while reducing some of the short-term significant effects of the Proposed Action (Alternative 2).

## 5.7 Controversies and Issues Raised by Agencies and the Public

CEQA requires disclosure of the controversial project issues raised by agencies and the public. Table 5-5 presents a summary of some of the most controversial project issues identified during the scoping period. In the case that an issue or controversy is not directly addressed in this EIS/EIR, the table describes the process and general timeline for analyzing or addressing the issue. The Scoping Report (available online at: <http://klamathrestoration.gov/>) provides further information on issues identified by agencies and the public during the public scoping process.

**Table 5-5. Summary of Controversies and Issues Raised by Agencies and the Public**

Issue	Summary of Issue	Timeline for Addressing or Document/Section Addressing Issue
<b>Loss of Renewable Power Supply</b>	Loss of the Klamath Hydroelectric Project will result in the loss of renewable power. The specific makeup of new power supplies is not certain and may come from non-renewable sources.	Greenhouse Gases/Global Climate Change (3.10.4.3)  Public Health and Safety, Utilities and Public Services, Solid Waste, Power (Section 3.18.4.3)
<b>Regional Economic Impacts</b>	Loss of the Klamath Hydroelectric Project and lost power generation will negatively and disproportionately affect resource-based economies of local communities, many of which are struggling economically.	Socioeconomics (Section 3.15.4.3)
<b>Sediment Impacts from Dam Removal</b>	Sediment release during dam removal will have significant and deleterious effects on the aquatic environment from Iron Gate Dam to the Pacific Ocean during the period of dam removal.	Water Quality (Section 3.2.4.3)  Aquatic Resources (Section 3.3.4.3)
<b>Historic Anadromous Fish Distribution in the Upper Klamath Basin</b>	Dam removal would open large areas of the Upper Klamath Basin watershed to anadromous fish. The historical distribution of anadromous fish above the dams has been questioned.	Chapter 1, Introduction  Aquatic Resources (Section 3.3.4.3)
<b>KBRA Benefits</b>	The KBRA may not produce enough social and economic benefits from implementation.	Socioeconomics (Section 3.15.4.3)

**Table 5-5. Summary of Controversies and Issues Raised by Agencies and the Public**

<b>Issue</b>	<b>Summary of Issue</b>	<b>Timeline for Addressing or Document/Section Addressing Issue</b>
<b>Loss of Reservoir Environment</b>	Dam removal will result in a loss of the three largest reservoirs, affecting individuals that live on or near the reservoirs and who value the reservoirs' aesthetic and recreational value.	Land Use, Agricultural, and Forest Resources (Section 3.14.4.3)  Scenic Quality (Section 3.19.4.3)  Recreation (Section 3.20.4.3)
<b>Flood Risk</b>	Dam removal will increase the incidence and magnitude of flooding to downstream communities.	Flood Hydrology (Section 3.6.4.3)
<b>FERC Relicensing</b>	In the event of a negative Secretarial Determination, PacifiCorp would re-enter the FERC relicensing process. The outcome of this process is not known but could be the continued operation of the dams under a new license that includes the agencies' mandatory conditions and prescriptions.	Chapter 2, Proposed Action and Description of Alternatives
<b>Agriculture and Refuge Management contributes to poor water quality in Keno and Upper Klamath Lake</b>	Runoff from agriculture and refuges results in poor water quality in Keno Reservoir and in the mainstem Klamath River. This causes fish stress, disease and mortality. Continued farming and ranching in the Tule Lake National Wildlife Refuge and Lower Klamath Lake National Wildlife Refuge under the KBRA would inhibit fish species reintroduction and survival.	Water Quality (Section 3.2.4.3)  Aquatic Resources (Section 3.3.4.3)
<b>Water Quality Conditions in Keno and Upper Klamath Lake would not allow sound fish passage.</b>	Low levels of dissolved oxygen and high water temperatures during certain times of year would prohibit passage of fish through Keno Reservoir and Upper Klamath Lake.	Water Quality (Section 3.2.4.3)  Aquatic Resources (Section 3.3.4.3)

## 5.8 References

California Air Resources Board (CARB). 2008. Climate Change Scoping Plan: A Framework for Change. December. Accessed on: March 22, 2011. Available at: <http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm>.

Department of the Interior (DOI). 2011. Dam Removal Real Estate Evaluation Report. Prepared as an appendix to the Klamath Facilities Removal Secretarial Determination Overview Report.

Philip Williams & Associates, LTD. (PWA). 2009. A River Once More: The Klamath River Following Removal of the Iron Gate, Copco, and J.C. Boyle Dams. Prepared for the California State Coastal Conservancy. April 17.

# Chapter 6

## Compliance with Applicable Laws, Policies, and Plans

### 6.1 Related Laws, Rules, Regulations, Executive Orders, and Other Authorities

This section is a summary of the federal, tribal, state, and local statutes and regulations that are potentially applicable to the proposed action and alternatives presented in this Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report (EIS/EIR). Some questions remain over the ultimate applicability of local regulations depending on the selection of the Dam Removal Entity (DRE) (responsible for dam deconstruction) or Hydropower Licensee (responsible for taking over the dams and operations). Future environmental analysis and compliance documentation of the Definite Plan and the Klamath Basin Restoration Agreement (KBRA) will specify the applicable regulations with greater certainty once the selection of the Dam Removal Entity or Hydropower Licensee is made.

The removal of The Four Facilities would be subject to multiple federal and state statutes and local planning regulations. Table 6-1 lists the federal statute or requirement, the section it is described in, any relevant permits or processes required, and the status of compliance. Table 6-2 provides the regulatory requirements of the State of California and Table 6-3 provides the regulatory requirements of the State of Oregon. Table 6-4 provides the county and city requirements.

**Table 6-1. Related Federal Laws, Rules, Regulations, Executive Orders, and Other Authorities**

Statute	Section	Relevant Permits and Processes
<b>Federal Authorities</b>		
Federal Endangered Species Act	Section 3.3, Aquatic Resources, Section 3.5, Terrestrial Resources	EIS/EIR, Section 7 Consultation, Biological Assessment, Biological Opinion
Fish and Wildlife Coordination Act	Section 3.3, Aquatic Resources, Section 3.5, Terrestrial Resources	EIS/EIR
Magnuson-Stevens Fishery Conservation and Management Act	Section 3.3, Aquatic Resources	EIS/EIR, Essential Fish Habitat Report
Marine Mammal Protection Act	Section 3.3, Aquatic Resources	EIS/EIR

**Table 6-1. Related Federal Laws, Rules, Regulations, Executive Orders, and Other Authorities**

<b>Statute</b>	<b>Section</b>	<b>Relevant Permits and Processes</b>
Safe Drinking Water Act	Section 3.2, Water Quality and Section 3.4, Algae	EIS/EIR
Coastal Zone Management Act	Section 3.2, Water Quality and Section 3.4, Algae	EIS/EIR, Coastal Zone Consistency Certification
Migratory Bird Treaty Act	Section 3.5, Terrestrial Resources	EIS/EIR
Clean Water Act	Section 3.2 Water Quality, Section 3.4, Algae, Section 3.5, Terrestrial Resources, Section 3.19, Scenic Resources	EIS/EIR, CWA Section 401 Water Quality Certification, CWA 402 NPDES, and 404 permits
Executive Order 11990 – Protection of Wetlands	Section 3.5, Terrestrial Resources	EIS/EIR
Executive Order 11988 – Floodplain Management	Section 3.5, Terrestrial Resources	EIS/EIR
Bald and Golden Eagle Protection Act	Section 3.5, Terrestrial Resources	EIS/EIR
National Wildlife Refuge Administration Act, as amended by the National Wildlife Refuge System Improvement Act of 1997	Section 3.5, Terrestrial Resources	EIS/EIR
Northwest Forest Plan	Section 3.5, Terrestrial Resources	EIS/EIR
National Flood Insurance Program	Section 3.6, Flood Hydrology	EIS/EIR
CFR Title 16 Conservation	Section 3.8, Water Supply and Water Rights	EIS/EIR
CFR Title 25 Indians	Section 3.8, Water Supply and Water Rights	EIS/EIR
CFR Title 33 Navigation and Navigable Waters	Section 3.8, Water Supply and Water Rights	EIS/EIR, CWA Section 404 Permit, Rivers and Harbors Act Section 10 Permit
CFR Title 43 Public Land	Section 3.8, Water Supply and Water Rights	EIS/EIR
Clean Air Act	Section 3.9, Air Quality	EIS/EIR, General Conformity
Department of the Interior, Secretarial Order 3289	Section 3.10, Greenhouse Gases/Global Climate Change	EIS/EIR
CFR Title 75 Section 31514	Section 3.10, Greenhouse Gases/Global Climate Change	EIS/EIR
National Historic Preservation Act	Section 3.12, Tribal Trust, Section 3.13, Cultural and Historic Resources	EIS/EIR, Section 106 Consultation with SHPO
American Indian Religious Freedom Act	Section 3.12, Tribal Trust, Section 3.13, Cultural and Historic Resources	EIS/EIR
Federal Power Act	Section 3.12, Tribal Trust, Section 3.13, Cultural and Historic Resources	EIS/EIR

