DEPARTMENT OF THE INTERIOR

## Background Technical Report Informing the Secretarial Determination Overview Report

# POTENTIAL EFFECTS OF IMPLEMENTING THE KHSA AND KBRA ON INDIAN TRUST RESOURCES AND CULTURAL VALUES

June 2011

*Prepared for:*
Department of the Interior

*Prepared by:*
North State Resources, Inc.

## Mission Statement

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

## Background Technical Report Informing the Secretarial Determination Overview Report

# POTENTIAL EFFECTS OF IMPLEMENTING THE KHSA AND KBRA ON INDIAN TRUST RESOURCES AND CULTURAL VALUES

**June 2011**

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# Executive Summary

The allocation of water among competing uses in the Klamath River basin is contentious. The proposed Federal Energy Regulatory Commission (FERC) relicensing of PacifiCorp's Iron Gate, Copco No. 1, Copco No. 2, and J. C. Boyle dams on the Klamath River is likewise controversial. Placement and operation of dams on the Klamath River have had a significant and sustained adverse effect on natural resources in the Klamath River basin and on the federally recognized Indian tribes that depend on these resources.

In recent years, stakeholders began discussions to reach a settlement agreement that would resolve or reduce water resource management conflicts in the basin. In February 2010, two settlement agreements were signed. The Klamath Hydroelectric Settlement Agreement (KHSA) could result in the removal of Iron Gate, Copco No. 1, Copco No. 2, and J. C. Boyle dams, facilities of the Klamath Hydroelectric Project located on the Klamath River and owned and operated by PacifiCorp, to allow upstream anadromous fish passage to historically occupied habitat, if the Secretary of the Interior determines such an action (1) will advance restoration of the salmonid fisheries of the Klamath Basin and (2) is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and tribes. The Klamath Basin Restoration Agreement (KBRA) addresses basinwide environmental restoration and resource management issues.

A Secretarial Determination Overview Report (SDOR) will be prepared to inform the Secretary in preparing a Record of Decision (ROD); the ROD will serve as the Secretarial Determination. In the Secretarial Determination, the Secretary will consider the ramifications of two scenarios for managing the Klamath River basin over a 50-year period into the future (from 2012 to 2062):

- Dams In Scenario: The Klamath River will continue to be managed with dams and hydroelectric facilities in place (i.e., there will be no change from current management). The total maximum daily loads (TMDLs) and biological opinions (BOs) from the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), are included with the assumption that these requirements under the current BOs are accepted by PacifiCorp.

- Dams Out Scenario: The lower four Klamath River dams that are part of the Klamath Hydroelectric Project will be removed and the KBRA will be fully implemented. This includes implementation of TMDLs and BOs specific to the KHSA and KBRA actions.

To inform the decision, two Background Technical Reports (BTRs) were prepared. The first, titled *Current Effects of PacifiCorp Dams on Indian Trust Resources and Cultural Values in the Klamath River Basin* (subsequently referred to as the CE BTR), was prepared for the U.S. Department of the Interior in March 2011.[1] Its focus is on current conditions in the region as they affect tribal trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultures related to these resources and rights. This report, titled *Potential Effects of Implementing the KHSA and KBRA on Indian Trust Resources and Cultural Values* (subsequently referred to as the PE BTR), relies in part on the findings of the first BTR. Its focus is on two scenarios—one considering conditions with the dams remaining in place and the other considering conditions with the dams removed—projected over a period of 50 years into the future.

This report (PE BTR) was prepared to accomplish two goals under the two scenarios. First, it assesses how the facilities' current operations have affected (1) Indian trust resources and tribal rights to take those resources, (2) other resources traditionally used by federally recognized tribes of the Klamath River basin that support a way of life centered on aquatic resources, and (3) cultural values related to such resources and rights of the tribes, as well as of owners and heirs of Public Domain Allotments (PDAs), in the Klamath River basin. Second, this report assesses how removing the dams would affect those same tribes as well as owners and heirs of PDAs going forward.

The six federally recognized tribal governments in the study area are the Yurok Tribe, Resighini Rancheria, Hoopa Valley Indian Tribe, Karuk Tribe, Quartz Valley Indian Community, and the Klamath Tribes. In addition, owners and heirs of PDAs on or near the Klamath River were contacted for the CE BTR. Minimal response was received from the numerous owners and heirs contacted via the consultation process. No respondent asserted any effects on PDAs from current operations or foresaw effects from either scenario. Thus, this report will not discuss these PDAs further.

The findings of the Cultural/Tribal Sub-team, as articulated in the CE BTR, are that the current operation of the dams adversely affects tribal trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and, by extension, the native cultures that depend on these resources and rights. Strong social, cultural, and economic ties have bound together the tribes of the Klamath River basin—ties based in large part on a shared reliance on the region's rivers and lakes and associated resources, particularly anadromous and resident fish. This reliance extends well beyond subsistence and commerce to the cultural and social fabric of the tribes, as evidenced by their traditional, ceremonial, and spiritual ways of life that depend on the rivers and lakes and the fish, wildlife, and vegetation the waters support.

[1] U.S. Department of the Interior (2011).

As described in this report, current operations of the four dam facilities under consideration for removal significantly contribute to compromised water quality, loss of habitat for anadromous and other aquatic species, and altered aquatic ecosystem functions. As determined by the CE BTR, these contributing factors have led to the decline of the anadromous and resident fisheries important to the continuance of an indigenous tribal way of life and their economies supported by aquatic resources in the Klamath River basin. The decline of the fisheries is directly and indirectly linked to the decline of the "Salmon People" of the Klamath River basin and their fishery-based economies. This decline is manifested in adverse effects, such as physical illness, mental illness, loss of traditional knowledge, economic instability of individual households, financial instability of tribal governments, and social conflict among native peoples and between native peoples and non-natives residing in the Klamath River basin.

For each scenario under consideration, the effects on trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultural values related to those resources and rights are similar for each tribe to the extent that under the Dams In Scenario, all tribes are negatively affected, and under the Dams Out Scenario, all tribes are positively affected.

Under the **Dams In Scenario**, minimal changes to current conditions will take place. Water quality will likely be improved because of the implementation of the TMDLs and the BOs once accepted. However, despite the benefits, the effects of climate change could mean that conditions will not worsen beyond their current state, but also that conditions likely will be precluded from improving. Additionally, the fish populations, both anadromous and resident, will remain depleted, potential ESA and/or CESA listings or upgraded listings could occur, and the upper basin will continue to lack anadromous fish.

This report demonstrates that under the Dams In Scenario, the trust resources and other resources traditionally used by tribes are expected to remain in their currently diminished state. The health, welfare, economic base, and cultural development (e.g., intergenerational transmission of tribal information, ceremonies, migration of younger generational members out of the reservation) of the tribes are expected to remain in poor condition, and are even likely to worsen under the Dams In Scenario.

Under the **Dams Out Scenario**, it is expected that the attainment and benefits of the TMDLs will be achieved and accelerated, and water quality will substantially improve. Both anadromous and resident fish populations are expected to substantially increase, potentially to the point of delisting of some or all of the fishes currently listed under the ESA and/or the CESA. Additionally, the upper watershed will be opened for the re-establishment of anadromous fish populations. Also, under the Dams Out Scenario, the Klamath

River basin's health and the functionality of the larger ecosystem will increase, thus benefiting more than fish.

Also, under the Dams Out Scenario, the health, welfare, economic base, and cultural development of the tribes would have the potential to substantially improve. Fishery-related food resources should trend toward historic conditions, an improvement that could lead to decreased heart disease, fewer strokes, decreased rates of diabetes, reduced risk of obesity, and reduced levels of depression. Healthy Chinook and coho salmon, steelhead, sturgeon, lamprey, suckers, trout, and freshwater clams and mussels would be available for tribal economic growth and cultural activities, such as fishing, hunting, gathering, and ceremonies. Restoration and availability of traditional resources, including fish, would facilitate the transmission of tribal information to the younger generation, thus providing an increased sense of unity and continuity over time.

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# Abbreviations and Acronyms

| | |
|---|---|
| °C | degrees Celsius |
| °F | degrees Fahrenheit |
| | |
| BIA | Bureau of Indian Affairs |
| BLM | Bureau of Land Management |
| BO | biological opinion |
| BTR | Background Technical Report\ |
| | |
| CDFG | California Department of Fish and Game |
| CE BTR | Current Effects Background Technical Report |
| CEQA | California Environmental Quality Act |
| CESA | California Endangered Species Act |
| cfs | cubic feet per second |
| | |
| DO | dissolved oxygen |
| DRE | dam removal entity |
| | |
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| EPA | Environmental Protection Agency |
| ESA | Federal Endangered Species Act |
| | |
| FERC | Federal Energy Regulatory Commission |
| | |
| Interior | U.S. Department of the Interior |
| | |
| KBRA | Klamath Basin Restoration Agreement |
| KHSA | Klamath Hydropower Settlement Agreement |
| KHP | Klamath Hydroelectric Project |
| | |
| LKNWR | Lower Klamath National Wildlife Refuge |
| | |
| µg/L | micrograms per liter |
| mg/L | milligrams per liter |

| | |
|---|---|
| NCRWQCB | North Coast Regional Water Quality Control Board |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NWR | National Wildlife Refuge |
| ODEQ | Oregon Department of Environmental Quality |
| ODFW | Oregon Department of Fish and Wildlife |
| OWRD | Oregon Water Resources Department |
| PDA | Public Domain Allotment |
| PE BTR | Potential Effects Background Technical Report |
| Reclamation | U.S. Department of the Interior, Bureau of Reclamation |
| RM | river mile |
| ROD | Record of Decision |
| SDOR | Secretarial Determination Overview Report |
| Secretary | Secretary of the Interior |
| TAF | thousand acre-feet |
| TMDL | total maximum daily load |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| WURP | Water Use Retirement Program |

# Chapter 1. Introduction

The Klamath Hydroelectric Settlement Agreement (KHSA) was approved by the dam owner; federal, state, and local governments; some of the tribal governments located in the Klamath River basin; and some of the stakeholders representing public and private interests. The Klamath Basin Restoration Agreement (KBRA) was approved by the parties that approved the KHSA, with the exception of the dam owner and the federal government. The agreements, if both are implemented, would result in the removal of four dams and related facilities on the Klamath River owned by PacifiCorp that currently block upstream passage for native anadromous fish (i.e., Chinook salmon, coho salmon, steelhead, Pacific lamprey, and possibly sturgeon) to historically occupied habitat. On or before March 31, 2012, the Secretary of the Interior (Secretary) must determine whether removal of the dams "(1) will advance restoration of the salmonid fisheries of the Klamath Basin, and (2) is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes."[2] The evaluation period is 50 years into the future (2012 through 2062).

