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

Resource	Method for Developing the Cumulative Condition
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 (KHSA). 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

Resource	Area of Analysis	Justification
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

Resource	Area of Analysis	Justification
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
Federal					
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 [1]	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

[1] 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.

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
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[2]	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

[2] 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.

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
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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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
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

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
Tribal					
Hoopa Valley Tribe	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan	Hoopa 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
State					
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 (Spirinchus thaleichthys) 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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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
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

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
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

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
County					
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

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
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
City					
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

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
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

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
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

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
Tribal				
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
Federal				
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)
State				
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
County				
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

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
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

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
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)
City				
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

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
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

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
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
Private				
Ruby Pipeline L.L.C.	Ruby Natural Gas Pipeline	Klamath County, OR	July 2010 to June 2011	http://www.rubypipeline.com/
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	http://www.oregon.gov/ENERGY/SITING/docs/KBE-PublicNotice.pdf

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 KHSA and full implementation of the KBRA are expected to required 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
Water Temperature				
Upper Klamath Basin				
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
Lower Klamath Basin				
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
Suspended Sediments				
Upper Klamath Basin				
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
Lower Klamath Basin				
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
Nutrients				
Upper Klamath Basin				
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
Lower Klamath Basin				
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
Dissolved Oxygen				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could cause long-term[3] 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[4] 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

[3] Long-term is defined as 2-50 years.
[4] 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
Lower Klamath Basin				
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
pH				
Upper Klamath Basin				
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
Lower Klamath Basin				
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)
Chlorophyll-a and Algal Toxins				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs 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.	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
Lower Klamath Basin				
Continued impoundment of water in the reservoirs 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 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
Inorganic and Organic Contaminants				
Upper Klamath Basin				
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
Lower Klamath Basin				
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
Trap and Haul Operations				
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
Keno Transfer				
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
East and West Side Facilities				
Decommissioning the East and West Side Facilities could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC
KBRA				
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 (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). 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 (≥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 (≥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 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 (≈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 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.

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
Critical Habitat				
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)
Essential Fish Habitat				
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)
Construction-Related Impacts				
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
Species Impacts				
Fall-Run Chinook				
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
Spring-Run Chinook				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCEFEC
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

Potential Impacts	Alternatives	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, 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
Coho Salmon				
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

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
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)
Steelhead				
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
Pacific Lamprey				
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

Potential Impacts	Alternatives	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 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
Green Sturgeon				
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
Lost River and Shortnose Sucker				
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
Redband Trout				
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

Potential Impacts	Alternatives	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 redband trout.	4	B	None	B
Bull Trout				
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
Eulachon				
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
Longfin Smelt				
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
Introduced Resident Species				
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

Potential Impacts	Alternatives	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 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
Freshwater Mussels				
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
Benthic Macroinvertebrates				
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

Potential Impacts	Alternatives	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 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)
Interim Measures				
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

Potential Impacts	Alternatives	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
Keno Transfer				
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
East and Westside Facilities				
Decommissioning the East and West Side Facilities could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement				
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

Potential Impacts	Alternatives	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)	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

Potential Impacts	Alternatives	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)
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

Potential Impacts	Alternatives	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

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
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
Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir				
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
Hydroelectric Reach				
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
Klamath River Downstream of Iron Gate Dam				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as *M. aeruginosa* 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 *Cladophora 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
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
Klamath River Estuary				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton such as *M. aeruginosa* 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
Marine Nearshore Environment				
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
Keno Transfer				
Implementation of the Keno Transfer could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
Decommissioning the East and West Side Facilities could cause adverse algae effects.	2. 3	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement				
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 KHSA**. 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 has 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
Keno Transfer				
Implementation of the Keno Transfer could cause impacts to terrestrial resources.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
Decommissioning the East and West Side Facilities could cause adverse effects to terrestrial resources.	2, 3	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement				
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

Key:
1 = No Action/No Project
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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

4.4.4.1 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 has 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 has 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
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.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
Decommissioning the East and West Side Facilities could cause changed in flood risk downstream of the facilities.	2, 3	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement				
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

	California Counties					Oregon Counties		
Year	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
Keno Transfer				
Implementation of the Keno Transfer could cause adverse effects to local groundwater.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
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
Klamath Basin Restoration Agreement				
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

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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 handeling 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
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.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
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
KBRA				
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[5]. 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**

[5] 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_2, PM_{10}, and $PM_{2.5}$ 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
	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
Interim Measures (IM's)				
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
Keno Transfer				
Implementation of the Keno Transfer could have adverse effects on air quality.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
Decommissioning the East and West Side Facilities could cause adverse air quality effects.	2, 3	LTS	None	LTS
KBRA				
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[6]
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[3]
Air Quality – Trap and Haul				
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