**Table 6-1. Related Federal Laws, Rules, Regulations, Executive Orders, and Other Authorities**

<b>Statute</b>	<b>Section</b>	<b>Relevant Permits and Processes</b>
Executive Order 13007	Section 3.12, Tribal Trust, Section 3.13, Cultural and Historic Resources	EIS/EIR
Executive Order 13084	Section 3.12, Tribal Trust, Section 3.13, Cultural and Historic Resources	EIS/EIR
Executive Order 12875, Enhancing the Intergovernmental Partnership	Section 3.12, Tribal Trust	EIS/EIR
Executive Order 13175, Consultation and Coordination with Indian Tribes	Section 3.12, Tribal Trust	EIS/EIR
Native American Graves Protection and Repatriation Act	Section 3.13, Cultural and Historic Resources	EIS/EIR, Section 106 Consultation with SHPO
Historic Sites Act of 1935	Section 3.13, Cultural and Historic Resources	EIS/EIR, Section 106 Consultation with SHPO
Archeological and Historic Preservation Act, 16 USC 469-469c-1	Section 3.13, Cultural and Historic Resources	EIS/EIR, Section 106 Consultation with SHPO
Protection of Archaeological Resources CFR Title 43 Section 7	Section 3.13, Cultural and Historic Resources	EIS/EIR, Section 106 Consultation with SHPO
Executive Order 11593, Protection and Enhancement of the Cultural Environment	Section 3.13, Cultural and Historic Resources	EIS/EIR, Section 106 Consultation with SHPO
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Section 3.16, Environmental Justice	EIS/EIR
Department of the Interior, The Environmental Justice Strategic Plan, 1995	Section 3.16, Environmental Justice	EIS/EIR
U.S. Environmental Protection Agency, Environmental Justice Implementation Plan, 1996	Section 3.16, Environmental Justice	EIS/EIR
Bureau of Land Management , Redding Resource Area Resource Management Plan	Section 3.14, Land Use, Agricultural and Forest Resources, Section 3.19, Scenic Resources	EIS/EIR
Bureau of Land Management , Klamath Falls Resource Area Resource Management Plan and Rangeland Program	Section 3.14, Land Use, Agricultural and Forest Resources, Section 3.19, Scenic Resources	EIS/EIR
Bureau of Land Management, Draft Upper Klamath River Management Plan EIS/EIR and Resource Management Plan Amendments	Section 3.19, Scenic Resources	EIS/EIR
Bureau of Land Management Visual Resource Management methodology	Section 3.19, Scenic Resources	EIS/EIR
U.S. Forest Service, Klamath National Forest Land and Resource Management Plan	Section 3.14, Land Use, Agricultural and Forest Resources, Section 3.19, Scenic Resources, Section 3.20, Recreation	EIS/EIR

**Table 6-1. Related Federal Laws, Rules, Regulations, Executive Orders, and Other Authorities**

<b>Statute</b>	<b>Section</b>	<b>Relevant Permits and Processes</b>
Kuchel Act	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
Wild and Scenic Rivers Act	Section 3.19, Scenic Resources, Section 3.20, Recreation	EIS/EIR, Fish and Game Code Section 1602 Streambed Alteration Agreement, Clean Water Act Section 404, Notification of Intent,
U.S. Forest Service Six Rivers National Forest Land and Resource Management Plan	Section 3.20, Recreation	EIS/EIR
U.S. Forest Service Fremont National Forest Land and Resource Management Plan	Section 3.20, Recreation	EIS/EIR
National Park Service General Management and Strategic Plan, Redwood National Park	Section 3.20, Recreation	EIS/EIR
Resource Conservation and Recovery Act	Section 3.21, Toxics and Hazardous Materials	EIS/EIR
Hazardous Material Transportation Act	Section 3.21, Toxics and Hazardous Materials	EIS/EIR
Comprehensive Environmental Response Compensation and Liability Act	Section 3.21, Toxics and Hazardous Materials	EIS/EIR
Superfund Amendment Reauthorization Act	Section 3.21, Toxics /Hazardous Materials	EIS/EIR
CFR Title 40 Section 260-279	Section 3.21, Toxics /Hazardous Materials	EIS/EIR
Emergency Planning and Community Right to Know Act, CFR Title 40 Section 301 et seq.	Section 3.21, Toxics /Hazardous Materials	EIS/EIR
Toxic Substance Control Act	Section 3.21, Toxics /Hazardous Materials	EIS/EIR
CFR Title 23 Part 772	Section 3.23, Noise and Vibration	EIS/EIR
<b>Tribal Plans and Policies</b>		
Hoop Valley Tribe Water Quality Control Plan	Section 3.2, Water Quality and Section 3.4, Algae	EIS/EIR, Water Quality Permit

Key:

CFR = Code of Federal Regulations

CWA = Clean Water Act

EIS/EIR = Environmental Impact Statement/Environmental Impact Report

NPDES = National Pollutant Discharge Elimination System

SHPO = State Historic Preservation Office

USC = United States Code

**Table 6-2. California State Statutes and Regulations**

<b>Statute</b>	<b>Section with Description</b>	<b>Relevant Permits and Processes</b>
California Coastal Management Act	Section 3.2 Water Quality, Section 3.3 Aquatic Resources, Section 3.4, Algae	Consistency Determination
California Endangered Species Act	Section 3.3, Aquatic Resources, Section 3.5, Terrestrial Resources	EIS/EIR, Fish and Game Code Section 2080.1 Consistency Determination or Fish and Game Code Section 2081 Incidental Take Permit
CFG Code Section 3511 Fully Protected Birds	Section 3.5, Terrestrial Resources	EIS/EIR, CEQA Findings
CFG Code Section 3503 prohibits the killing of birds and/or the destruction of bird nests	Section 3.5, Terrestrial Resources	EIS/EIR, CEQA Findings
CFG Code Section 3503.5 prohibition on the killing of raptor species and/or the destruction of raptor nests.	Section 3.5, Terrestrial Resources	EIS/EIR, CEQA Findings
CFG Code Section 5515 Fully Protected Fish	Section 3.3, Aquatic Resources,	EIS/EIR, CEQA Findings
CFG Code, Section 1600 et seq., Streambed Alterations	Section 3.3, Aquatic Resources, Section 3.5, Terrestrial Resources	EIS/EIR, Fish and Game Code Section 1602 Streambed Alteration Agreement
North Coast Regional Basin Plan	Section 3.2, Water Quality and Section 3.4, Algae	EIS/EIR, CWA Section 401 Water Quality Certification and CWA 402 NPDES Permit
California Porter-Cologne Water Quality Act	Section 3.2, Water Quality and Section 3.4, Algae	EIS/EIR, CWA Section 401 Water Quality Certification and CWA 402 NPDES Permit
California Wild and Scenic Rivers Act	Section 3.19, Scenic Quality and Section 3.20, Recreation	Fish and Game Code Section 1602 Streambed Alteration Agreement
California Ocean Plan	Section 3.2, Water Quality and Section 3.4, Algae	EIS/EIR
California Fish and Game Code, Section 3500-3705, Migratory Bird Protection	Section 3.5, Terrestrial Resources	EIS/EIR
California Department of Water Resources, Bulletin 118	Section 3.7, Groundwater	EIS/EIR
California Water Code, Sections 10750, 10753.7, 1702, 1706, 1727, 1736, 1810	Section 3.7, Groundwater	EIS/EIR
Groundwater Management Act	Section 3.7, Groundwater	EIS/EIR
Klamath Basin Compact	Section 3.8, Water Supply/Water Rights, Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
California Clean Air Act	Section 3.9, Air Quality	EIS/EIR
California Executive Order S-3-05	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR

**Table 6-2. California State Statutes and Regulations**

<b>Statute</b>	<b>Section with Description</b>	<b>Relevant Permits and Processes</b>
California Assembly Bill 32	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR
California Executive Order S-13-8	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR
California Executive Order S-14-08	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR
California Executive Order S-21-09	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR
California Environmental Quality Act, Guidelines Section 15064.4	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR
California Government Code Section 65040.12(e)	Section 3.16, Environmental Justice	EIS/EIR
California Government Code Section 6596.2	Section 3.21, Toxics/Hazardous Materials	EIS/EIR
California Hazardous Waste Control Law, California Health and Safety Code, Division 20, Chapter 6.5	Section 3.21, Toxics/Hazardous Materials	EIS/EIR
Carpenter-Presley-Tanner Hazardous Substances Account Act, California Health and Safety Code, Division 10, Chapter 6.8	Section 3.21, Toxics/Hazardous Materials	EIS/EIR
Unified Hazardous Waste and Hazardous Materials Management Regulatory Program	Section 3.21, Toxics/Hazardous Materials	EIS/EIR
California Land Conservation Act	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
California Farmland Mapping and Monitoring Program	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
California Code of Regulations Title 14 Chapter 3 Minimum Standards for Solid Waste Handling and Disposal	Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste, and Power	EIS/EIR

Key:

CEQA = California Environmental Quality Act

CFG = California Fish and Game

CWA = Clean Water Act

EIS/EIR = Environmental Impact Statement/Environmental Impact Report

NPDES = National Pollutant Discharge Elimination System

**Table 6-3. Oregon State Statutes and Regulations**

<b>Statute</b>	<b>Section with Description</b>	<b>Relevant Permits and Processes</b>
Oregon Endangered Species Act	Section 3.3, Aquatic Resources, Section 3.5, Terrestrial Resources	EIS/EIR, Incidental Take Permit
Oregon Removal-Fill Law	Section 3.3, Aquatic Resources, Section 3.5, Terrestrial Resources	EIS/EIR, Individual Removal-Fill Permit
Oregon Statewide Planning Program	Section 3.3, Aquatic Resources	EIS/EIR
Oregon Administrative Rules for Water Pollution Control	Section 3.2, Water Quality	EIS/EIR, CWA 401 Water Quality Certification, CWA 402 Permit
ORS 2009, Chapters 536 – 541, 448.271	Section 3.7, Groundwater	EIS/EIR
Oregon Water Laws, Title 45, Chapters 536-558	Section 3.8, Water Supply/ Water Rights	EIS/EIR
Oregon House Bill 3543 Global Warming Actions	Section 3.10 Greenhouse Gases/Global Climate Change	EIS/EIR
ORS, Chapter 308 Assessment of Property for Taxation	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
Oregon Senate Bill 420 Environmental Justice	Section 3.16, Environmental Justice	EIS/EIR
Oregon Administrative Rules 340, Division 94 Solid Waste: Municipal Solid Waste Landfills	Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste, and Power	EIS/EIR
Oregon Parks and Recreation Department, Klamath River Scenic Waterway Rules	Section 3.19, Scenic Resources, Section 3.20, Recreation	EIS/EIR, Notification of Intent
Solid Waste Management, ORS 459	Section 3.21, Toxics/ Hazardous Materials	EIS/EIR
Solid Waste Management, OAR 340-093	Section 3.21, Toxics/ Hazardous Materials	EIS/EIR
Hazardous Waste and Hazardous Materials, ORS 465 -466, OAR 340-100	Section 3.21, Toxics/ Hazardous Materials	EIS/EIR