There are two management scenarios before the Secretary that must be addressed in the Secretarial Determination:

- Dams In Scenario: The Klamath River will continue to be managed with dams and hydroelectric facilities in place. The total maximum daily loads (TMDLs) and biological opinions (BOs) from the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) are included with the assumption that these requirements under the current BOs are accepted by PacifiCorp.

- Dams Out Scenario: The lower four Klamath River dams that are part of the Klamath Hydroelectric Project will be removed, and the KBRA will be fully implemented. This includes implementation of TMDLs and BOs specific to the KHSA and KBRA actions.

The Secretarial Determination Overview Report (SDOR) will be a stand-alone technical document for the Secretary to use in preparation of the Record of Decision (ROD); the ROD will serve as the Secretarial Determination.

To inform the decision, two Background Technical Reports (BTRs) were prepared. The first, titled *Current Effects of PacifiCorp Dams on Indian Trust Resources and Cultural Values in the Klamath River Basin* (subsequently referred to as the CE BTR), was prepared for the U.S. Department of the

[2] KHSA Section 3.3.1.

Interior in March 2011.[3] Its focus is on current conditions in the region as they affect tribal trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultures related to these resources and rights. The present report, titled *Potential Effects of Implementing the KHSA and KBRA on Indian Trust Resources and Cultural Values* (subsequently referred to as the PE BTR), relies in part on the findings of the CE BTR.

## Purpose of This Report

This PE BTR addresses the effects of the two scenarios for a period of time 50 years into the future (2012 through 2062). It was prepared to accomplish two goals. First, the report assesses how the facilities' current operations have affected (1) Indian trust resources and tribal rights to take those resources, (2) other resources traditionally used by tribes that contribute to a Native American way of life supported by aquatic resources in the Klamath River basin, and (3) cultural values related to those rights and resources for the six tribes that are potentially affected by either scenario. Second, this report assesses how the removal of the dams would impact those same tribes going forward.

For the preparation of the CE BTR, the Cultural/Tribal Sub-team conducted outreach to owners and heirs of Public Domain Allotments (PDAs) on or near the Klamath River (see Appendix D). A PDA differs somewhat from tribal trust lands or allotments on reservations in that a PDA is controlled, not by a tribal governing body, but by an individual or individuals referred to as owners and heirs. PDAs can be sold or taken out of trust status by request of the owners and heirs. The U.S. Bureau of Indian Affairs (BIA) maintains a trust relationship with owners and heirs of PDAs and acts as the federal land manager for such allotment lands.[4] Minimal response was received from the numerous owners and heirs contacted via the consultation process. No respondent asserted any effects on PDAs from current operations or foresaw effects from either scenario. Thus, this report will not discuss these PDAs further.

## Method of the Study

As part of the study for the CE BTR, the Cultural/Tribal Sub-team conducted government-to-government consultations with the six basin tribes to solicit input from the tribal governments regarding the effects on Indian trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultural values related to those resources and rights within the study area resulting from the current operations of the four PacifiCorp dams on

[3] U.S. Department of the Interior (2011).
[4] http://ftp.resource.org/courts.gov/c/F2/945/.F2d.1441.88-1088.html.

the Klamath River. The reader should note that inclusion of any claims and assertions put forth by these tribes in the CE BTR or in this report does not necessarily imply that the U.S. government endorses those views.

Three rounds of consultation meetings were held between the Cultural/Tribal Sub-team and each of the six tribal governments (Table 1-1). The purpose of the first consultation meetings (Round 1) was for the Sub-team to describe the process of the CE BTR, elicit information about the histories and backgrounds of the tribes, and discuss how the dams might be currently affecting their resources and rights and related cultural values. In response, the Yurok, Resighini, Karuk, and Klamath Tribes provided comprehensive background documents. The Round 2 meetings were conducted to collect comments from the tribes concerning the CE BTR and the potential effects of the Dams In Scenario and the Dams Out Scenario on their trust and other resources and rights. In Round 3, the Sub-team sought comments from the tribes on the first draft of the PE BTR.

**Table 1-1. Schedule of Government-to-Government Tribal Consultation Meetings**

| Tribal Government | Round 1 Consultation Meetings (September 28 through November 8, 2010) | Round 2 Consultation Meetings (January 24 through January 27, 2011) | Round 3 Consultation Meetings (April 4 through April 8, 2011) |
|---|---|---|---|
| Yurok Tribe | September 28, 2010 | January 26, 2011* | Meeting not held at the request of the tribe* |
| Resighini Rancheria | September 29, 2010 | January 25, 2011 | April 7, 2011 |
| Hoopa Valley Indian Tribe | November 8, 2010 | January 25, 2011 | Meeting not held based on non-response of the tribe |
| Karuk Tribe | September 29, 2010 | January 27, 2011 | April 5, 2011 |
| Quartz Valley Indian Community | September 30, 2010 | January 27, 2011 | Meeting not held based on non-response of the tribe |
| Klamath Tribes | October 4, 2010 | January 24, 2011 | April 4, 2011 |

* The Yurok Tribe did not consider this meeting to be a government-to-government tribal consultation meeting.

## Descriptions of Terms

Indian trust resources consist of certain real property, natural resources, and related rights held in trust by the federal government for the benefit of one or more federally recognized Indian tribes or individual Indians. Trust resources attributed to tribes are called “tribal” trust resources, and trust resources attributed to individual Indians (usually called “allottees”) are called “individual” trust resources. Some tribes have the right to use resources that are transitory or migratory in nature and that move beyond the reach of federal or tribal management (e.g., fish and water). In such cases, it is a tribe’s *right* to use the resource that is the trust resource, not the resource itself. In the case of

the Klamath River basin Indian tribes, the federal government has the responsibility to safeguard the fishery to ensure that tribes with fishing rights are able to practice those rights. Water quantity and quality are essential for the success of a safeguarded fishery, with some Klamath River basin tribes also maintaining federally recognized water rights. Tribes of the Klamath River basin also use resources that may not meet the legal definition of trust resources, but which are nonetheless part of their traditional or cultural lifestyle, and which may have independent legal protection. For the purposes of this document, these resources are referred to as other resources traditionally used by tribes. Also for the purpose of this report, cultural values are larger sets of values, unique to the tribal cultures and transmitted from generation to generation, that are placed on resources (cultural and natural) and are so intertwined with the resources that it is impossible to tease them apart. The terms used in this report are described in more detail below.

### Indian Trust Resources

Indian trust resources are property or legal interests that the United States has a legal obligation to manage for the benefit of one or more federally recognized Indian tribes or individual Indians. An Indian trust resource has three components: (a) the trustee, (b) the beneficiary, and (c) the trust resource or right. Indian trust resources can include, but are not limited to, water rights, fishing rights, land, and minerals. Beneficiaries of the Indian trust relationship are federally recognized Indian tribes with trust land and individual Indians with trust allotments; the United States is the trustee. Tribal trust resources and rights cannot be sold, leased, or otherwise encumbered without approval of the United States. Specific duties of the United States as trustee are defined by case law that interprets congressional acts, executive orders, and treaty provisions.

### Tribal Rights

The nature and scope of tribal rights in the Klamath River basin are defined by treaties, statutes, executive orders, and other laws specific to the individual Indian tribes in the basin, resulting in unique tribal rights to trust resources for each tribe. Tribal rights relating to migratory trust resources (water and fish) include, but are not necessarily limited to, the ability to access, use, and obtain sufficient quantities of those resources.

### Other Resources Traditionally Used by Tribes

Other resources traditionally used by tribes are those that are related to tribal cultural values associated with a tribal way of life that may not meet the definition of a trust resource, but which may or may not be entitled to legal protection under statute, regulation, or other law or regulation. Although the tribes of the Klamath River basin share many cultural values, their histories and practices are not necessarily the same. Thus, each of the six tribes addressed in this study may have its own set of resources that it considers important to the formation and maintenance of its culture but that the United States does not currently regard as a trust resource.

### Cultural Values

Cultural values related to a tribal way of life centered on rivers and lakes are composed of myriad values, styles, practices, resources, and items transmitted and evolving through time that together define the unique identities of the Yurok, Hupa, Karuk, Shasta, Klamath, Modoc, and Yahooskin (a band of Snake) cultures that are found in the six federally recognized Klamath River basin tribes. Cultural values more specifically can be described as the unique manner in which tribal people access, take, prepare, administer, consider, and otherwise use natural resources in unique tribal ways. To the extent that such resources and related values are diminished by ecosystem degradation, related cultures are also degraded and cultural transmissions become inhibited, which can contribute to the detriment of the mental, spiritual, and physical health of the Indians of the Klamath River basin. For some tribes, these cultural values are linked to trust resources and rights only, but cultural values are also linked to other resources traditionally used by tribes.

### Federal Laws

The federal government has a responsibility to ensure that trust resources and other associated rights are properly managed for the benefit of the tribe or individual Indian. But the federal government may have additional responsibilities towards such resources as set out in multiple federal laws and related regulations, such as the NEPA, Clean Water Act, National Historic Preservation Act, American Indian Religious Freedom Act, Executive Order No.13007: Indian Sacred Sites, and Environmental Justice Executive Order No. 12898. The federal government has an obligation to consult with tribal governments concerning its actions per Executive Order No. 13175 and Secretarial Order No. 3206.

## Organization of This Report

Throughout this report, the six federally recognized tribal governments in the study area are presented in geographical order from downriver to upriver on the Klamath River as follows: the Yurok Tribe, the Resighini Rancheria, the Hoopa Valley Indian Tribe, the Karuk Tribe, Quartz Valley Indian Community, and the Klamath Tribes. The map of the Klamath River basin in Figure 1-1 (below) indicates locations of the tribal offices of the potentially affected tribes and the four dams under discussion on the Klamath River.

The organization of this document is as follows. Chapter 1 contains the introduction and describes the background related to the KHSA and KBRA agreements, the reasons for this report, and the scope and organization of this report; a section of this chapter describes the terms used in this report. Chapter 2 describes current conditions of the affected trust resources and other resources traditionally used by each of the tribes in the Klamath River basin that would be impacted by the project and cultural values and tribal rights related to those

resources. Chapter 3 describes the Dams In Scenario and analyzes the effects of this scenario on each of the six tribes over the next 50 years. Chapter 4 assesses the effects of the Dams Out Scenario on the six tribes over the next 50 years. Chapter 5 summarizes the findings of this report and draws conclusions based on the findings. Chapter 6 provides a list of references used in this report. The appendices contain copies of letters for the three rounds of tribal consultations sent in September 2010, December 2010, and March 2011, and PDA outreach letters sent to owners and heirs of PDAs in December 2010; these letters were sent as part of the consultation process required for the CE BTR and the PE BTR that will be used to inform the SDOR.