[6] 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

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_x), carbon monoxide (CO), sulfur dioxide (SO_2), inhalable particulate matter < 10 microns (PM_{10}), and fine particulate matter < 2.5 microns ($PM_{2.5}$) to levels that could exceed Siskiyou County's thresholds of significance. Under the Proposed Action, total emissions of NOx, PM_{10}, and $PM_{2.5}$ exceed the significance criteria for the Four Facilities. The greatest source of NOx 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_{10} and $PM_{2.5}$ emissions would be fugitive dust from unpaved roads and then cut/fill activities. Secondary formation of $PM_{2.5}$ could also occur from NOx and sulfur oxide (SOx) 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_{10} 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

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
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
Keno Transfer				
Implementation of the Keno Transfer could cause short-term and temporary increases in GHG emissions.	2,3	NCFEC	None	NCFEC
East and West Side Facility Decommissioning				
Decommissioning the East and West Side Facilities could cause short-term and temporary increases in GHG emissions.	2,3	LTS	None	LTS
KBRA				
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_2) equivalent ($MTCO_2e$) to California's GHG emission for one year[7]. Amortizing these construction emissions over thirty years results in approximately 292 $MTCO_2e$ per year, well below the 10,000 $MTCO_2e$ threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 1,253 $MTCO_2e$ 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_2e ($MMTCO_2e$). The emissions from dam removal would be 0.002 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 $MMTCO_2e$; 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[8] is the twelfth to sixteenth largest emitter of CO_2, and is responsible for approximately two percent of the world's CO_2 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

[7] The value of 8,747 $MTCO_2e$ 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.

[8] 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_2 emissions in the long-term, but the sequestered CO_2 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 $MTCO_2e$ 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 $MTCO_2e$ 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
Keno Transfer				
The Keno Transfer could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
The decommissioning of the East and West Side Facilities could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
KBRA				
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

Key:
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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 1and 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

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
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

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
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
Keno Transfer				
The Transfer of Keno Dam to the DOI could have adverse effects to historic properties or historic resources.	2, 3	B	None	B
East and Westside Facilities				
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
KBRA				
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
NCFEC = 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
Keno Transfer				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could result in a change in land use.	2,3	NCFEC	None	NCFEC
East and Westside Facilities				
The decommissioning of the East and West Side facilities could impact land use.	2, 3	NCFEC	None	NCFEC
KBRA				
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

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

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
Keno Transfer				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could affect population and housing.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
The decommissioning of the East and Westside Facilities could impact population and housing.	2, 3	NCFEC	None	NCFEC
KBRA				
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:
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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.[9] 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

[9] 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
Keno Transfer				
The Keno Facility would be transferred to the DOI, which could cause adverse effects to Public Health and Safety.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
The East and West Side Facilities would be decommissioned, resulting in the loss of generated power.	2, 3	LTS	None	LTS
KBRA				
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

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). 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[10] (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**

[10] Dependable capacity is the MW output of a generator of 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)
Keno Transfer				
Implementation of the Keno Transfer could affect scenic resources.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
Decommissioning of the East and Westside canals and hydropower facilities could affect scenic resources.	2, 3	LTS	None	LTS
KBRA				
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
Keno Transfer				
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
East and Westside Facilities				
The decommissioning of the East and West Side Facilities could have adverse effects on recreational resources.	2, 3	NCFEC	None	NCFEC
KBRA				
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 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. 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
Keno Transfer				
The transfer of the Keno Facility to DOI could result in affects to HTRW.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
The decommissioning of the East and West Side Facilities could have adverse effects in terms of toxics and hazards.	2, 3	LTS	None	LTS
KBRA				
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
Traffic Flow Effects				
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
Traffic Safety Effects				
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

Potential Impact	Alternatives	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
Trap and Haul				
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
Road Condition Effects				
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
Public Transit Effects				
Construction vehicle trip volumes and material hauling routes could affect regional transit service.	2, 3, 4, 5	LTS	None	LTS
Non-Motorized Transportation Effects				
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
Keno Transfer				
The transfer of the Keno Facility could impact traffic and transportation.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities				
Activities associated with the decommissioning of the East and Westside Facilities could affect traffic and transportation.	2, 3	LTS	None	LTS
KBRA				
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

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
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
Keno Transfer				
The transfer of Keno dam to the DOI could have adverse effects on noise and vibration.	2,3	NCFEC	None	NCFEC
East and West Side Facility Decommissioning				
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
Klamath Basin Restoration Agreement				
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 actiosn 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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