## Key:

CWA = Clean Water Act

EIS/EIR = Environmental Impact Statement/Environmental Impact Report

OAR = Oregon Administrative Rule

ORS = Oregon Revised Statutes

**Table 6-4. Local Plans and Policies**

Statute	Section with Description	Relevant Permits and Processes
Siskiyou County General Plan	Section 3.5, Terrestrial Resources, Section 3.9, Air Quality, Section 3.11, Geology, Soils, and Geologic Hazards, Section 3.14, Land Use, Agricultural and Forest Resources, Section 3.19, Scenic Resources, Section 3.23, Noise and Vibration	EIS/EIR, Maximum Allowable Noise Limits, Potential Air Quality Certification for generators and other temporary stationary sources
Siskiyou County Land Development Code, Chapter 13	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
Siskiyou County Source Reduction and Recycling Element	Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste, and Power	EIS/EIR
Humboldt County General Plan	Section 3.5, Terrestrial Resources, Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
Del Norte County General Plan	Section 3.5, Terrestrial Resources	EIS/EIR
Klamath County Comprehensive Plan	Section 3.5, Terrestrial Resources, Section 3.14, Land Use, Agricultural and Forest Resources, Section 3.19, Scenic Resources	EIS/EIR
Klamath County Land Development Code, Article 59	Section 3.6, Flood Hydrology	EIS/EIR
Klamath County Land Development Code, Chapter 70	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
Klamath County Solid Waste Management Plan	Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste, and Power	EIS/EIR
Record of Decision and Resource Management Plan Klamath Falls Resource Area (December 2008)	The RMP guides the BLM's management of the area according to ecological, economic, social, and managerial principles.	EIS/EIR
Klamath National Forest Land and Resource Management Plan	The plan guides USFS management of the forest (including recreation goals) and allocates each Wild and Scenic Rivers -designated segment on the Klamath, Scott, and Salmon Rivers within its planning boundary to a management area according to its classification.	EIS/EIR

**Table 6-4. Local Plans and Policies**

Statute	Section with Description	Relevant Permits and Processes
Redding RMP – covering the Mallard Cove Recreation Area at Copco 1 Reservoir and several parcels crossed by transmission lines at Copco Road and Iron Gate Reservoir.	The RMP focuses on four primary issues: land tenure adjustment, recreation management, access, and forest management (FERC 2007). Recreation opportunities in the Klamath Management Area identified in the RMP include fishing, whitewater boating, hunting, and off-highway vehicle use (BLM 1992)	EIS/EIR
Six Rivers National Forest Land and Resource Management Plan	The plan guides USFS management of the forest (including recreation goals).	EIS/EIR
Siskiyou County Zoning Ordinance, Article 54 & Chapter 10	Section 3.6, Flood Hydrology	EIS/EIR
Siskiyou County Zoning Ordinance, Chapter 19, Title 3	Section 3.7, Groundwater	EIS/EIR
Modoc County General Plan	Section 3.14, Land Use, Agricultural and Forest Resources	EIS/EIR
City of Klamath Falls Comprehensive Plan	Section 3.19, Scenic Resources	EIS/EIR
City of Klamath Falls Community Development Ordinance	Section 3.19, Scenic Resources	EIS/EIR
City of Klamath Falls Parks, Recreation, and Open Space Master Plan	Section 3.19, Scenic Resources and Section 3.20, Recreation	EIS/EIR
City of Yreka General Plan	Section 3.14, Land Use, Agricultural and Forest Resources, Section 3.18, Public Health and Safety, Utilities and Public Services, Solid Waste, and Power	EIS/EIR

Key:

BLM = Bureau of Land Management

EIS/EIR = Environmental Impact Statement/Environmental Impact Report

FERC = Federal Energy Regulatory Commission

USFS = United States Forest Service

## **6.2 References**

Bureau of Land Management [BLM]. 1992. Proposed Redding Resource Management Plan and Final Environmental Impact Statement. Prepared By Redding Resource Area, July 1992.

Federal Energy Regulatory Commission (FERC). 2007. Final Environmental Impact Statement for Hydropower License, Klamath Hydroelectric Project, FERC Project No. 2082-027, FERC/EIS-0201F. Washington, DC, Federal Energy Regulatory Commission, Office of Energy Projects, Division of Hydropower Licensing.

# **Chapter 7**

## **Consultation and Coordination, Document Availability, and Distribution List**

This chapter documents the consultation and coordination activities that have occurred during the development of this Klamath Facilities Removal Environmental Impact Statement/ Environmental Impact Report (EIS/EIR). This chapter states where the draft EIS/EIR can be viewed and provides information about recipients receiving a copy of the draft EIS/EIR or a notice of its availability.

### **7.1 Public Involvement**

Public involvement is an essential component of the environmental compliance process. The National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) require public participation during the preparation of EISs and EIRs. The following sections describe public involvement opportunities that have occurred or will occur for this EIS/EIR.

#### **7.1.1 Public Scoping**

In June 2010, the Department of the Interior (DOI) published a Notice of Intent in the Federal Register (Vol.75, No. 133, Monday June 14, 2010) and the California Department of Fish and Game (CDFG) posted a Notice of Preparation with the State Clearinghouse (# 2010062060), announcing the preparation of an EIS/EIR and inviting the public to attend public meetings and submit comments on the project. The Lead Agencies held seven public scoping meetings in a variety of locations around the Klamath Basin. Written and verbal comments were accepted at each meeting. The Lead Agencies also accepted written comments through mail, e-mail, posted on the website, and fax, throughout the scoping period of June 14, 2010 through July 21, 2010. Approximately 270 written documents (letters, comment cards, e-mails) and 214 verbal statements were received and reviewed. A Scoping Report that summarizes all comments received through July 21, 2010 was published in September 2010 and is available on the project website (<http://klamathrestoration.gov/>).

### **7.2 Agency Coordination**

Development of this EIS/EIR has involved coordination with a variety of federal, state, and local agencies. Table 7-1 provides a list of the participating agencies.

**Table 7-1. EIS/EIR Participating Agencies**

<b>Federal Agency/Entity</b>	<b>State Agency/Entity</b>
<b>DOI – Lead Agency</b>	<b>CDFG – Lead Agency</b>
Bureau of Reclamation	State Water Resources Control Board
Bureau of Indian Affairs	North Coast Regional Water Quality Control Board
Bureau of Land Management	<b>State of Oregon</b>
U.S. Geological Survey	Oregon Department of Environmental Quality
National Park Service	Oregon Water Resources Department
U.S. Fish and Wildlife Service	
<b>U.S. Department of Commerce</b>	
National Oceanic and Atmospheric Administration, Fisheries Service	
<b>U.S. Department of Agriculture</b>	
U.S. Forest Service	
<b>U.S. Environmental Protection Agency</b>	

Key:  
DOI = Department of Interior  
CDFG = California Department of Fish and Game  
EIS/EIR = Environmental Impact Statement/Environmental Impact Report

### 7.2.1 Cooperating Agencies

Cooperating Agencies are Tribes, federal, state, and local governments (40 CFR Part 1501.6) which have the following:

- Jurisdiction by law, which means authority to approve, veto, or finance all or part of the proposal (40 CFR Part 1508.15); or
- Special expertise, for example, statutory responsibility, agency mission, or related program experience with respect to the proposal or reasonable alternatives (40 CFR Part 1508.26).

Agencies were invited by DOI to be Cooperating Agencies for this EIS/EIR. Table 7-2 presents the list of agencies who were invited as well as those who have accepted the invitation at the time of this document.

Cooperating Agencies help to identify issues that need to be addressed in the EIS/EIR, arrange for data collection, analyze data, provide input on alternatives development, and evaluate the impacts of implementing the alternatives. The CEQA Lead Agency is not required to be a Cooperating Agency, and California state agencies do not have to become a Cooperating Agency to fulfill their responsibilities under CEQA.

**Table 7-2. Cooperating Agencies**

<b>Type of Agency</b>	<b>Agencies Invited by DOI</b>	<b>Agencies Who Accepted</b>
Tribes	Hoopa Valley Tribe Karuk Tribe The Klamath Tribes Quartz Valley Indian Reservation Resighini Rancheria Yurok Tribe	Karuk Tribe The Klamath Tribes Quartz Valley Indian Reservation Resighini Rancheria Yurok Tribe Hoopa Valley Tribe
County & Local Governments	City of Yreka (CA) Curry County (OR) Del Norte County (CA) Humboldt County (CA) Jackson County (OR) Klamath County (OR) Modoc County (CA) Trinity County (CA) Siskiyou County (CA) Siskiyou County Air Pollution Control District (CA)	Humboldt County (CA) Trinity County (CA)
State of California Agencies	California State Water Resources Control Board North Coast Regional Water Quality Control Board California Coastal Commission California State Lands Commission North Coast Unified Air Quality Management District California Department of Water Resources Division of Safety of Dams	California State Water Resources Control Board North Coast Regional Water Quality Control Board
State of Oregon Agencies	Oregon Department of Environmental Quality Oregon Department of State Lands Oregon Department of Fish and Wildlife Oregon Water Resources Department	Oregon Department of Environmental Quality Oregon Department of State Lands Oregon Department of Fish and Wildlife Oregon Water Resources Department
Federal Agencies	U.S. Environmental Protection Agency - Region 9 - Region 10 NOAA Fisheries Service (Southwest Region) U.S. Geological Survey U.S. Forest Service Bureau of Land Management Bureau of Indian Affairs - Pacific Region - Northwest Region Army Corp of Engineers U.S. Fish and Wildlife Service National Park Service (Pacific West Region)	U.S. Environmental Protection Agency <sup>1</sup> NOAA Fisheries Service (Southwest Region) U.S. Geological Survey U.S. Forest Service Bureau of Land Management Bureau of Indian Affairs <sup>1</sup> U.S. Fish and Wildlife Service

Notes:

<sup>1</sup> Although more than one region has jurisdiction for the project area, both U.S. EPA Regions 9 and 10 and Bureau of Indian Affairs Pacific and Northwest Regions are each participating jointly as one Cooperating Agency.

Abbreviations:

NOAA = National Oceanic and Atmospheric Administration

The Cooperating Agencies participated in three meetings in 2010 and six meetings in 2011 as well as receiving several email updates to share information and provide input in the environmental compliance process, as described in Table 7-3.