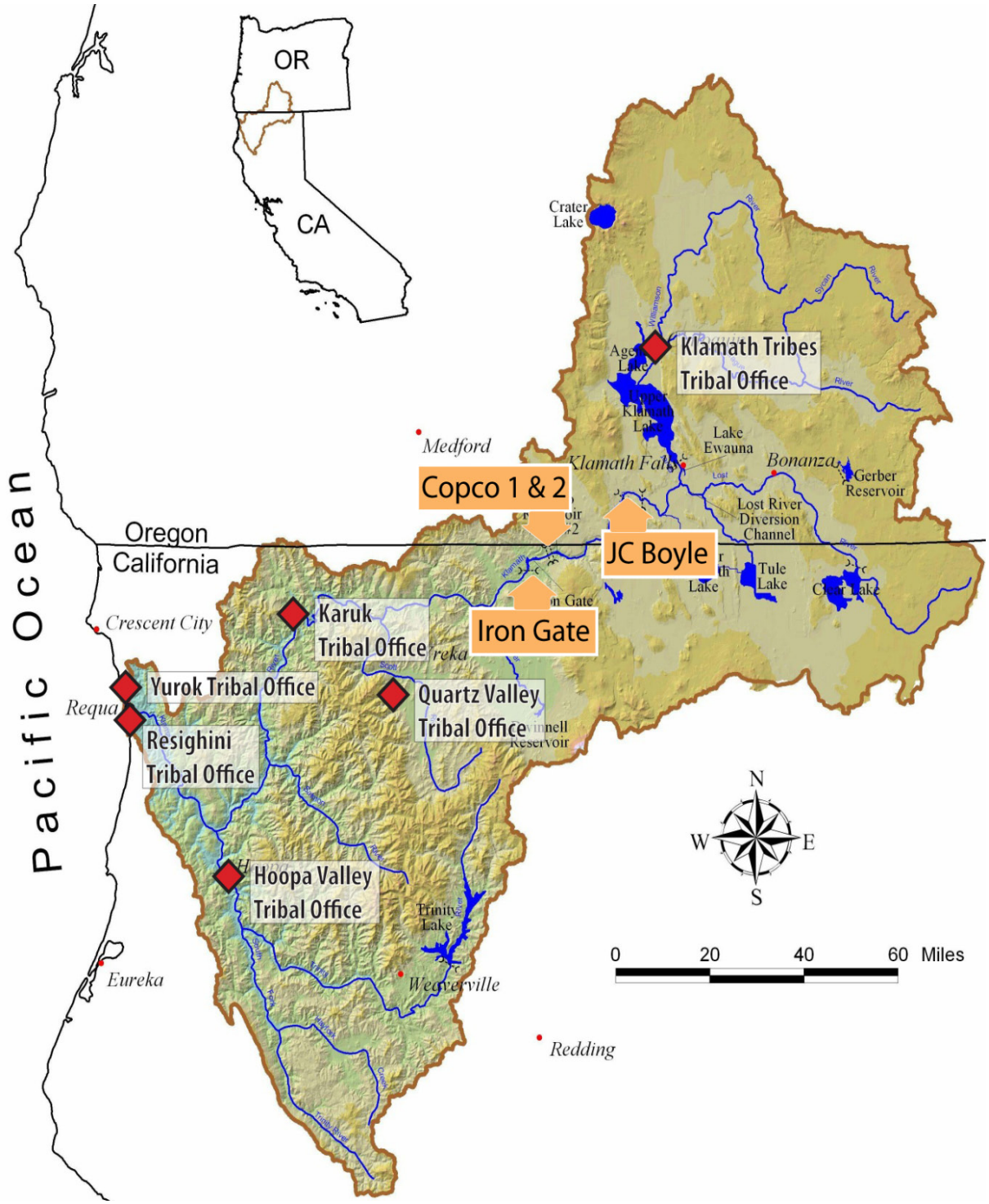


**Figure 1-1. Map of the Klamath River Basin Showing Tribal Governments, Rivers, and Dams.**

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# Chapter 2. Current Conditions

This chapter provides specific tribe-by-tribe reviews of effects of current operations of the four PacifiCorp dams on each tribe's trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultural values related to those resources and rights. The reader will note that trust resources, other resources traditionally used by tribes, and related tribal rights and cultural values vary among tribes.

## Yurok Tribe

With more than 5,600 members, the Yurok Tribe is the largest in California. The tribe's reservation, located in Del Norte and Humboldt counties, California, and encompassing approximately 57,000 acres, consists of a strip of land extending a mile along each side of the Klamath River from the Pacific Ocean and extending about 45 miles inland to just above the confluence of the Klamath and Trinity rivers.

During a government-to-government consultation held on September 28, 2010, representatives of the Yurok Tribe stated that trust resources are broader than fishing and water rights. The additional trust resources asserted are land, wildlife, minerals, and timber. However, only effects on tribal fishing and water rights were further discussed in the consultation meeting. The Yurok Tribe's assertion of trust resources was coupled with the assertion that the United States has a trust responsibility to protect these resources and ensure that they are managed for the beneficial use of the tribe and its membership. In addition, it was also stressed that the federal government has other trust responsibilities to the Yurok in the areas of social welfare, education, and health. The Yurok Tribe's definition of trust resources was noted.

Despite significant degradation of the river ecosystem of the Klamath region through the latter 19th and first half of the 20th centuries, the Yurok persist in their traditional reliance on the river and its resources. Many of today's older Yurok grew up with a strong physical connection to the river and a great appreciation for the traditions and riverine way of life of their ancestors. Although the Klamath River has changed during the recent past because of degradation discussed previously, Yurok today continue to have a strong connection to the river. Although it has become increasingly difficult, the tribe continues to practice its ceremonies and religion and to gather vegetation for baskets, food, medicines, and other purposes. As much as possible, Klamath River fish caught by the Yurok tribal membership continues to be an important component of their diets. However, tribal members are experiencing physical

and emotional conditions, such as increased heart disease, strokes, diabetes, obesity, depression, and alienation as a result of the loss of the traditional salmon diet.

The damming of the river has resulted in changes in the flows of the water and the resources it offers to the tribe. Sites of fishing and traditional use have become clogged with debris, and fish populations have continued to decline. Observers report that when tribal members try to use their traditional fishing nets, the nets fill with algae that are growing because the water temperatures are rising—a sign of an unhealthy river.[5]

In the past, the Yurok were not prone to leave their territory. Now, an inability to meet subsistence or other needs from the fishery, a perception that the rivers are dirty, a loss of intergenerational transmission of traditional knowledge, and a general malaise contribute to younger tribal members leaving the area to find work and community elsewhere.[6]

Limitations in the Yuroks' access to resources have restricted the practice of some of their most important traditions. Although many ethnographers have worked to characterize these traditions, little has been done to assess the impact on the tribe from their loss. These impacts include no longer being able to freely fish the once-prolific seasonal salmon runs and participate in the cycle of concurrent ceremonies. During the consultation meetings with the Yurok in October of 2010, the Yurok World Renewal Ceremony was identified as an example of how Yurok understand and pray for the integrity of the riverine ecosystem.

Table 2-1 lists the effects of current dam operations on the Yurok trust resources, tribal rights to take those resources, and other resources traditionally used by the Yurok Tribe.

[5] U.S. Fish and Wildlife Service and Reclamation (2000),
[6] Ibid.

**Table 2-1. Effects of Current Dam Operations on Yurok Tribe Trust Resources and Rights and on Other Resources Traditionally Used by the Tribe**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribe | Effects[1] |
|---|---|---|
| Water resources | | • Altered flows<br>• Altered water temperature regime<br>• Reduced bedload/sediment transfer<br>• Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants |
| Aquatic resources | | • Loss of habitat<br>• Less suitable water temperature regime<br>• Slightly reduced bedload transfer<br>• Increased potential for disease/parasites<br>• Reduced population size<br>• Altered run timing |
| Terrestrial resources | | • Reduced food availability<br>• Loss of riparian habitat |

[1] These effects are muted by the time the water reaches the reservation, but more severe effects on upstream reaches affect fish populations used by the Yurok.
Note: Blank cells indicate that the Yurok Tribe has no resources in this category that are affected by this project.

Table 2-2 lists the effects of current dam operations on the Yurok cultural values related to trust resources and tribal rights to take those resources and on other resources traditionally used by the Yurok Tribe.

**Table 2-2. Effects of Current Dam Operations on Yurok Tribe Cultural Values Related to Trust Resources and Rights and on Other Resources Traditionally Used by the Tribe**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribe | Effects |
|---|---|---|
| Water resources (instream flow) | | • Diminished aesthetics<br>• Algae-clogged fishing nets<br>• Human exposure to toxic water while conducting cultural activities<br>• Diminished opportunity for traditional bathing |
| Aquatic resources | | • Diminished livelihood<br>• Loss of traditional salmon diet causes increased heart disease, strokes, diabetes, and obesity among tribal members<br>• Loss of opportunity for intergenerational traditional knowledge transmission<br>• Tribal members leaving reservation<br>• Depression, alienation, and possibly suicide |
| Terrestrial resources | | • Diminished plant availability for cultural practices and related benefits<br>• Loss of opportunity for intergenerational traditional knowledge transmission |

Note: Blank cells indicate that the Yurok Tribe has no resources in this category that are affected by this project.

## Resighini Rancheria

The 238.78-acre Resighini Rancheria is located several miles inland from the mouth of the Klamath River in Del Norte County, California, and rests on the southern banks of the river, completely surrounded by the Yurok Reservation. It is primarily settled by Yurok Indians affiliated with the Yurok Coast Indian Community.[7] A population of 36 was reported on rancheria lands in the 2000 U.S. Census.[8]

During a government-to-government consultation held on September 29, 2010, members of the Resighini Rancheria stated that rancheria trust resources are gravel (minerals); water as it relates to groundwater for domestic, agricultural, and recreational (campground) uses; riparian plants; wetlands; fish; land; and wildlife. They also asserted that the United States has a trust responsibility to protect these resources and ensure that they are managed for the beneficial use of the tribe and its membership. In addition, tribal representatives stated that the federal government has trust responsibilities in the areas of social welfare, education, and health. The tribe's assertions were noted. The U.S. Department of the Interior (Interior) does not currently recognize a rancheria right to a fishery. Further, in this instance, the rancheria does not have an instream river water right. Nonetheless, the lack of fishes in the local economy affects general tribal health and cultural well-being and impairs water quality, which contributes to the decline of the instream fisheries and affects related cultural values.