**Table 7-3. Cooperating Agency Meeting Updates**

Date	Location
June, 2010	Ashland, OR
September, 2010	Conference Call
November, 2010	Conference Call
May 18, 2011	Conference Call
June 1, 2011	Conference Call
June 6, 2011	Conference Call
June 15, 2011	Conference Call
June 22, 2011	Conference Call
June 28, 2011	Redding, CA

In addition to these meetings, the Lead Agencies were assisted by the Yurok Tribe, North Coast Regional Water Quality Control Board (NCWQCB), Oregon Department of Environmental Quality (ODEQ), Oregon Department of Fish and Wildlife (ODFW), and Oregon Water Resources Department (OWRD) with technical and policy review of draft sections of the EIS/EIR.

Siskiyou County (CA) and Klamath County (OR) were invited to participate as Cooperating Agencies for this EIS/EIR; however, these entities have not made a formal commitment at the time of this document. The Lead Agencies have responded to multiple requests for meetings to discuss concerns regarding participation, as shown in Table 7-4.

**Table 7-4. Meetings with Potential Cooperating Agencies or Non-Government Groups**

Date	Entity	Meeting Details
April 1, 2010	Siskiyou County	Board of Supervisors Meeting, Yreka, CA
July 9, 2010	Klamath County	Board of Commissioners Special Meeting, Klamath Falls, OR
July 16, 2010	Hoopa Valley Tribe <sup>1</sup>	Tribal Council Chambers Informal Briefing, Hoopa, CA
September 3, 2010	Hoopa Valley Tribe <sup>1</sup>	Conference Call
September, 2010	Siskiyou County	Siskiyou County Assessor's Office - Mike Mallory
September, 2010	Siskiyou County	Siskiyou County Assessor's Office - Elizabeth Giacomelli
September, 2010	Private Group	Michele Duchi – Lake Shastina Real Estate Center
October, 2010	Siskiyou County	Siskiyou County Assessor's Office - Dan Weale
October, 2010	Siskiyou County	Siskiyou County Public Health & Community Development - Wendy Lucky
October, 2010	Siskiyou County	Siskiyou County Planning Department – Roland Hickel
October, 2010	Private Entity	Ray Singleton – Siskiyou County Broker/Appraiser
October, 2010	Private Entity	Kathy Hayden – Siskiyou County Agent
October, 2010	Private Group	Sharon Grace – Siskiyou County Association of Realtors
February 8, 2011	Siskiyou County	Board of Supervisors Meeting, Yreka, CA
March 3, 2011	Hoopa Valley Tribe <sup>1</sup>	Bureau of Land Management District Office, Medford, OR

1: Hoopa Valley Tribe became a Cooperating Agency on March 30, 2011.

### **7.2.2 Reviewing Agencies**

The following California state agencies will review the EIS/EIR pursuant to CEQA (State Clearinghouse No. 2010062060):

- California Coastal Commission (CCC)
- California Air Resources Board (CARB)
- Department of Parks and Recreation (California State Parks)
- California Department of Water Resources (CDWR)
- Native American Heritage Commission (NAHC)
- California State Lands Commission (State Lands Commission)
- California Department of Transportation (Caltrans), Districts 1 and 2
- State Water Resources Control Board (SWRCB)
- Regional Water Quality Control Board, Regions 1 and 5
- Integrated Waste Management Board (IWMB)
- California Environmental Protection Agency (CalEPA)
- California Department of Boating and Waterways (CDBW)

### **7.3 Government-to-Government Consultation**

On September 16, 2010, the United States through the Bureau of Indian Affairs (BIA) formally requested government-to-government consultation with the six federally recognized Indian Tribes in the project area: The Klamath Tribes, Quartz Valley Indian Reservation, Karuk Tribe, Hoopa Valley Tribe, Resighini Rancheria, and the Yurok Tribe. Government-to-government consultation was for the federal trustee to provide tribes with advance notice of an action contemplated and the potential concerns or impacts that may affect their trust resources, and to give the tribes an opportunity to provide input regarding potential concerns or impacts prior to announcing a decision to the public.

Each tribe defined its preferred methods of consultation, the frequency of interactions, and the topics to be discussed with regard to trust resources. The tribes have contributed information for the ongoing scientific studies; two reports on Indian Trust Assets have been produced by BIA for analysis in the EIS/EIR. Tribes have been provided the opportunity to comment on the cultural resources technical report and the draft EIS/EIR. Tribes acting as Cooperating Agencies for the project have attended the Cooperating Agency meetings and conference calls and have been provided the opportunity to review and comment on the EIS/EIR prior to its release to the public.

Government-to-government consultations were also initiated under Section 106 of the NHPA, see discussion below, to provide the Tribes the opportunity to identify concerns about historic properties, advise on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, articulate views on potential effects on such properties, and participate in the potential resolution of adverse effects. The six federally recognized Indian Tribes in the project area have been invited to be consulting parties under 36 CFR Part 800

While government-to-government consultation is ongoing, Table 7-5 presents a summary of consultations and their subject matter that occurred prior to the release of the Draft EIS/EIR.

**Table 7-5. Tribal Consultations**

<b>Discussion on the Impacts to ITAs of the Current Operations</b>	
September 28, 2010	Yurok Tribe
September 29, 2010	Resighini Rancheria and Karuk Tribe
September 30, 2010	Quartz Valley Indian Reservation
October 4, 2010	The Klamath Tribes
November 8, 2010	Hoopa Valley Tribe
<b>Discussion on the Impacts to ITAs of the Alternatives/Comments on the Background Ethnographic Technical Report</b>	
January 24, 2011	The Klamath Tribes
January 25, 2011	Hoopa Valley Tribe and the Resighini Rancheria
January 26, 2011	Yurok Tribal Council
January 27, 2011	Karuk Tribe and Quartz Valley Indian Reservation
April 4, 2001	The Klamath Tribes
April 5, 2001	Karuk Tribe
April 7, 2001	Resighini Rancheria
<b>Other Tribal Consultations</b>	
April 14, 2011	Hoopa Valley Tribe
May 2, 2011	Hoopa Valley Tribe

## 7.4 Non-Government Organization Coordination

The Lead Agencies have encouraged participation of non-government organizations during the environmental review process. DOI has granted the Shasta Nation and the Shasta Indian Nation consulting party status for the Section 106 process pursuant to 36 CFR §§ 800.2(c)(5), 800.3(f). DOI has consulted with, and will continue to consult with, the Shasta Indian Nation through the Section 106 process, which is described below and in Chapter 3.13, Cultural and Historic Resources.

In addition, through [KlamathRestoration.gov](http://klamathrestoration.gov) and the public engagement plan for the Secretarial Determination, DOI invites organizations and groups to request briefings about the project. See <http://klamathrestoration.gov/keep-me-informed>.

### 7.4.1 Stakeholder Briefings and Technical Workshops

Throughout development of the EIS/EIR and Secretarial Determination scientific studies, the Lead Agencies have held periodic stakeholder briefings and technical workshops that were open to the public. The purpose of the workshops was to gather input, ideas, and information from individual participants for use by the Lead Agencies, and to provide updates on progress, findings, and future plans. Advance notice of briefings and technical workshops was provided on the project website, where meeting materials, if

applicable, were also posted. Table 7-6 presents a list of the stakeholder briefings and technical workshops that occurred prior to release of the Draft EIS/EIR.

The Lead Agencies presented these briefings for interest groups, affected community members, or others as requested. Information presented at briefings for interested stakeholders is posted on the project website.

**Table 7-6. Stakeholder Briefings and Technical Workshops**

<b>Meeting</b>	<b>Date</b>	<b>Location</b>
Stakeholder/Public Workshop	September 28, 2010	Klamath Falls, OR
Stakeholder/Public Workshop	May 6, 2010	Mt. Shasta, CA
Public Information Meeting on Secretarial Determination Science Studies and Technical Report	September 29, 2010	Eureka, CA
Stakeholder/Public Informational Workshop on Water Quality Issues	October 5, 2010	Klamath Falls, OR
Stakeholder/Public Informational Workshop about the fall Chinook salmon production model	October 13, 2010	Yreka, CA
Public Information Meeting on Secretarial Determination Science Studies and Technical Reports	December 9, 2010	Montague, CA (Copco Lake) and Yreka, CA
Public Information Meeting on Secretarial Determination	March 16, 2011	Klamath Falls, OR
Public Information Meeting on Secretarial Determination	June 15, 2011	Orleans, CA

#### **7.4.2 Briefings on Request**

The Klamath Hydroelectric Settlement Agreement (KHSAs) created a Technical Coordination Committee (TCC) of non-federal parties to the KHSAs. Appendix A of the KHSAs describes the process used by the TCC for meetings and conference calls. At the request of the TCC, federal team members working on the Secretarial Determination have been invited to provide periodic updates on the process. Several TCC meetings took place in 2010 and 2011. Meeting dates include:

- July 21, 2010
- Sept 9, 2010
- October 6, 2010
- December 14, 2010
- February 23, 2011

- April 6, 2011
- June 16, 2011

The Lead Agencies are prepared to present briefings to interest groups, communities surrounding the project area, local governments, or others as requested and as resources have permitted.

## **7.5 Endangered Species Act Consultation**

The Federal Endangered Species Act (ESA) provides for the conservation of federally endangered and threatened species and the ecosystems upon which they depend. Section 7 of the ESA requires federal agencies to aid in the conservation of listed species and to ensure that the activities of federal agencies do not jeopardize the continued existence of listed species or adversely modify designated critical habitat. The United States Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries Service) are responsible for administration of the ESA. DOI has initiated informal consultation with NOAA Fisheries Service regarding this project and will prepare a biological assessment to evaluate the potential effects on listed and proposed species and designated and proposed critical habitat.

Informal consultation with NOAA Fisheries Service has been ongoing since the issuance of a notice to prepare an EIS/EIR. On March 4, 2011 a letter from USFWS was received in response to a written request for a list of species that may be present in the action area. No project actions will be implemented until DOI receives biological opinions from NOAA Fisheries Service stating that the project will not jeopardize the continued existence of listed species or adversely modify designated critical habitat.

In addition, compliance with the California ESA may be necessary, depending upon the Dam Removal Entity (DRE).

## **7.6 Consultation under the Magnuson-Stevens Act**

The Magnuson-Stevens Fishery Conservation and Management Act established a management system for national marine and estuarine fishery resources. Pursuant to Section 305(b)(2), all federal agencies are required to consult with NOAA Fisheries Service regarding any action permitted, funded, or undertaken that may adversely affect essential fish habitat. Effects on habitat managed under any relevant Fishery Management Plans must also be considered. This act pertains primarily to habitat used by species caught in commercial fisheries, which may include habitats in the ocean, estuary and river. DOI will consult with NOAA Fisheries Service on the effects of the preferred alternative on essential fish habitat. This consultation will occur in parallel with the ESA consultation (Section 7.5).

## 7.7 Consultation Pursuant to Section 106 of the NHPA

The National Historic Preservation Act (NHPA) is the primary federal legislation governing preservation of cultural and historical resources in the United States. The NHPA established a national historic preservation program which encourages the identification and protection of cultural and historic resources. Section 106 of the NHPA is a provision that requires federal agencies to take into account the effects of their undertakings on historic properties and they must afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment with regard to the undertaking. Section 106 is implemented by regulations found at 36 CFR Part 800 that guide the consultation process. DOI has elected to integrate compliance with Section 106 of the NHPA through the NEPA process as allowed under 36 CFR Part 800.8(c). DOI has notified the Advisory Council, the California and Oregon State Historical Preservation Office's (SHPO), the federally recognized Indian Tribes identified above, and the two Indian organizations. Consulting parties include federal agencies involved in the undertaking; the ACHP; SHPO; federally recognized Indian Tribes; local governments; and individuals with a demonstrated interest in the undertaking (including non-federally recognized tribal organizations and members of the public).

On November 23, 2010, DOI, through the Bureau of Reclamation (Reclamation) initiated formal Section 106 consultation with California and Oregon SHPOs describing DOI's proposal to remove the four PacifiCorp dams. On June 20, 2011, DOI contacted the California and Oregon SHPOs to discuss DOI's intention of using the NEPA process to comply with the requirements of Section 106 of the NHPA, and sent an official notification letter to the California and Oregon SHPOs on June 23, 2011. DOI also sent the California and Oregon SHPOs a copy of the Cooperating Agency Draft of the cultural resources sections of the Draft EIS/EIR and the draft technical cultural resources report for their internal review.

On March 29, 2011, DOI sought the advice of the ACHP regarding how to comply with Section 106 of the NHPA for the decision-making process to evaluate the proposal to remove the four PacifiCorp dams in the Klamath River basin. DOI had a second conversation with the ACHP to outline an approach to comply with Section 106 of the NHPA on April 8, 2011. On June 24, 2011, DOI officially notified the ACHP of its intention to use the NEPA process to comply with the requirements of Section 106 of the NHPA. In that letter, DOI requested that the ACHP formally participate in the Section 106 consultation process due to the complexities of the proposed action which may lead to important questions of policy or interpretation of the NHPA Section 106 regulations and the unique relationships with Indian Tribes which may present issues of concern to those tribes.

On October 19, 2010, the Reclamation sent a letter to the federally recognized Tribes and two non-federally recognized Indian organizations with demonstrated interests in the project area for the KHSA and EIS/EIR initiating Section 106 of the NHPA, and in particular, seeking information regarding traditional cultural properties within the area potentially affected by the proposed removal of the four PacifiCorp dams. Opportunities

to comment on historic properties have also been provided during the public scoping and technical meetings, during government-to-government meetings and through other contacts, and during public reviews of the document.

On June 15, 2011, DOI hosted a conference call with the Cooperating Agencies, which includes all of the federally-recognized Tribes, to discuss the cultural and tribal resources sections of the Draft EIS/EIR and the draft technical cultural resources report, and to describe DOI's approach to meeting the requirements of Section 106 of the NHPA. During this meeting, DOI answered general questions about the content of cultural and tribal resources sections of the Cooperating Agency Draft of the Draft EIS/EIR and about DOI's Section 106 process. On June 24, 2011, DOI sent an official letter notifying the federally recognized Tribes and two non-federally recognized Indian organizations of its intention to use the NEPA process to comply with the requirements of Section 106 of the NHPA.

The Section 106 consultation process among DOI, the California and Oregon SHPOs, the federally recognized Tribes and two non-federally recognized Indian organizations, and any other interested parties will be on-going throughout the EIS/EIR process. The consultation effort with all consulting parties will meet the standards set forth in 36 C.F.R. § 800.8(c)(1)-(4), including additional opportunities to comment on the identification of historic properties, the assessment of effects on such properties, and develop proposed measures that might avoid, minimize, or mitigate any adverse effects on historic properties.

## **7.8 Environmental Justice – E.O. 12898**

The 1994 Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Population*, requires all federal agencies to identify and address “disproportionately high and adverse human health or environmental effects” of programs on minority and low-income populations (United States Environmental Protection Agency, 1994).

As noted in Section 7.3, the Lead Agencies have initiated government-to-government consultation with Tribes that may be affected by the project, and have invited all six federally recognized Tribes in the basin to act as Cooperating Agencies for the EIS/EIR. The Lead Agencies held scoping meetings for the project at the Karuk Tribe Community Room in Orleans, California, and the Chiloquin Community Center, in Chiloquin, Oregon. The Tribes will have the opportunity to comment on the Draft EIS/EIR and participate in additional public meetings associated with the release of the Draft EIS/EIR. Upon the Tribes' request, the Lead Agencies held many separate meetings and calls with Tribes during the preparation of the EIS/EIR to address concerns, to receive input and to share information from tribal agencies and program personnel. Information exchange occurred frequently on technical aspects of flows, biological impacts, water quality,

economic impacts, dam deconstruction design, sediment transport and cultural resource protection.

In addition to consultation with the Tribes, the Lead Agencies made efforts to reach other low income or minority communities. These efforts included mailed notifications to property owners along the river and the placement of documents and other information in libraries and on the public website. The Lead Agencies held seven public scoping meetings in July 2010 throughout the Klamath Basin. Notifications for these meeting were posted on the website and in area newspapers. Agency members were available for media interviews during this process.

Section 3.16, Environmental Justice, of this EIS/EIR provides further discussion on Environmental Justice issues.

## **7.9 Document Availability**

This Draft EIS/EIR was made available for review and comment for 60 days with the filing of the Notice of Availability of the EIS on September 22, 2011 with the U.S. Environmental Protection Agency (USEPA) and the Notice of Completion of the EIR with the California State Clearinghouse. The purpose for public review of the Draft EIS/EIR is to receive comments from interested parties on its completeness and adequacy in disclosing the environmental effects of the proposed project. Following the close of the Draft EIS/EIR public review period, the Lead Agencies will prepare and publish a second document containing comments received on the Draft EIS/EIR and responses to the significant environmental points raised in those comments. Together, the Draft EIS/EIR and the responses to comments as well as any changes to the EIS/EIR made in light of comments received will constitute the Final EIS/EIR. The DOI is responsible for adopting the EIS as adequate in compliance with the NEPA and CDFG is responsible for certifying the EIR as adequate in compliance with CEQA. After the Final EIS/EIR is complete, the Secretary will consider the EIS/EIR among other information when making his decision whether removal of the dams will facilitate fish recovery and is in the best interest of the people of the United States. If the decision is affirmative, DOI will complete a record of decision according to NEPA. In the event of an affirmative Secretarial Determination, the States of California and Oregon will consider the EIS/EIR when determining if they concur with the Secretary's Determination. The States of California and Oregon will have 60 days after an affirmative Secretarial Determination to concur with that determination.

Hard copies of this document are available to view at the libraries and Federal and State Agency offices in the Klamath Basin. An electronic version of the document can be viewed on the project website listed in Section 7.9.2. Hard copies are also available for purchase, at the expense of the requestor, online via the project website listed in Section 7.9.2. To request an electronic copy on CD of the Draft EIS/EIR (accompanied by a hard copy of the Executive Summary), please contact representatives of the Lead Agencies as follows:

**Elizabeth Vasquez**  
Bureau of Reclamation  
2800 Cottage Way  
Sacramento, CA 95825  
**Phone:** (916) 978-5040  
**Email:** [klamathsd@usbr.gov](mailto:klamathsd@usbr.gov)  
**Fax:** (916) 978-5055

**Gordon Leppig**  
California Department of Fish and Game  
619 Second Street  
Eureka, CA 95501  
**Phone:** (707) 441-2062  
**Email:** [ksdcomments@dfg.ca.gov](mailto:ksdcomments@dfg.ca.gov)  
**Fax:** (707) 441-2021

### 7.9.1 Libraries and Federal and State Agencies

Hard copies of the Draft EIS/EIR are available for public viewing at the libraries and Federal and State Agencies as presented in Table 7-7 and Table 7-8.

**Table 7-7. Libraries with Draft EIS/EIR Available**

State	County	Library	Address	
Oregon	Klamath	Main Library	126 South 3 <sup>rd</sup> Street, Klamath Falls, OR 97601	
		Chiloquin Branch Library	140 South 1 <sup>st</sup> Street, Chiloquin, OR 97264	
		Keno Branch Library	15555 Hwy 66 Unit 8, Keno, OR 97627	
		Merrill Branch Library	365 Front Street, Merrill, OR 97633	
		South Suburban Branch Library	3706 South 6 <sup>th</sup> Street, Klamath Falls, OR 97603	
		Sprague River Branch Library	23402 Sprague River Hwy, Sprague River, OR 97639	
		Bonanza Branch Library	31703 Hwy 70, Bonanza, OR 97623	
	Jackson	Ashland Branch Library	410 Siskiyou Boulevard, Ashland, OR 97520	
	Medford Branch Library	205 S. Central Avenue, Medford, OR 97501		
California	Siskiyou	Yreka Branch Library	719 4 <sup>th</sup> Street, Yreka, CA 96097	
		Butte Valley Branch Library	800 West 3 <sup>rd</sup> Street, Dorris, CA 96023	
		Etna Branch Library	130 Main Street, Etna, CA 96027	
		Happy Camp Branch Library	143 Buckhorn Road, Happy Camp, CA 96039	
		Montague Branch Library	230 South 13 <sup>th</sup> Street, Montague, CA 96064	
		Mt. Shasta Branch Library	515 East Alma St., Mt Shasta, CA 96067	
		Tulelake Branch Library	451 Main St, Tulelake, CA 96134	
		Fort Jones Branch Library	11960 East Street, PO Box 632, Fort Jones, CA 96032	
		Dunsmuir Branch Library	5714 Dunsmuir Avenue, Dunsmuir, CA 96025	
		Weed Branch Library	780 South Davis Avenue, Weed, CA 96094	
		Scott Bar Branch Library	Post Office, Scott Bar, CA 96032	
		Del Norte	Main Branch	190 Price Mall, Crescent City, CA 95531
		Humboldt	Kim Yerton Memorial Library	Intersection of Loop Road and Orchard Street, Hoopa, CA 95546
	Willow Creek Branch Library		Intersection of Hwy 299 and Hwy 96, Willow Creek, CA 95573	
	Arcata Branch Library		500 7 <sup>th</sup> Street, Arcata, CA 95521	
		Eureka Branch Library	1313 3 <sup>rd</sup> Street, Eureka, CA 95501	