A rancheria tribal councilperson told the Cultural/Tribal Sub-team during a government-to-government consultation that erosion of lands is occurring at a higher rate, gravel extraction beds are being depleted, fish returns are low, and water quality is degraded. The tribal councilperson also stated that because they rely on the river for so many aspects of their lives, the people of the rancheria are concerned about the quality of the water.[9]

The rancheria leadership asserts that alterations have affected the formation of the sand spit at the mouth of the Klamath River in terms of sand buildup and the ability of the river to clear a path through the spit to the ocean. It is also claimed that altered functions, such as increased sand buildup coupled with seasonal low flows, cause increased fall flooding of the rancheria lands.

Resighini Rancheria members have also noticed an invasion of clams (identified generally as "Asian clams"). The rancheria members are not sure whether invasive species can be directly attributed to the dams, but they maintain that the clams have migrated from upriver to downriver. The rancheria also asserts

[7] Letter from Richard B. Davis to Acting Superintendent of Indian Affairs Mr. Tipaconic (July 27, 1973).
[8] http://en.wikipedia.org/wiki/Resighini_Rancheria.
[9] Federal Energy Regulatory Commission Project Number P-2082-027.

that tribal members witnessed the demise of traditional species such as the coho salmon and spring-run Chinook salmon and the near extinction of the Klamath population of eulachon. The decline of these populations is generally attributed to poor Klamath River water quality.

Although the rancheria leadership contends that groundwater quality is adversely affected as well, no additional information could be identified to substantiate this assertion.

The cultural values affected by the Dams Out Scenario are related to and contingent on the other resources traditionally used by members of the rancheria mentioned above. Although fishes and instream water are not considered trust resources of the Resighini Rancheria, the lack of fishes in the local economy impacts general tribal health and cultural well-being. The effects of the Klamath River dams on the related cultural values of the Resighini Rancheria include emotional and physical health effects such as increased heart disease, strokes, diabetes, and obesity caused by loss of the traditional salmon diet. Additionally, the rancheria members experience a loss of opportunity for intergenerational transmission of traditional knowledge, which results in weakening ties to a riverine way of life. The lack of economic stability is driving younger members to areas outside the rancheria.

The people of the Resighini Rancheria bathe in the river and use its water for daily and ceremonial purposes. But under existing water conditions, bathing in the Klamath River imperils peoples' health, and the diminished aesthetics of the river reduce its attraction. The cumulative effects of Klamath River water contact can result in health problems, not just for the people who live on the rancheria, but for others as well. Under these conditions, tourists who come to camp in the area every year are less interested in visiting the Klamath River. Additionally, people who use the water for business purposes or who work for those businesses are deterred by the quality and quantity of the water available.[10]

The Klamath River dams have significantly reduced the ability of rancheria members to engage in traditional and contemporary subsistence and religious practices in other ways. For example, limited access to traditional foods and basket-making materials on which these practices are based means that the Resighini members have had to modify or forgo some of their traditional practices.

Table 2-3 lists the effects of current dam operations on the trust resources and rights and on other resources traditionally used by the Resighini Rancheria.

[10] Ibid., 31–32.

**Table 2-3. Effects of Current Dam Operations on Resighini Rancheria Trust Resources and Rights and on Other Resources Traditionally Used by the Rancheria**

| Trust Resource/ Right | Other Resources Traditionally Used by the Rancheria | Effects |
|---|---|---|
| Water resources (groundwater) | | • Indeterminate groundwater quality |
| | Water resources (instream) | • Altered flows<br>• Altered water temperature regime<br>• Reduced bedload sediment transfer<br>• Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants |
| | Aquatic resources | • Loss of habitat<br>• Less suitable water temperature regime<br>• Reduced bedload transfer<br>• Increased potential for disease/parasites<br>• Reduced population size |
| Terrestrial resources | | • Real property: Erosion and flooding<br>• Mineral: Less gravel replenishment |
| | Terrestrial resources | • Reduced food availability<br>• Loss of riparian habitat |

Note: Blank cells indicate that the Resighini Rancheria has no resources in this category that are affected by this project.

Table 2-4 lists the effects of current dam operations on Resighini Rancheria cultural values related to trust resources, tribal rights to take those resources, and on other resources traditionally used by the rancheria.

**Table 2-4. Effects of Current Dam Operations on Resighini Rancheria Cultural Values Related to Trust Resources and Rights and to Other Resources Traditionally Used by the Rancheria**

| Trust Resource/ Right | Other Resources Traditionally Used by the Rancheria | Effects |
|---|---|---|
| | Water resources | • Diminished aesthetics<br>• Algae-clogged fishing nets<br>• Human exposure to toxic water while conducting cultural activities<br>• Diminished opportunity for traditional bathing |
| | Aquatic resources | • Less traditional salmon diet and increased heart disease, strokes, diabetes, and obesity<br>• Tribal members leaving reservation<br>• Fewer opportunities for transmitting traditional knowledge<br>• Increase in invasive species (Asian clams) |
| | Terrestrial resources | • Diminished plant availability for cultural practices and related benefits<br>• Loss of opportunity for intergenerational traditional knowledge transmission |

Note: Blank cells indicate that the Resighini Rancheria has no resources in this category that are affected by this project.

## Hoopa Valley Indian Tribe

Located in the northeastern corner of Humboldt County in northern California, approximately 35 miles inland from the Pacific Ocean, the Hoopa Valley Indian Reservation is laid out geometrically as a square with sides approximately 12 miles in length, for a total of a little less than 144 square miles. At close to 90,000 acres, the reservation is the largest in California.

The Trinity River bisects the reservation. A small portion of the northern border of the reservation includes approximately a 0.3-mile reach of the Klamath River called Saints Rest Bar, located several miles upriver from Weitchpec, California. The 2000 U.S. Census counted 2,633 people on the reservation,[11] and the tribe listed an enrollment of 2,930 in 2010.[12] (Note that when referring to the reservation and tribal government, it is proper to use the spelling "Hoopa," as in "the Hoopa Valley Indian Tribe." When referring to the people and related culture, it is proper to use the spelling "Hupa," as in "the Hupa culture.")

A government-to-government consultation was held on November 8, 2010, to discuss the effects of current dam operations on Hoopa Valley Indian Tribe trust resources. During consultations, representatives of the Hoopa Valley Indian Tribe indicated that the Tribal Trust section of the Trinity River Mainstem Fishery Restoration Environmental Impact Statement/Environmental Impact Report, prepared in 2000, adequately represented the effects on Hoopa trust resources, which are water, fishes, and related cultural values. Although current operations of the four Klamath dams are more likely to affect resources of the Klamath River, Klamath water quality impacts Hoopa trust rights by adversely affecting fishes destined for the Trinity River. These fishes must pass through approximately 42 miles of the Klamath River before turning up the Trinity River and traveling through the Hoopa Valley, where Hoopa tribal members participate in a subsistence, ceremonial, and commercial fishery.

The Hoopa Valley Indian Tribe also provided information suggesting that no mitigation was historically required for the reduction of miles of salmonid fishery habitat upriver of Copco dams nos. 1 and 2 because such mitigation was not required when the dams were completed. When the later dams were constructed, mitigation was required for the loss of fish habitat but only for the several miles between Iron Gate Dam and Copco No. 2 Dam (i.e., the Iron Gate Fish Hatchery was not built to mitigate for the loss of the entire upriver habitat). The hatchery does not manage spring Chinook because these fish were primarily affected by the earlier dams and only to a lesser extent by the Iron Gate Dam.

[11] Hoopa Tribe website, http://www.hoopa-nsn.gov/government/statistics.htm.
[12] Hoopa Enrollment Office, pers. comm. (May 2010).

The dams, along with other diversions and impoundments in the Klamath River basin, have drastically altered the Klamath River, thereby affecting the culture of the Hupa people. Despite significant degradation of the river ecosystem of the Klamath/Trinity region through the end of the 19th century and the first half of the 20th century, fishes caught by the tribes, to the extent possible, continued to be an important component of the diets of the Hupa. Thus, many of today's Hupa people grew up with a strong physical connection to the rivers and great appreciation for the traditions and ways of life of their ancestors. One reason the tribe was able to maintain their traditional relationship to the rivers was that the rivers' flows remained relatively unimpeded.

This all changed with the building of the dams, including the 1957-62 construction of the Trinity Dam along the upper reaches of the mainstem Trinity River, which have had wide-ranging effects on the culture of the Hupa people.[13] Congress has enacted legislation directing restoration of fish populations in the Trinity River, including Pub. L. 102-575 § 3406 (b) (23), which directs action "to meet federal trust responsibilities to protect the fishery resources of the Hoopa Valley Tribe." A Record of Decision in 2000 governs the Trinity River Restoration Program,[14] but the success of the restoration is adversely affected by underfunding, low water flows, and fish disease conditions in the portion of the Klamath River through which the Trinity runs must pass. The dams, along with other diversions and impoundments in the Klamath/Trinity basin, have dramatically altered the region's rivers.

In the past, federal regulations governing fishing on the Hoopa Valley Indian Reservation have permitted the taking of fishes for ceremonial purposes even when the fisheries were closed to harvest—evidence that the federal government recognizes that fishing and fishes are integral and indispensable parts of the religious and ceremonial life of the tribe. Unfortunately, the poor condition of the fishery in recent times has in some instances forced the Hupa to purchase fishes from sources off their reservations to provide for all who attend their ceremonies.[15] Because the federal actions setting aside the Hoopa Valley Reservation also reserved rights to an instream flow of water sufficient to protect the tribe's rights to take fishes within its reservation, the United States has the responsibility to safeguard the fishery to ensure that the tribe is able to exercise that right.

According to a report by the California Department of Fish and Game (CDFG), the fish kill of 2002 affected all of the tribes along the Klamath River.[16] Because the fish kill occurred below the confluence of the Trinity and the Klamath rivers, the Trinity River in the Hoopa territory was also affected. The

[13] U.S. Fish and Wildlife Service and Reclamation (1999).
[14] U.S. Department of the Interior (December 2000).
[15] Byron Nelson, tribal elder, pers. comm. (November 1996), in Trinity DEIS/EIR, 3-216.
[16] California Department of Fish and Game (2004).

Trinity River runs have accounted for approximately half of the Klamath system totals since 1978, and the Trinity run was at its peak during the height of the fish kill.[17] Although a larger number of Klamath River fall-run Chinook salmon died, a greater proportion of the Trinity River run was affected by the fish kill.