**Table 7-8. Federal and State Agencies with Draft EIS/EIR Available**

	<b>Agency</b>	<b>Address</b>
Federal Agencies	Bureau of Reclamation	6600 Washburn Way, Klamath Falls OR 97603-9365
	U.S. Fish and Wildlife Service	1936 California Avenue, Klamath Falls, Oregon 97601
		1655 Heindon Road, Arcata, CA 95521-5582
		4009 Hill Road, Tulelake, CA. 96134
		1829 S. Oregon Street, Yreka, CA 96037
	U.S. Forest Service	1312 Fairlane Road, Yreka, CA. 96097
		63822 Highway 96, Happy Camp, CA 96039
	Bureau of Land Management	2795 Anderson Avenue, Bldg. #25, Klamath Falls, OR 97603
1695 Heindon Road, Arcata, CA 95521-4573		
State Agencies	California Department of Fish and Game	619 Second Street, Eureka, CA 95501
		601 Locust Street, Redding, CA 96001
		1625 South Main Street, Yreka, CA 96097

### 7.9.2 Website

An electronic version of this Draft EIS/EIR is available on the project website:

<http://klamathrestoration.gov/>

## 7.10 Distribution List

Elected officials and representatives, government agencies, private organizations, businesses, and individual members of the public have received a copy of this Draft EIS/EIR or a notification of document availability. This section presents the distribution list of the Draft EIS/EIR.

### 7.10.1 Elected Officials, Representatives and Government Agencies

Table 7-9 presents the elected officials, representatives and government agencies that have received a copy of this Draft EIS/EIR or a notification of document availability.

**Table 7-9. EIS/EIR Distribution List**

<b>Elected Officials and Representatives</b>		
Federal	United States Senate	Barbara Boxer, CA
		Diane Feinstein, CA
		Jeff Merkley, OR
		Ron Wyden, OR
	House of Representatives	Michael Thompson, 1 <sup>st</sup> District, CA
		Walter Herger, 2 <sup>nd</sup> District, CA
		David Wu, 1 <sup>st</sup> District, OR
Greg Walden, 2 <sup>nd</sup> District, OR		
California	Governor	Jerry Brown
	Senate	Doug LaMalfa, 4 <sup>th</sup> District
		Ted Gaines, 1 <sup>st</sup> District
		Noreen Evans, 2 <sup>nd</sup> District
	Assembly	Wesley Chesbro, 1 <sup>st</sup> District
		Jim Neilson, 2 <sup>nd</sup> District
Oregon	Governor	John Kitzhaber
	Senate	Jeff Kruse, 1 <sup>st</sup> District
		Jason Atkinson, 2 <sup>nd</sup> District
		Alan Bates, 3 <sup>rd</sup> District
		Doug Whitsett, 28 <sup>th</sup> District
	House of Representatives	Wayne Krieger, 1 <sup>st</sup> District
		Wally Hicks, 3 <sup>rd</sup> District
		Peter Buckley, 5 <sup>th</sup> District
		Bill Garrard, 56 <sup>th</sup> District
<b>Government Agencies</b>		
Federal	Army Corps of Engineers	
	Department of Agriculture	
	Department of Energy	
	Department of Transportation	
	Federal Energy Regulatory Commission	
	National Oceanic and Atmospheric Administration	
	Environmental Protection Agency	
	U.S. Forest Service	
	Klamath River Compact Commission	
Tribes	Hoopa Valley Tribe	
	Karuk Tribe	
	The Klamath Tribes	
	Quartz Valley Indian Reservation	
	Resighini Rancheria	
	Yurok Tribe	
	Shasta Indian Nation	

**Table 7-9. EIS/EIR Distribution List**

State	California	California Coastal Commission
		California Air Resources Board
		California Department of Boating and Waterways
		California Department of Forestry and Fire Protection
		California Department of Toxic Substances Control
		California Department of Transportation
		California Department of Water Resources
		California Energy Commission
		California Native American Heritage Commission
		California Public Utilities Commission
		State Water Resources Control Board
		California State Lands Commission
		California State Office of Historic Preservation
		California Department of Parks and Recreation
		California Department of Conservation
	California Department of Food and Agriculture	
	Oregon	Oregon Department of Fish and Wildlife
		Oregon Water Resources Department
		Oregon Department of Environmental Quality
Oregon Division of State Lands		
County	California	Del Norte County
		Humboldt County
		Mendocino County
		Modoc County
		Siskiyou County
	Oregon	Curry County
		Jackson County
		Klamath County
City	California	Arcata
		Crescent City
		Eureka
		Montague
		Mount Shasta
		Weed
		Yreka
		Oregon
	Brookings	
	Klamath Falls	
	Medford	

**7.10.2 Businesses, Organizations, and Individual Members of the Public**

The Lead Agencies continue to update an extensive project mailing list with over 4,000 businesses, organizations, and property owners along the Klamath River, and members of the public. Those who have attended meetings, provided comments, or expressed an interest in the project have been added to the mailing list. All individuals on the mailing list have received either a copy of the Draft EIS/EIR or notification of its release. The mailing list will continue to be updated throughout the project.

## 7.11 References

U.S. Environmental Protection Agency (USEPA). 1994. Executive Order No. 12898, 59 CFR Part 7629, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Accessed: February 11, 1994. Available at: [http://www.epa.gov/environmentaljustice/resources/policy/exec\\_order\\_12898.pdf](http://www.epa.gov/environmentaljustice/resources/policy/exec_order_12898.pdf)

# Chapter 8

## List of Preparers and Contributors

The following is a list of preparers who contributed to the development of this Draft Environmental Impact Statement/Environmental Impact Report.

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Elizabeth Vasquez	Bureau of Reclamation, NEPA Document Lead

Key:

NEPA = National Environmental Policy Act

NHPA = National Historic Preservation Act

NOAA = National Oceanic and Atmospheric Administration

**California Department of Fish and Game**

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Larry Hanson	Reviewer of Biology, Fisheries
Morgan Knechtle	Reviewer of Biology, Fisheries
Karen Kovacs	Reviewer of Biology – Terrestrial Resources, Public Health and Safety, Aesthetics, Traffic and Transportation, Recreation, Land Use/Real Estate
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Mary Olswang	Reviewer of Biology, Fisheries
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Mark Stopher	CEQA compliance and technical review
Jane Vorpagel	Reviewer of Water Quality, Water Rights, Air Quality, Toxic/Hazardous Materials, Solid Waste, Algae

Key:  
CEQA = California Environmental Quality Act

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Key:

CEQA = California Environmental Quality Act

GIS = Geographic Information Systems

NEPA = National Environmental Policy Act

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<b>Preparers</b>	<b>Degree(s) / Years of Experience</b>	<b>Experience and Expertise</b>	<b>Role in Preparation</b>
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# Chapter 9

## Glossary

abeyance	A state of temporary suspension.
abutment	Structural element that ties a dam into the existing ground.
acclimation (of fish)	The process of a fish adjusting to change in its environment, allowing it to survive changes in temperature, water and food availability, and other stresses.
acre-foot	The amount of water required to cover 1 acre to a depth of 1 foot. One acre-foot equals 326,851 gallons or 43,560 cubic feet. This volume measurement is used to describe a quantity of storage in a reservoir.
adfluvial	Fish who live in lakes and migrate into rivers or stream to spawn.
adjudication	The final judgment in a legal proceeding; the act of pronouncing judgment based on the evidence presented.
Affirmative Determination	A determination by the Secretary of the Interior under Section 3 of the Klamath Hydroelectric Settlement Agreement that facilities removal should proceed.
alluvial	Deposition of sediment over a long period of time by a river; an alluvial layer; pertaining to the soil deposited by a stream.
ammocoete	Juvenile lamprey.
anadromous	A type of fish that hatch in freshwater, migrate to the ocean, mature there, and return to freshwater to spawn. Salmon and steelhead are examples.
anoxic conditions	Conditions with a deficiency of oxygen.

anthropogenic	Made by people or resulting from human activities.
antidegradation policy	A policy designed to prevent deterioration of existing levels of good water quality.
appropriations	Funds set aside (as by a legislature) for a specific purpose.
attraction flows	Drawing fish to dam fishways or spillways through the use of water flows.
bedload sediment	Particles carried along the bottom of a river or stream, rather than in the current.
beneficial use	The uses of a water resource that are protected by state water quality standards. Beneficial uses include human consumption, aquatic life, recreation, and fish and wildlife habitat.
benthic	The ecological region at the lowest level of a body of water, including the sediment surface and some sub-surface layers. Organisms living in this zone are called benthos or benthic organisms.
berm	A mound or linear embankment of fill material, typically earth fill.
best management practices (BMPs)	Physical, structural or managerial practices that control soil loss and reduce water quality pollution caused by nutrients, animal wastes, toxics, and sediment.
bioaccumulation	The process by which substances accumulate in the tissues of living organisms.
biochemical oxygen demand (BOD)	The amount of oxygen needed by aerobic microorganisms to decompose all the organic matter in a sample of water; it is used as a measure of pollution.
biological opinion	The product of Endangered Species Act consultation, a document stating the opinion of the United State Fish and Wildlife Service or National Marine Fisheries Service on whether or not a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

blue-green algae	Algae that can cause problems in aquatic environments because some produce chemicals that are toxic to animals, including humans.
bulk bag	A container made from abrasion resistant fabric designed to contain loose material such as seeds, or in this case sand and gravel, and used for work area isolation.
camas	A type of lily used as a food source by Native Americans.
cession (of property)	The assignment of property to another entity.
chlorophyll-a	A photosynthetic pigment that serves as a surrogate measure for abundance of algae.
cofferdam	A temporary enclosure designed to be watertight or minimize water infiltration to isolate work areas for construction.
cohort	A group of fish spawned during a given period, usually within a year.
confluence	The meeting of two or more bodies of water, such as the point where a tributary joins the mainstem.
connected action	The National Environmental Policy Act defines a <u>connected action</u> as an action that (i) automatically triggers other actions that may require environmental impact statements (ii) cannot or will not proceed unless other actions are taken previously or simultaneously (iii) is an interdependent part of a larger action and depends on the larger action for its justification. Connected actions are closely related and therefore should be discussed in the same impact statement (40 CFR Part 1508.25 (a)1).
consolidation (of sediments)	The process by which sediments are compacted together.
contour line	A line connecting points of equal elevation.
Cooperating Agencies	Under the National Environmental Protection Act (NEPA), the agencies having responsibility to assist the lead agency by participating in the NEPA process. The role of the cooperating agencies may

include conducting environmental analyses of resources which the cooperating agency has jurisdiction by law or special expertise.

critical habitat

Areas that are essential to the conservation of a species listed under the federal Endangered Species Act.

cyanobacteria

Photosynthetic bacteria, also known as blue-green algae. Cyanobacteria form extensive and highly visible blooms in the freshwater and marine environment.