The effects of the Klamath River dams on the related cultural values of the people of the Hoopa Valley Indian Tribe include physical health effects such as increased heart disease, strokes, diabetes, and obesity because of loss of the traditional fish diet and emotional effects such as depression, alienation, and possibly suicide. Cultural stress related to an unhealthy river has also resulted in a broad spectrum of social and educational problems for members of the Hoopa Valley Indian Tribe, including the disruption of traditional occupations and the loss of opportunities for religious practices and community participation in tribal culture. Limitations in the tribe's access to resources have restricted the practice of some of their most important traditions, such as freely fishing the once prolific seasonal salmon runs and participating in the concurrent cycle of ceremonies. With changes in the river, the tribal members have experienced a loss of opportunity for intergenerational transmission of traditional knowledge. These conditions result in tribal members, especially young people, leaving the reservation, further diminishing the strength of the tribe.

Table 2-5 lists the effects of current dam operations on the trust resources, tribal rights to take those resources, and other traditional use resources traditionally used by the Hoopa Valley Indian Tribe.

**Table 2-5. Effects of Current Dam Operations on Hoopa Valley Indian Tribe Trust Resources and Rights and on Other Resources Traditionally Used by the Tribe**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribe | Effects |
|---|---|---|
| Water resources[1] | | • Altered flows<br>• Altered water temperature regime<br>• Reduced bedload/sediment transfer<br>• Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants |
| Aquatic resources[2] | | • Loss of habitat<br>• Less suitable water temperature regime<br>• Reduced bedload transfer<br>• Increased potential for disease/parasites<br>• Reduced population size |
| Terrestrial resources[3] | | • Reduced food availability<br>• Loss of riparian habitat |

[1] To the extent that it affects Trinity River–destined fish or any fish taken by Hoopa tribal members in the approximately 1/3 mile of the Klamath River that is within the Hoopa Indian Valley Reservation (see next entry, Fish).
[2] Applies to Trinity River–destined fish or any fish taken by Hoopa Tribal members in the approximately 1/3 mile of the Klamath River that is within the Hoopa Indian Valley Reservation.
[3] Terrestrial resources refer to the 1/3 mile of the Klamath River that is within Hoopa Reservation boundaries.

[17] Ibid, III.

Note: Blank cells indicate that the Hoopa Valley Indian Tribe has no resources in this category that are affected by this project.

Table 2-6 lists the effects of current dam operations on the cultural values of the Hoopa Valley Indian Tribe related to trust resources, tribal rights to take those resources, other resources traditionally used by the tribe, and cultural values related to those resources and rights.

**Table 2-6. Effects of Current Dam Operations on Hoopa Valley Indian Tribe Cultural Values Related to Trust Resources and Rights and on Other Resources Traditionally Used by the Tribe**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribe | Effects |
|---|---|---|
| Water resources | | • Contributes to the decline of health of those fish in the Klamath River that are destined for the Trinity River |
| Aquatic resources | | • Diminished livelihood<br>• Loss of traditional salmon diet causes increased heart disease, strokes, diabetes, and obesity among tribal members<br>• Loss of opportunity for intergenerational traditional knowledge transmission<br>• Tribal members leaving reservation<br>• Depression, alienation, and possibly suicide |
| Terrestrial resources[1] | | • Diminished plant availability for cultural practices and related benefits<br>• Loss of opportunity for intergenerational traditional knowledge transmission |

[1] Terrestrial resources refer to the approximately 1/3 mile of the Klamath River that is within Hoopa Reservation boundaries.
Note: Blank cells indicate that the Hoopa Valley Indian Tribe has no resources in this category that are affected by this project.

## Karuk Tribe

The Karuk Tribe has been a federally recognized entity since 1979.[18] The Tribe occupies territory inland along the middle section of the Klamath River on land characterized by the steeply folded and faulted mountains typical of the lower and middle Klamath River basin, where mountains range from 600 to 7,500 feet in elevation and give rise to a dendritic pattern of streams that empty into the Klamath and Salmon Rivers.[19] In the 2000 U.S. Census, tribal membership was determined to be 2,702.[20] Today, the Karuk Tribe is one of the largest in California with approximately 4,800 members.

The Karuk Tribe has no federally recognized trust resources or federally accepted rights that are connected to this project. However, it should be noted

[18] Pritzker (2000), 129.
[19] Karuk tribe website: http://www.karuk.us.
[20] Ibid.

that Karuk tribal representatives highlighted the fact that, although the United States has not formally recognized the Klamath River's associated fisheries as a trust resource for the Karuk Tribe, this issue has never been adjudicated. Indeed, tribal representatives have reiterated their assertion that the Klamath River fishery and other species associated with ceremonial use and subsistence living should be considered Karuk trust resources.

Regardless of the legal status of these resources, dam operations have led to a drastic reduction in spawning habitat and many other changes in the river system, such as water quality, water temperature, and flow regimes, have affected the Karuk Tribe. All of these changes have created an environment in which it is difficult or impossible for many species to flourish. In addition to environmental effects, the changes in the river caused by the dams have resulted in diminished physical, mental, and social health for the Karuk Tribe. With that being said, the Karuk people have been performing Pikiawish (World Renewal Ceremonies) since time immemorial. The ceremonies have been altered, not because of the lack of knowledge, but because of the lack of resources that were abundantly available before the Klamath Hydroelectric Project. The resources ranged from food to regalia species to specific aquatic resources prescribed by the physical acts of the ceremonies.[21]

Although the Karuk Tribe does not have a federally recognized fishing right, the Karuk still fish for salmon at Ishi Pishi Falls using traditional dip nets. This fishery is recognized by the State of California. Regardless of the legal status of the Karuk fishery, clearly the lack of fishes in the local economy has effects on general tribal health and cultural well-being. The Karuk Tribe emphatically asserted that resources traditionally used by the tribe are affected by the current dam operations. During a government-to-government consultation, tribal representatives stated that water quality and fish returns have diminished and tribal members' quality of life has declined because of degraded water quality. They rarely bathe in the river, and in an area with fewer available fish, tribal members are likely to consume less of the traditional food base and pay less attention to the culturally inherited management traditions of a "Salmon People."

A person who is considered a member of the "Salmon People" has inherent responsibilities dependent on his or her specific participation in the Pikiawish World Renewal Ceremonies. The Karuk social system depends on the handing down of cultural practices to the next generation. Creation stories, ceremonies, and daily activities are passed down generation to generation to ensure the next generation's physical and spiritual well-being.

Regardless of the views of the United States, the Karuk Tribe not only identifies the water and the salmon fishery as tribal trust resources, but also as traditional

[21] Ron Reed, pers. comm. to Thomas Gates (2010, 2011).

food base species (i.e., pacific lamprey, sturgeon, steelhead, resident trout, suckers, freshwater mussels and clams), regalia and artisan species, and terrestrial animals associated with the river. The loss of these species and the opportunity to harvest them have led to dramatic increases in diet related diseases among Tribal members such as heart disease, strokes, diabetes, obesity and mental illnesses, such as depression.

Since the construction of the dams on the Klamath River, the numbers of a variety of river species have plummeted. Some of these fishes have traditionally been a source of food and cultural ceremonies and practices for the Karuk Tribe, as well as a means of trade and income. Not only salmon, but also steelhead, sturgeon, and other fishes (such as suckers and lampreys), as well as clams, mussels, and other aquatic species, are experiencing declining populations. These impacts are directly caused by the effects of the dams on water flow and temperature and on the river environment, including accumulated toxicity in mussels and in plants growing adjacent to waterways, which tribal members process as basketry materials by passing them through their mouths. Moreover, the dams play a fundamental role in the life cycle of myxozoan parasites that infect and kill many fish. The tribe has also noticed a down river increase in invasive species such as bluegill, catfish, bass, sunfish, and perch, which thrive in the reservoirs.

For the Karuk, one of the most significant impacts of the Klamath dams is the way that the natural process of seasonal warming and cooling trends in the river is altered by the presence of reservoirs. In effect, the reservoirs create a "thermal lag" in both the spring and the fall. This means that the river warms more slowly in the spring and cools more slowly in the fall. The result of these thermal effects is a delay in timing of migration of both juvenile and adult spring-run and fall-run Chinook salmon as well as an overall decline in numbers. For Karuk, this translates into a near-zero opportunity to fish for spring-run Chinook salmon and a significantly shorter fishing season in the fall. In addition to limiting the number of fishing days available in the fall, the opportunity to harvest spring-run Chinook salmon has been completely lost to the Karuk since construction of Iron Gate Dam.

Table 2-7 lists the effects of current dam operations on the Karuk trust resources, tribal rights to take those resources, and on other resources traditionally used by the Karuk Tribe.

**Table 2-7. Effects of Current Dam Operations on Karuk Tribe Trust Resources and Rights and on Other Resources Traditionally Used by the Tribe**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribe | Effects |
|---|---|---|
| | Water resources | • Altered flows<br>• Altered water temperature regime<br>• Reduced bedload/sediment transfer<br>• Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants |
| | Aquatic resources | • Loss of habitat<br>• Less suitable water temperature regime<br>• Reduced bedload transfer<br>• Increased potential for disease/parasites<br>• Reduced population size |
| | Terrestrial resources | • Reduced food availability<br>• Loss of riparian habitat |

Note: Blank cells indicate that the Karuk Tribe has no resources in this category that are affected by this project.

Table 2-8 lists the effects of the current dam operations on resources traditionally used by the Karuk Tribe and related cultural values.

**Table 2-8. Effects of Current Dam Operations on Karuk Tribe Cultural Values and on Other Resources Traditionally Used by the Tribe**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribe | Effects |
|---|---|---|
| | Water resources | • Diminished aesthetics<br>• Human exposure to toxic water while conducting cultural activities<br>• Diminished opportunity for traditional bathing |
| | Aquatic resources | • Loss of traditional salmon diet and increased risk of heart disease, strokes, diabetes, and obesity<br>• Depression, alienation, and possibly suicide<br>• Tribal members leaving ancestral territory<br>• Lost opportunities for transmitting traditional knowledge |
| | Terrestrial resources | • Diminished plant availability for cultural practices and related benefits<br>• Loss of opportunity for intergenerational traditional knowledge transmission |

Note: Blank cells indicate that the Karuk Tribe has no resources in this category that are affected by this project.

## Quartz Valley Indian Community

The Quartz Valley Indian Community does not have a reserved legal right to the Klamath River fishery. The tribe is not reliant on Klamath River water, nor does it retain Klamath River reserved water rights. The tribe's land base is not along the Klamath River but on a tributary to the Scott River, which is a tributary to the Klamath. Therefore, there are no primary effects on Quartz Valley trust resources or rights. Although there may be effects on Quartz Valley health, well-being, and other resources traditionally used by the tribe and related cultural values, these were not declared by the tribe in the government-to-government consultation.

## Klamath Tribes

The Klamath Tribes are composed of three historically separate tribes: the Klamath Tribe, the Modoc Tribe, and the Yahooskin Band of Snake Indians. The current membership is about 3,700. Although the tribes currently own approximately 600 acres in the upper Klamath River basin, the tribes have exercised treaty-reserved hunting, fishing, gathering, and trapping rights over a much larger area. The loss of the tribes' land base and its retention of hunting, fishing, trapping, and gathering rights are based in the unique history of the tribes and of federal "termination" of Indian tribes.

The Klamath Tribes occupied as their aboriginal lands an area of more than 22 million acres in what is now south central Oregon and northern California. In 1864, the Klamath Tribes entered into a treaty with the United States in which they ceded a large portion of these aboriginal lands in exchange for the rights to permanently and exclusively occupy a reservation of approximately 2.2 million acres (which was subsequently diminished to approximately 1 million acres). In 1954, however, as part of a nationwide effort to assimilate American Indian tribes into the cultural and economic mainstream, the federal government chose the Klamath Tribes for "termination" under the Klamath Termination Act (25 USC §564, et seq.). As a result of the Klamath Termination Act, the Klamath Tribes were deprived of federal recognition as Indian people. Further, ownership of nearly all the tribes' reservation lands passed on to the United States Forest Service (with some parcels going to private landowners). The Klamath Termination Act, however, expressly stated that it did not abrogate the tribes' rights to fish and water.

Despite termination, the Klamath Tribes retained their identity and their members continued to advocate for the rights of the tribes. In the 1970s, tribal members obtained judicial recognition which reaffirmed their continuing legal rights to hunt, fish, trap, and gather on the lands of the 1954 Klamath Reservation (Kimball v. Callahan, 493 F.2d 564 (9th Cir. 1974)), as well as the right to sufficient water to support the exercise of those rights (United States v.

Adair, 723 F.2d 1394 (9th Cir. 1984)). In 1986, the Klamath Tribes were restored to federal recognition by an act of Congress (25 USC §566, et seq.). The tribes continue to hold and exercise treaty-reserved rights to hunt, fish, trap, and gather within the 1954 Klamath Reservation Boundary.

A government-to-government consultation was held on October 4, 2010, to discuss the effects of current dam operations on Klamath Tribes trust resources and rights. Even though a variety of trust resources and rights of the Klamath Tribes have been affected by current dam operations, the consultation focused on the tribes' fishing rights and the water conditions that contribute to the health of the fishery.

The construction of Copco No. 1 Dam, completed in 1917, blocked anadromous fish runs into the upper Klamath River basin and abruptly extinguished Klamath Tribes' access to anadromous fish. No fewer than 10 traditional cultural properties in the upper Klamath River basin have been documented as having National Register eligibility based largely on salmonid procurement at these locations and the cultural and historical importance of the fishes to the tribes prior to construction of Copco No. 1 Dam.[22] The remaining major fisheries available to the Klamath Tribes are resident salmonids ("trout") and catostomids (suckers). The catostomid fishery consisted primarily of *c'waam* (Lost River sucker) and *koptu* (shortnose sucker) until the tribes closed their fishery in 1986 to protect it in the face of severe population declines. In 1988, fish-kill studies conducted by Oregon tribes and USFWS provided information that led to the listing of these fishes as endangered under the federal Endangered Species Act (ESA). As one of the few surviving tribal fisheries, resident salmonids today represent a resource to tribal members that merits protection.

Water quality and quantities in the Klamath River and its tributaries are implicated in the current dam operations. Water conditions, in turn, affect the functionality of the aquatic ecosystem and the ability of anadromous and resident fish species to survive. As previously noted, the Klamath Tribes retain a right to instream water quantities in off-reservation locations at levels that are sufficient to support fishing and other harvest rights on former reservation lands, as affirmed in the 9th Circuit Court of Appeals' decision in *United States v. Adair*, 723 F.2d 1394. A number of ritual traditions of the Klamath Tribes depend on access to clean water from natural sources, which is used in ritual purification of people, places, and objects, as well as in rituals associated with drought abatement and other environmentally restorative activities. Although tribal members sometimes acquire water for these purposes from the Klamath River canyon area, the water is viewed as being of compromised quality for these ritual uses because of its temperature, algae development, and other variables of water quality.

[22] Deur (2004); Butler et al. (2010).

In 1907, before the dams were constructed and operating, an anthropologist wrote, "Fish were abundant in the lakes, salmon and salmon trout being especially esteemed by the Indians."[23] Other firsthand observations confirm the presence of salmon before the dams. In the 1940s, in preparation for a lawsuit against Copco for blocking the anadromous fish runs, BIA Superintendent B. G. Courtright interviewed 50 elders of the Klamath Tribe and non-Indian settlers in the area about salmon in the Klamath River basin.[24] These unpublished affidavits unanimously claim there were salmon as far upstream from Klamath Lake as the Sprague and Williamson rivers and Upper Klamath Lake.[25] Anthropologist Leslie Spier reported on salmon in the Klamath River basin: "They ascend all the rivers leading from Klamath Lake ... going as far up Sprague river as Yainax, but are stopped by the falls below the outlet of Klamath marsh."[26] A tribal elder in the 1940s claimed that he had observed salmon as far up the Sprague River as Bly.[27] Salmon and steelhead have not been sighted in their historically inhabited areas above the dams in about 100 years.

Salmon, steelhead, suckers, lampreys, and redband trout continue to be symbolically and culturally important to members of the Klamath Tribes. Tribal members insist that traditional salmon and steelhead fishing stations continue to be used today, whether for subsistence purposes, ceremonial activities, historical memorialization, or instruction of children on tribal history and culture. Resources that were once harvested secondarily to the salmon and steelhead harvest have now become the focus of subsistence activity at these stations, and tribal members still use certain historic campsites at these stations during subsistence, social, and ceremonial activities. In addition to ritual activities "to bring back the salmon," the Klamath Tribes government continues to explore legal and administrative options to achieve the same goal.[28]

Table 2-9 lists the effects of the current dam operations on the trust resources, tribal rights to take those resources, and other resources traditionally used by the Klamath Tribes.

[23] Barrett, 1910, 243.
[24] B. G. Courtright. "Memorandum—Salmon on the Klamath." Klamath Agency Oregon, January 16, 1941. Also Letters to K.R.L. Simmons dated August 13, 1941; June 24, 1942; and January 29, 1943; Courtright was superintendent and Simmons was an attorney with the Bureau of Indian Affairs. Reported in Lane and Lane Associates, pp. 57–63.
[25] Butler et al. (2010); Hamilton et al. (2010).
[26] Spier (1930), 148.
[27] Lane and Lane (1981), 54.
[28] Ibid.

**Table 2-9. Effects of Current Dam Operations on Klamath Tribes Trust Resources and Rights and on Other Resources Traditionally Used by the Tribes**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribes | Effects |
|---|---|---|
| Water resources | | • Poor flow management (e.g., peaking regimes, flow pulses, flow homogenization, aquatic ecosystem functionality)<br>• Altered water temperature regime<br>• Reduced bedload sediment transfer<br>• Degraded water quality caused by nutrient input, dissolved oxygen, pH, algal toxins and other contaminants |
| Aquatic resources | | • Loss of habitat<br>• Less suitable water temperature regime<br>• Reduced bedload transfer<br>• Increased potential for disease/parasites<br>• Reduced population size |
| Terrestrial resources | | • Reduced food availability<br>• Loss of riparian habitat |

Note: Blank cells indicate that the Klamath Tribes have no resources in this category that are affected by this project.

Table 2-10 lists the effects of the current dam operations on the cultural values related to the resources, tribal rights to take those resources, and other resources traditionally used by the Klamath Tribes.

**Table 2-10. Effects of Current Dam Operations on Klamath Tribes Cultural Values Related to Trust Resources and Rights and on Other Resources Traditionally Used by the Tribes**

| Trust Resource/ Right | Other Resources Traditionally Used by the Tribes | Effects |
|---|---|---|
| Water resources | | • Diminished aesthetics<br>• Algae-clogged fishing nets<br>• Human exposure to toxic water while conducting cultural activities<br>• Diminished opportunity for traditional bathing |
| Aquatic resources | | • Lost opportunities for transmitting traditional knowledge<br>• Extirpation of treaty-protected anadromous fish<br>• Reduced populations of remaining fish species |
| Terrestrial resources | | • Diminished plant availability for cultural practices and related benefits<br>• Loss of opportunity for intergenerational traditional knowledge transmission |

Note: Blank cells indicate that the Klamath Tribes have no resources in this category that are affected by this project.

## Summary of Current Conditions

Under current conditions, water quality in the mainstem of the Klamath River has been listed as impaired because of the following caused or induced conditions: organic enrichment, low dissolved oxygen, water temperature impairment, nutrient impairment, and microcystin impairment.[29]

Anadromous fish in the Klamath River basin need cold, clean water that is rich in oxygen, but the water in the reservoirs behind the dams is warm. These elevated temperatures reduce the oxygen in the water during summer months and are unsuitable for native fish. The overheated, oxygen-deficient waters create prime conditions for algae to bloom in the reservoirs behind the dams. The algae secrete a toxin that is known to cause liver damage and promote tumor growth. Dangerous levels of this toxin have been detected in the tissue of resident fish.

Below the dams, water conditions are ideal for promoting fish disease by allowing polychaete worms, which serve as an intermediate host to the fish disease that causes parasites, to thrive. The stable flows and warm water on the Klamath, especially between Iron Gate Dam and the Shasta River, are full of the parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta*.[30] In some years, about 80 percent of the juvenile salmonids in the Klamath River become infected and most die from these diseases.[31] Over time, dam removal would allow natural fluctuations in water flow to flush out the algae and disease-causing parasites and create a more normative river flow and ecosystem function that allows fishes to become distributed once again into the upper reaches of the river rather than crowding at the base of Iron Gate Dam.[32]

Water management, particularly hydroelectric generation, has changed the patterns of water flows through the system, affecting the channel geomorphology and spawning and rearing habitat for fish. The four facilities block anadromous and resident fish passage to and from the upper river and have converted portions of former riverine habitat to reservoir habitat, which has dramatically reduced the quality and quantity of salmonid habitat in the basin. Indeed, approximately 350 miles of habitat historically used by salmonids are inaccessible because of the dams.[33] The reduction in available habitat, impairment of water quality, changes in channel geomorphology downstream from the dams, water diversions, and factors outside the current operations have led to a significant decrease in salmonid, sturgeon, lamprey,

[29] North Coast Regional Water Quality Control Board Basin Plan (2011).
[30] California Department of Fish and Game (July 2004).
[31] Ibid.
[32] Klamath Restoration Agreements website: http://www.klamathrestoration.org/top-10-reasons-to-remove-klamath-dams.html.
[33] Hamilton et al. (2010).

and sucker populations in the Klamath River basin.[34] The decline of the cultural traditions and health of the Klamath River basin tribal peoples is directly linked to the decline in fish populations.