Dam Removal Entity

The party with primary responsibility for carrying out the dam removal and other components of the Klamath Hydroelectric Settlement Agreement.

decommissioning

Taking out of use, such as dismantling a dam or destroying an unneeded road.

desiccation

Drying out.

diel

Pertaining to a 24-hour period; daily.

direct effects

Related to socioeconomics, they are one or a series of production changes or expenditures made by producers/consumers as a result of an activity or policy. These initial changes are determined by an analyst to be a result of this activity or policy. Applying these initial changes to the multipliers in an IMPLAN model will then display how the region will respond, economically to these initial changes.

dissolved oxygen

The amount of oxygen in the water available to aquatic organisms measured in mg/L or percent saturation.

diversion

The act of diverting water from the main river course down a water separate conveyance system.

drawdown

Lowering of the water level in a reservoir.

drop structure

A structure, often part of a dam's spillway, to pass water to a lower elevation while controlling the energy and velocity of the water as it passes over.

elutriate	Separation of fine particles into size fractions according to their rate of fall through an upward current of water.
embankment	Earth or stone fill designed to hold back water.
emergent vegetation	Aquatic plants rooted underwater that grow above (emerge from) the surface of the water (e.g., cattails).
employment (jobs)	Employment in IMPLAN is measured in number of jobs. A job is the annual average of monthly jobs in that industry (this is the same definition used by Quarterly Census of Employment Wages, Bureau of Labor Statistics, and Bureau of Economic Analysis nationally). Thus, 1 job lasting 12 months = 2 jobs lasting 6 months each = 3 jobs lasting 4 months each. A job can be either full-time or part-time.
endemic	Native to or confined to a certain region.
entrainment (of fish)	The loss of fish during water diversion due to their movement with the flow of water. Entrainment can result in mortality from direct contact with structures, from steep drops, or from stranding in areas where water does not persist, such as irrigation systems.
environmental water	The quantity and quality of instream water available to support fisheries and other aquatic resources.
epilimnion	The top-most layer in a lake stratified by temperature. It is warmer and typically has a higher pH and dissolved oxygen concentration than the lower layers (the hypolimnion).
erosion	The wearing away of the land surface by wind or water. Erosion occurs naturally from weather or runoff but is often intensified by land-clearing practices.
ESA consultation	In compliance with the Endangered Species Act, the process by which a federal agency presents information to the United States Fisheries and Wildlife Service or National Oceanic and Atmospheric Administration Fisheries Service

regarding actions that may affect listed species or their designated habitat.

escapement (of fish)

That portion of an anadromous fish population that escapes the commercial and recreational fisheries and reaches the freshwater spawning grounds.

escapement floor

The lower bound of an escapement goal, which sets the number of salmonids that are not harvested and return to the river for spawning.

estuary

A partly enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea.

eutrophic

Waters rich in dissolved nutrients (especially nitrogen and phosphorus); leads to accelerated growth of algae and plants that depletes oxygen levels.

extirpation

Local extinction of a species over a portion of its total range.

ex-vessel value

Gross value of all fish caught within the area of analysis.

final demand

The value of goods & services produced and sold to final users (institutions) during the calendar year. This value is also equivalent to the Direct Effect of the impact.

fine sediment

Sediment with small particle size such as silts and clays.

fish ladder (fishway, fish passageway)

A structure on or around artificial barriers such as dams and locks to allow fish to move around the barrier during migration.

flume

Open-channel water conveyance system.

focal species

Species of ecological and/or human value that is of priority interest for study or management.

forebay

Water conveyance area between reservoir and power generation facilities.

fry

A juvenile salmon or steelhead.

genotype	The genetic identity of an individual.
geomorphic	Relating to surface features of a landscape.
gravel augmentation	The direct placement of spawning-size gravel into the stream channel to increase spawning habitat by increasing the amount of area with suitable substrate.
gravity arch dam	A dam that curves upstream in a narrowing curve that directs most of the water against the canyon rock walls, providing the force to compress the dam.
greenhouse gases	Gases including carbon dioxide, methane, and nitrous oxide, that prevent heat from escaping from the atmosphere, resulting in climate change (also known as global warming).
groundwater recharge	The natural or intentional infiltration of surface water for the replenishment of existing natural underground water supplies.
hatchery	A place where large numbers of fish eggs are artificially fertilized and fry are hatched in an enclosed environment.
headcut	An erosional feature in waterways where an abrupt vertical drop in the stream bed occurs.
herbaceous	Referring to a plant that has leaves and stems that die down at the end of the growing season to the soil level. They have no persistent woody stem above ground.
hibernacula	A place where a hibernating animal shelters for the winter.
humic	Having a high organic carbon content.
Hydroelectric Reach	The portion of the Klamath River that includes the four most downstream dams (J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams).
hydrophilic	Plants especially suited to thrive in soils that are always wet.

hydroseeding	A planting process which utilizes a slurry of seed and mulch. The slurry is transported in a tank, either truck- or trailer-mounted and sprayed over prepared ground in a uniform layer.
hypereutrophic	Very nutrient-rich lakes characterized by frequent and severe nuisance algal blooms and low transparency.
hypolimnetic anoxia	The absence of oxygen in the lower layers of a lake or reservoir.
hyporheic	Beneath the bed of a stream, where there is mixing of shallow groundwater and surface water.
hypoxia	Oxygen deficiency.
IMPLAN®	IMpact Analysis for PLANning, a regional input-output model that evaluates regional economic effects.
incidental take	The “take” (adverse effect) of a listed species that results from, but is not the purpose of, an activity. Incidental take cannot result in jeopardy to the species and must be specifically authorized in the biological opinion.
indirect effects	Related to socioeconomics, they represent the impact of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy, either through imports or by payments to value added (employee).
induced effects	Related to socioeconomics, they represent the response by an economy to an initial change that occurs through re-spending of income received by a component of value added (employee). The labor income is recirculated through the household spending patterns causing further local economic activity.
in situ	In the original or natural place.
intake structure	Facility designed to divert water from the river or reservoir.

ipos	Roots of the plant <i>Carum oregonum</i> , important to some Native Americans tribes.
isobath	A type of contour line connecting points of equal water depth in a body of water.
J.C. Boyle Bypass Reach	The reach of the Klamath River between J. C. Boyle Dam and J. C. Boyle Powerhouse. A bypass reach is that section of a river from which water is removed to generate hydropower. Water is often diverted from the river at the dam, transported through channels or penstocks downstream, and released back in the river at the powerhouse.
J.C. Boyle Peaking Reach	The reach of the Klamath River between the J. C. Boyle Powerhouse and the mouth of Shovel Creek. A peaking reach is that section of a river that receives the water from the generation of hydroelectric power at the powerhouse.
Keno Impoundment	The water body created by Keno Dam.
Keno Transfer	The transfer ownership and operational responsibility of the Keno facility from PacifiCorp to the United States Department of the Interior as part of Klamath Hydroelectric Settlement Agreement implementation.
Klamath Allottee	A tribal member who owns a beneficial interest in a tract of land within the original (1864) boundaries of the Klamath Indian Reservation.
Klamath Hydroelectric Project	A system of hydroelectric components that includes the dams, powerhouses, and other facilities for generation of hydroelectric power on the Klamath River and developed jointly by Reclamation and the California-Oregon Power Company (COPCO, the predecessor to PacifiCorp).
Klamath River Basin	The portion of land drained by the Klamath River and its tributaries. The Klamath River Basin is divided into the Upper Klamath Basin and the Lower Klamath Basin.
Klamath River Basin Compact	Agreement between the State of California and the State of Oregon and consented by U.S. Congress in 1957 that established the Klamath River Compact

Commission to promote comprehensive development, conservation, and control of the resources of the Klamath River and to foster interstate comity between California and Oregon.

Klamath Tribes

The Tribes of the Klamath Basin include the Karuk Tribe, Yurok Tribe, Klamath Tribes (made up of the Klamaths, the Modocs, and the Yahooskin), Resighini Rancheria, Hoopa Valley Tribe, and Quartz Valley Indian Community.

Lake Ewauna

Also known as Keno Impoundment.

labile

Active, possessing rapid turnover rates.

labor income

All forms of employment income, including Employee Compensation (wages and benefits) and Proprietor Income.

lacustrine

Of or pertaining to lakes.