The managed (i.e., altered) flows in their current state have resulted in an unhealthy ecosystem. Dams have caused a loss of coarse sediment transport, resulting in reduced spawning habitat downstream from the dams, altered sediment erosion and deposition patterns, loss of or impacted riparian habitat, reduced instream structure, decreased habitat heterogeneity, increased water temperatures, increased nutrient input, decreased dissolved oxygen, decreased food web support, and increased predation. These changes have led to conditions that are less than suitable for native anadromous and resident fishes and their food resources in the Klamath River basin.

For the tribes of the Klamath River basin, salmon, steelhead, sturgeon, and other fishes (e.g., suckers, redband trout, and lampreys), as well as clams, mussels, and other aquatic species, represent a significant subsistence food source and economic base for river communities. Moreover, cultural practices of these tribes such as rituals celebrating the arrival of the first salmon center on catching and eating fish. Without the fish and other culturally imbued riverine resources, traditional religion and culture become dissociated from everyday life and might eventually disappear completely.

[34] National Oceanic and Atmospheric Administration Klamath River Basin 2010 Report to Congress. Available at: www.swr.noaa.gov/klamath/Klamath_2010.pdf.

# Chapter 3. Dams In Scenario

This chapter is an overview of the Dams In Scenario for consideration in the SDOR and the potential effects on the trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and cultural values related to those resources and rights.

## Description of the Dams In Scenario

The Dams In Scenario represents the state of the environment without the Dams Out Scenario. In this instance, the Dams In Scenario would be no change from current management conditions, with the dams remaining in place. The Dams In Scenario would only include the ongoing resource management activities that are in the KBRA. These resource management actions could receive additional funding and could be expanded or accelerated through the KBRA; however, they would move forward even without the KBRA.

Under the Dams In Scenario, the Klamath Hydroelectric Project interim operations outlined in the KHSA and currently underway would cease. PacifiCorp would need to obtain an operating license from FERC to replace the current annual license. PacifiCorp would resume relicensing negotiations with FERC to obtain the required operating license. While PacifiCorp would continue to operate under annual licenses until FERC makes a new long-term licensing decision, any new long-term license issued by FERC must include the NMFS and Interior prescriptions. The prescriptions require changes from current operations and installation of fish passage facilities. It is unknown whether PacifiCorp would accept these conditions. For the purposes of analysis, the current operations are assumed to continue for the Dams In Scenario. PacifiCorp would also need to coordinate with Reclamation to operate in compliance with the existing NMFS and USFWS BOs for Reclamation's Klamath Project. PacifiCorp would continue to operate the Iron Gate Hatchery as under its current operations.

USFWS issued a BO to Reclamation on the operation and maintenance of Reclamation's Klamath Project.[35] This BO outlines measures to improve the habitat for the Lost River sucker and shortnose sucker affected by Reclamation's Klamath Project operations. Among other measures to protect the suckers, the BO requires that specific surface elevations of Upper Klamath Lake be maintained to meet certain criteria.

[35] U.S. Fish and Wildlife Service 2008

NMFS issued a BO to Reclamation requiring releases from Reclamation's Klamath Project to produce specified rates of flow for the Klamath River downstream of Iron Gate Dam, based on the habitat needs of anadromous salmonids.[36] Target flow rates in the Klamath River downstream of Iron Gate Dam vary by month and partially depend on the amount of water entering Upper Klamath Lake.

PacifiCorp would continue to coordinate with Reclamation to operate the Klamath Hydroelectric Project in compliance with existing NMFS and USFWS BOs issued for Reclamation's Klamath Project Operation Plan. These BOs add operational requirements to the Klamath Hydroelectric Project. Under the Dams In Scenario, the four dams would continue to operate in the same way that they currently operate:

- Operate the peaking facility at J. C. Boyle Dam such that the river does not rise or fall more quickly than 9 inches per hour and that minimum flows immediately downstream of the dam are maintained at 100 cubic feet per second (cfs).
- Maintain minimum flows downstream of Iron Gate Dam.
- Limit the change in the rate of the release of water from Iron Gate Dam to no more than 250 cfs per hour or a 3-inch change in river stage.

The coordinated operations of the Klamath Hydroelectric Project and Reclamation's Klamath Project would continue according to the reasonable and prudent alternatives and terms and conditions of the BOs issued to Reclamation. These coordinated operations are a part of the Dams In Scenario.

The Dams In Scenario would include other activities that would affect conditions in the Klamath River basin. To improve water quality, the Oregon Department of Environmental Quality (ODEQ) and California North Coast Regional Water Quality Control Board (NCRWQCB) are cooperating on the development of TMDLs for nine impaired water bodies within the basin. TMDLs are pollution control plans that identify the pollutant load reductions that are necessary from point and nonpoint sources to meet water quality standards. The California Klamath River TMDLs mainly focus on reducing high water temperatures, increasing dissolved oxygen levels, and reducing nutrient concentrations in the mainstem Klamath River.[37] The entire Klamath River basin is included in the associated Implementation Plan.[38] The Implementation Plan focuses on four areas of the Klamath River basin, two of which are pertinent to this document:

[36] National Marine Fisheries Service (2010).
[37] North Coast Regional Water Quality Control Board (2010).
[38] Ibid. (2010b).

- *Stateline (the area near the Oregon-California state line).* Nutrient loading from Oregon is believed to be primarily responsible for nuisance blue-green algae growth and associated water quality impairments in Copco No. 1 and Iron Gate reservoirs as well as aquatic plant growth in the Klamath River. ODEQ is developing TMDLs for the upper Klamath and Lost rivers to meet both Oregon and California water quality standards.[39]

- *Klamath Hydroelectric Project and Iron Gate Hatchery.* The TMDLs assign three allocations to the Klamath Hydroelectric Project in California: water temperature, dissolved oxygen, and nutrients (total phosphorus and total nitrogen). To achieve compliance with the TMDLs, multiple targets are also assigned, including nutrients, organic matter, and algae-based targets (chlorophyll-a, *Microcystis aeruginosa* cell density, the algal toxin microcystin).

TMDLs for eight of the nine impaired subbasins in the Klamath River basin have been adopted and are currently in the implementation phase (TMDLs for the California mainstem Klamath River were adopted on December 28, 2010). The upper Klamath River basin and Lost River TMDLs will be completed during the KHSA and KBRA NEPA/CEQA documentation period of analysis. These TMDLs are expected to result in improvements to water quality conditions, but the improvements cannot be quantified.

## Effects Analysis of the Dams In Scenario

The area of analysis includes the lower and upper Klamath River basins, which are organized into the following analysis segments:

Lower Klamath River basin

- Klamath Estuary
- Klamath Estuary to Salmon River
- Salmon River to Iron Gate Dam

Upper Klamath River basin

- Hydroelectric Reach (Iron Gate Reservoir to J. C. Boyle Reservoir)
- Klamath River upstream of J. C. Boyle Reservoir to Link River Dam
- Upper Klamath Lake
- Wood, Williamson, and Sprague rivers

[39] Oregon Department of Environmental Quality (2010).

This evaluation examines the effects of the Dams In Scenario on characteristics of water resources such as hydrology, water temperature, pH, dissolved oxygen, and toxins and contaminants. This document also evaluates the effects of the Dams In Scenario on anadromous and resident fishes, such as Chinook salmon, coho salmon, steelhead, green sturgeon, lamprey, eulachon, shortnose sucker, Lost River sucker, redband trout, and invertebrate species, such as mussels, where they are pertinent to each tribe.

## Yurok Tribe

### *Water Resources*

The Yurok Tribe has a reserved right to water in the Klamath River to support the harvest of fishes that the Yurok require to maintain a moderate standard of living. Hydrology and water quality throughout the Klamath River are important for supporting the aquatic ecosystems on which these fishes rely. In addition, the Klamath River is central to many Yurok cultural activities such as bathing and religious ceremonies.

### Hydrology

In the Klamath River between Keno Dam and Iron Gate Dam, operation of the project dams, including peaking operations for hydropower production and diversion of water out of the channel, cause flow and water quality impairments that degrade habitat and other beneficial uses, both within the reach and downstream.[40] U.S. Geological Survey (USGS) records indicate that, relative to historical conditions, operation of the dams has slightly increased fall base flows downstream, while spring, summer, and winter base flows have dramatically decreased. USGS records for Iron Gate Dam also show a decrease in the magnitude of peak flows, a 2-month shift in timing of flow minimums from September to July, and a reduction in the total volume of discharge during the summer months.[41] By reducing variability in the range of flows that lead to diverse life history strategies, changes in the annual hydrology have negatively impacted populations of fish that have evolved under the natural flow regime.

Under the Dams In Scenario, Klamath River flows would continue to be regulated at the USGS gage immediately downstream from Iron Gate Dam. Reduced flow variability relative to pre-dam conditions would continue. Evaporation in the reservoirs would continue, resulting in lower flows below Iron Gate Dam. However, water releases at Iron Gate Dam are expected to be consistent with the NMFS 2010 BO (as of this writing not accepted by PacifiCorp), which prescribes instantaneous minimum flows to increase fall and winter flow variability and increase spring discharge in select average and wetter flow conditions.[42]

### Water temperature

The Klamath River, from River Mile 231.1 (about 23 miles upstream from the California-Oregon border) to the river mouth, has been listed as impaired for water temperature.[43] Based on modeled current conditions, the reservoirs alter the natural thermal regime of the river by delaying the warming of water in the spring and the cooling of water in the late summer and fall in the lower Klamath

[40] Hamilton et al. (2010)
[41] Ibid.
[42] National Marine Fisheries Service (2010).
[43] California State Water Resources Control Board (2010); Oregon Department of Environmental Quality (2010).

River, with the largest effects occurring just downstream of Iron Gate Dam.[44] These effects diminish with distance downstream such that they are not discernible below the confluence of the Klamath River and the Scott River.

Under the Dams In Scenario, water temperatures would continue the temporal shift from natural conditions, with water that is 1ºC to 2.5 degrees Celsius (ºC) (1.8°F to 4.5 degrees Fahrenheit (°F)) cooler than natural conditions in the spring and 2ºC to 10ºC (3.6°F to 18°F) warmer than natural conditions in the summer and fall. These water temperatures would result in non-attainment of designated beneficial uses immediately downstream of Iron Gate Dam. Implementation of NMFS 2010 BO mandatory flows and CDFG Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River would increase seasonal stream flow and might moderately decrease water temperatures in the lower Klamath River, particularly during summer and fall months. Although full implementation of these mandatory flows and Oregon and California TMDLs would result in a long-term trend toward compliance with water temperature objectives and unimpaired support of beneficial uses, this would require decades to achieve and may be offset by climate change, particularly during summer when water would be warmest.