Lead Agencies

The agencies with the primarily responsibility under the National Environmental Protection Agency (NEPA) and equivalent state environmental policy acts (e.g., California Environmental Quality Act [CEQA]) for carrying out an evaluation of the environmental effects of their decision-making and for preparation of the appropriate environmental document. For the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report, the Department of Interior is lead agency under NEPA and the California Department of Fish and Game is lead agency under CEQA.

lease lands

Land located near Tule Lake National Wildlife Refuge or the Lower Klamath National Wildlife Refuge, leased by the Bureau of Reclamation.

lentic

Of, relating to, or living in still waters (lakes, ponds, or swamps).

levee

A natural or artificial slope or wall to regulate water levels. It is usually earthen and often parallel to the course of a river or the coast.

littoral

The zone between high tide and low tide waterlines of a lake or ocean.

liquid limit	The water content at which the behavior of the soil changes from a plastic to a semi-liquid state.
lotic	Of, relating to or living in actively moving waters (streams and rivers).
Lower Klamath Basin	The portion of the Klamath River Basin downstream of Iron Gate Dam.
macroinvertebrate	Aquatic insects, worms, clams, snails, and other animals without backbones that can be seen without the aid of a microscope.
macrophyte	An aquatic plant that grows in or near water and is either emergent, submergent, or floating.
mainstem	The principal river in a basin, as opposed to the tributary streams and smaller rivers that feed into it.
mitigation	The act of alleviating or lessening an adverse condition.
microcystin	A toxin produced by the blue-green algal species <i>Microcystis aeruginosa</i> .
morphological	Related to the form of. Morphology is the study of the forms of things.
Negative Determination	A determination by the Secretary of the Interior under Section 3 of the Klamath Hydroelectric Settlement Agreement that facilities removal should not proceed.
nonpoint source pollution	A term in the Clean Water Act also called “polluted runoff,” water pollution produced by diffuse land-use activities. Occurs when runoff carries fertilizer, animal wastes, and other pollution into rivers, streams, lakes, reservoirs, and other bodies of water.
noxious weed	A plant species that has been designated by state or national agricultural authorities as a plant that is injurious to native plants, agricultural and/or horticultural crops, and/or humans and livestock.
nutrient loading	Discharging of nutrients from the watershed (basin) into a receiving water body (lake, stream, wetland).

off-Project	Not associated with (not receiving water from, in the case of irrigators) Reclamation's Klamath Project.
ogee-type drop structure	A drop structure with a curved shape consisting of two arcs that curve in opposite directions so that their ends are parallel.
on-Project	Associated with (receiving water from, in the case of irrigators) Reclamation's Klamath Project.
output (sales)	Related to socioeconomic, output represents the value of industry production. In IMPLAN these are annual production estimates for the year of the data set and are in producer prices. For manufacturers this would be sales plus/minus change in inventory. For service sectors production = sales. For Retail and wholesale trade, output = gross margin and not gross sales.
PacifiCorp	An electric power company in the northwestern United States that owns and operates the Klamath River dams.
palustrine	Of or pertaining to wetlands or freshwater marsh.
Parties	Signatories to the Klamath Hydroelectric Settlement Agreement.
pelagic	Relating to or occurring, living in, or frequenting the open ocean.
penstock	A pipe or conduit that carries water to a power generation turbine.
periphyton	A complex mixture of algae, bacteria, their secretions, associated detritus, and various species of microinvertebrates attached to submerged surfaces in most aquatic ecosystems.
phytoplankton	Small, photosynthetic aquatic organisms, including diatoms, green algae, and cyanobacteria (blue-green algae).
plasticity	The ability of a soil to transform from a solid state to a liquid state by adding water.

point source pollution	Pollution into bodies of water from specific discharge points such as sewer outfalls or industrial-waste pipes.
polychaete	Aquatic annelid worms belonging to the Class Polychaeta, segmented and have bristles for movement or attachment.
powerhouse	Structure that contains the power generation equipment such as the turbine, may be an enclosed building or an open area with concrete slabs and equipment.
programmatic analysis	For purposes of the California Environmental Quality Act (CEQA), the Klamath Basin Restoration Agreement analysis is programmatic, as described in Section 15168 of the CEQA Guidelines. A program-level document is appropriate when a project consists of a series of smaller projects or phases that may be implemented separately. Under the programmatic Environmental Impact Report approach, future projects or phases may require additional, project-specific environmental analysis.
Project Team	The group of lead, cooperating, and responsible agencies responsible for evaluating the alternatives in the Environmental Impact Statement/Report.
Proposed Action	One of the alternatives evaluated in the Environmental Impact Statement/Report, the Proposed Action (also known as the Full Facilities Removal of Four Dams Alternative) includes the removal of four PacifiCorp Dams (J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams) during a 20-month period which includes an 8-month period of site preparation and partial drawdown at Copco 1 and a 12-month period for full drawdown and removal of facilities. This alternative would include the complete removal of power generation facilities, water intake structures, canals, pipelines, ancillary buildings, and dam foundations.
protocol-level surveys	Standardized methods approved by the U.S. Fish and Wildlife Service or other resource agency for establishing the presence or absence of special-status species.

radial gate	Tainter gate.
Reclamation's Klamath Project	The system of reservoirs, dams, canals, and pumps built to drain and reclaim lake bed lands of the Lower Klamath and Tule Lakes, to store water of the Klamath and Lost Rivers, to divert irrigation supplies, and to control flooding of the reclaimed lands.
redd	A depression in streambed gravel dug by a female fish for depositing eggs during spawning.
regalia	Especially fine or decorative clothing.
relicensing	The administrative proceeding in which Federal Energy Regulatory Commission (FERC), in consultation with other federal and state agencies, decides whether and on what terms to issue a new license for an existing hydroelectric project at the expiration of the original license.
remediation	To address a problem. Often refers to the removal of pollution or contaminants from environmental media such as soil, groundwater, sediment, or surface water for the general protection of human health and the environment.
riffle	A shallow section of river characterized by numerous small waves on the surface often caused by gravel bars.
Resource Agencies	Government entities that have jurisdictional authority over various natural resources.
Responsible Agencies	Under the California Environmental Quality Act (CEQA), the agencies with discretionary approval authority over a portion of a CEQA project such as required permits.
restoration	The return of a landscape, ecosystem, or other system to a predefined historical state.
riparian	The area adjacent to a river or stream (and sometimes along shorelines of lakes or reservoirs).
riprap	Broken stone, cut stone blocks, or rubble that is placed on slopes to protect them from erosion.

riverine	Of or pertaining to rivers.
river left and right	The designated side of the river when looking downstream in the direction of flow.
river mile	Measure of distance in miles along a river from its mouth. River mile numbers begin at zero and increase further upstream.
river mouth	The place where a river ends by flowing into another body of water such as a lake, ocean, or another river.
run (of salmonids)	A group of fish that is migrating from the ocean to spawn in the rivers or streams where they were born.
salmonid	Of, belonging to, or characteristic of the family Salmonidae, which includes salmon, trout, and whitefish.
scour	The hole left behind when sediment is washed away from the bottom of a river. Although scour may occur at any time, scour action is especially strong during floods. Swiftly flowing water has more energy than calm water to lift and carry sediment down river.
secondary effects	Related to socioeconomics, they are indirect effects plus induced effects.
Secretarial Determination	Decision by the Secretary of the Interior based on a thorough scientific review of existing science, data and other information whether removal of the dams: (1) will advance restoration of the salmonid fisheries of the Klamath Basin; and 2) is in the public interest.
sedimentation	Settling of particulate matter in water related to particle size, water velocity, and water flow.
senescence	In plants, death triggered by an increase in the enzymes that promote the breakdown of plant cells.
smolt	A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt its body from a freshwater to a saltwater environment.

spawning	The process by which fish release eggs and sperm and deposit them on the stream substrate.
special-status species	Plant and wildlife species listed as threatened or endangered under the federal or state endangered species acts. Also included are federal candidate species, federal species of concern, state sensitive species, state species of concern, and those given special status by the Bureau of Land Management, the U.S Forest Service, or Indian Tribes.
spillway	Open-channel used to convey water over a dam, typically constructed of concrete to resist scour and erosion.
soil moisture content	The weight of water contained in a sample of soil, typically expressed as a percentage of the dry weight of the soil.
stormwater	Water that is not absorbed into soil and rapidly flows downstream, increasing the level of waterways.
stratification (in lakes)	The formation of layers based on temperature, oxygen levels, salinity, and density that act as barriers to water mixing.
subsistence	The way by which a culture obtains its food.
supersaturation	When oxygen (or other substance) is more highly concentrated in water (or other substance) than is normally possible under normal temperature and pressure.
suspended sediment	Particles that settle slowly enough to be carried in flowing water.
switchyard	The enclosed areas at power stations containing switching facilities and equipment for the purpose of connecting to the transmission network.
Tainter gate	A radial arm water control structure used to control flow into a spillway or overflow area.
tailrace	Open-channel area downstream of power generation turbine for return water to flow back to the river.

talus	A deposit of broken, coarse rock found at the base of a cliff or mountain.
Tidal prism	The volume of water in an estuary or inlet between mean high tide and mean low tide, or the volume of water leaving an estuary at ebb tide.
thalweg	The deepest part of a stream or river channel.
thermal refugia	Cool, well-oxygenated areas of rivers utilized by salmon and other species to avoid thermal stress.
thermocline	A layer within a body of water or air where the temperature changes rapidly with depth.
topographical	Of or relating to the arrangement or accurate representation of the physical features of an area.
total effects	Related to socioeconomics, they are direct effects plus indirect effects plus induced effects.
total maximum daily load (TMDL)	A regulatory term in the Clean Water Act that describes the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.
total Kjeldahl nitrogen	A measure of organic nitrogen plus ammonia.
toxigenic	Producing or containing toxins.
transformer bushings	A transformer is a device that transfers electrical energy from one circuit to another; a bushing provides insulation for the transformer.
transhumance	The seasonal movement of people with their livestock over relatively short distances, typically to higher pastures in summer and to lower valleys in winter.
tributary	A stream or river that flows into a mainstem river and contributes water to it.
turbidity	A measure of the extent to which light passing through water is reduced owing to suspended materials.
Upper Klamath Basin	The portion of the Klamath River Basin located upstream of Iron Gate Dam. The Upper Klamath

Basin is divided into two sub-basins: the Klamath Hydropower Reach from Iron Gate Dam to J.C. Boyle Dam and the basin upstream of J.C. Boyle Dam.

V-screen

A V-shaped screen over the water intake to prevent fish from swimming through.

volitional fish passage

The movement of migratory fish around a dam via an upstream fish ladder or downstream bypass system as opposed to being trapped and hauled around the dam or attempting to move through hydropower turbines where many would be killed. Volitional fishways allow anadromous fish to migrate when they are physiologically ready.

watershed

All the land drained by a given river and its tributaries. An entire drainage basin including all living and nonliving components of the system.

weir

A low structure built across a stream to raise the upstream water level while allowing water to flow over the top of the structure.

wocas

The nutritious seeds of the yellow pond lily, important to some Native Americans tribes.