**Suspended and Bedload Sediment**

Under the Dams In Scenario, suspended sediment would continue to range from less than 5 milligrams per liter (mg/L) during summer low flows to greater than 5,000 mg/L during winter high flows downstream from Iron Gate Dam. During large winter storms or following landslides in the Klamath River basin, extremely high concentrations of suspended sediments have been observed in the Klamath River mainstem and tributaries. The Dams In Scenario would not change suspended sediment transport relative to existing levels.

Ongoing interception and retention of suspended material with large seasonal increases in algae-derived suspended material from reservoir algal blooms would continue in the Hydroelectric Reach and downstream from Iron Gate Dam. Although full implementation of Oregon and California TMDLs would indirectly decrease algae-derived suspended sediment in the reservoirs, TMDLs would not eliminate the conditions that support episodic increases in downstream suspended sediment under the Dams In Scenario; and they would require decades to achieve. Additionally, some of these benefits could be offset by climate change.

Under the Dams In Scenario, the Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Reclamation[45] estimates that the four subject reservoirs would store 2.35 million cubic yards of fine and coarse sediment by 2061. The Klamath

[44] PacifiCorp (2004); North Coast Regional Water Quality Control Board (2010).
[45] U.S. Bureau of Reclamation (2010).

River would, however, continue to receive coarse sediment from the tributaries.[46] The Dams In Scenario would not change bedload transport to the Klamath Estuary or the Pacific Ocean relative to existing conditions.

**Nutrients**

On an annual basis, concentrations of nutrients in the lower Klamath River downstream from Iron Gate Dam tend to be lower than in upstream reaches because of the settling of particulate matter and associated nutrients in the larger Klamath Hydroelectric Project reservoirs, as well as dilution from large springs below J. C. Boyle Reservoir. Nutrient levels tend to decrease farther downstream in the mainstem lower Klamath River because of a combination of tributary dilution and in-river nutrient removal processes. Despite this, nutrient concentrations during late summer and early fall do not meet the relevant water quality objectives. On a seasonal basis, nutrients can increase downstream of the reservoirs because of release of phosphorus and ammonia to the water column during periods of anoxic conditions.

Under the Dams In Scenario, ongoing interception and retention of nutrients with seasonal releases of phosphorus and ammonia in the project reservoirs would continue. Although full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with nutrient objectives and unimpaired support of beneficial uses, this would require decades to achieve.

**Dissolved oxygen**

Similar to current conditions, dissolved oxygen levels under the Dams In Scenario would continue to exhibit summer and fall levels substantially below water quality objectives. As long as Iron Gate and Copco reservoirs remain in place, they are likely to have water with low/zero oxygen in their depths during the summer months when the reservoirs are thermally stratified. Dissolved oxygen levels would not consistently support designated beneficial uses for decades into the future, when full implementation of Oregon and California TMDLs could be achieved. Resource management actions in the upper watershed, such as the Williamson River Delta Project and Agency Lake and Barnes Ranches Project, could contribute to long-term improvements in seasonally low dissolved oxygen in Upper Klamath Lake. These actions could decrease overall suspended sediment and nutrient inputs to Upper Klamath Lake and downstream reaches, and correspondingly decrease oxygen demand in the Hydroelectric Reach.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with dissolved oxygen objectives and unimpaired support of beneficial uses in the Hydroelectric Reach, this would require decades to

[46] Hetrick et al. (2009).

achieve. Improvements resulting from full implementation of TMDLs might be slightly offset by climate change, particularly during summer when water temperatures are highest.

**pH**

Currently, high rates of algal photosynthesis in Upper Klamath Lake and the project reservoirs result in pH values that do not consistently meet applicable water quality objectives and could adversely affect beneficial uses. Under the Dams In Scenario, ongoing seasonal and daily variability in pH would continue, with large daily fluctuations occurring in reservoir surface waters during periods of intense algal blooms in the Hydroelectric Reach and the lower Klamath River downstream from Iron Gate Dam.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with pH objectives and unimpaired support of beneficial uses, this would require decades to achieve. Improvements resulting from full implementation of TMDLs may be slightly offset by climate change, particularly during summer and early fall when rates of photosynthesis reach maximum levels. In the meantime, although flow conditions exceeding the pH objective would occur during periods of high photosynthesis, they would not be expected to substantially adversely affect beneficial uses.

**Algal toxins and chlorophylls**

The Klamath Hydroelectric Project reservoirs currently create favorable growth conditions for toxin-producing nuisance algal species and produce high seasonal concentrations of cyanotoxins (e.g., microcystin >8 micrograms per liter (µg/L)) and chlorophyll-a (>15 µg/L). Public health advisories were issued in 2009 and 2010 (including locations on the Yurok Reservation) when ambient and/or freshwater mussel tissue samples exceeded public health threshold values.[47] In addition, substantial bioaccumulation (exceeding public health guidelines) of microcystin in freshwater mussels has been shown.[48] Under the Dams In Scenario, continued impoundment of water in the project reservoirs would substantially impact seasonal algal toxins and chlorophyll-a in the Hydroelectric Reach for decades into the future, when full implementation of the Oregon and California TMDLs can be achieved. TMDL implementation is highly dependent on improvements in nutrients in upstream reaches. Improvements resulting from full implementation of TMDLs may be slightly offset by climate change, particularly during summer and early fall when photosynthesis is greatest.

[47] Kann and Corum (2010); Kann et al. (2010); Kann (2010); Fetcho (2010).
[48] Kann (2008); Kann et al. (2010).

**Inorganic and organic contaminants**

Low levels of organic and inorganic contaminants have been identified in the sediment deposits trapped behind the dams in the Hydroelectric Reach.[49] Benthic uptake and subsequent transfer through the food web is one potential pathway of contaminant exposure for aquatic organisms in the Hydroelectric Reach; exposure to water column contaminants is also a possible pathway. For contaminants influenced by pH or dissolved oxygen, concentrations at the sediment-water interface, such as methylmercury, could be transported to the water column via low redox conditions supported by reservoir stratification and seasonal anoxia. Human exposure to methylmercury and organic contaminants associated with reservoir sediments could occur through consumption of contaminated reservoir fishes or shellfish.

Existing data from the 2004 to 2005 and 2009 to 2010 sediment chemistry analyses, results of the 2009 to 2010 sediment bioassay tests, and fish tissue concentrations from a 2003 screening level study by PacifiCorp indicate that, for the most part, continued retention of sediments behind the Klamath Hydroelectric Project (KHP) dams under the Dams In Scenario would not result in concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses, are toxic to humans, are toxic to national benchmark toxicity species, or result in bioaccumulation in the Hydroelectric Reach. Exceptions to this include possible exposure to low-level bioaccumulation of arsenic and mercury in fishes residing in the lacustrine environment of the project reservoirs. Effects of the Dams In Scenario on inorganic and organic contaminants in the lower Klamath River basin could not be assessed because of a lack of information.

### *Aquatic Resources*

Aquatic resources in the Klamath River basin are currently considered to be in poor condition relative to historic conditions. Fish, both anadromous and native resident, are considered to have low populations, and some have been listed under the ESA and CESA. Various environmental conditions can have strong effects on the survival of aquatic resources in the Klamath River that are important to the Yurok Tribe. The following evaluation examines the aquatic resources in the Klamath River basin, and how any potential changes (or lack thereof) resulting from the Dams In Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Yurok Tribe. These fisheries are affected by riverine conditions that include water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) are described in the

[49] North Coast Regional Water Quality Control Board (2010); Shannon & Wilson, Inc. (2006); U.S. Department of the Interior (2010); Block Environmental Services (2010a–2010d).

previous section, while this section describes how the water resource conditions affect the fisheries of the Klamath River.

*Habitat Area*

The quantity and quality of aquatic and riparian habitats affect aquatic resource growth and survival. In-channel and floodplain habitat are important for spawning and rearing life stages. Habitat quality is affected directly and indirectly by changes in geomorphic processes, in-channel connectivity, food resources, and predation.

Under the Dams In Scenario, hydrology of the Klamath River from its headwaters to the estuary would generally remain the same as under current conditions, subject to the influence of climate change. Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the Klamath River (i.e., downstream from Iron Gate Dam) unless the NMFS BO is accepted by PacifiCorp, and fish passage is required. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat. This blockage particularly reduces the ability of coho salmon and coho salmon and spring-run Chinook salmon populations to recover. In addition, the structures not only block fish passage, but also alter bedload movement. The dams on the Klamath River have reduced the amount of available spawning habitat for fish in the Klamath River downstream from Iron Gate Dam. These contribute to the impacts to the anadromous fish populations. Recovery actions under the Klamath River Coho Salmon Recovery Plan would continue, depending on available funding. These actions would improve habitat conditions over time relative to current conditions.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[50] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to infections by stressing their immune systems. [51]

Anadromous fish currently experience increased water temperatures, and water temperature regimes have altered the migration timing for both juveniles and adults. Climate change is expected to result in further water temperature increases and changes in the flow hydrograph; that is, flow peaks and lows will occur at different times of the year than currently. Implementation of the TMDLs and the NMFS 2010 BO as described above will work toward reduced water temperature; however, the progression of climate change is expected to

[50] Hamilton et al. (2010).
[51] Wood et al. (2006).

reduce those benefits. The resulting water temperatures under the Dams In Scenario are expected to remain similar to present conditions.

*Suspended and Bedload Sediments*

The success of fish populations has been linked to levels of turbidity and siltation in a watershed. Prolonged exposure to high levels of suspended sediment can create a loss of visual capability, leading to a reduction in feeding and growth rates; a thickening of the gill epithelium, potentially causing the loss of respiratory function; a clogging and abrasion of gill filaments; and increases in stress levels, reducing the tolerance of fishes to disease and toxicants.[52]

In addition, high suspended sediment levels cause the movement and redistribution of fish populations and can affect physical habitat. After the suspended sediment is deposited, it can reduce water depth in pools, decreasing the water's physical carrying capacity for juvenile and adult fish.[53] Increased sediment loading can also degrade food-producing habitat downstream of the project area. Sediment loading can interfere with photosynthesis of aquatic flora and result in the displacement of aquatic fauna.

Many fish, including juvenile salmonids, are sight feeders. Turbid waters reduce the fish's efficiency in locating and feeding on prey. Some fish, particularly juveniles, can get disoriented and leave areas where their main food sources are located, which can result in reduced growth rates.

Sediment transport processes on bed elevation and bed substrate have the potential to affect riverine spawning habitat, as well as habitat for macroinvertebrates.

Under the Dams In Scenario, there is no anticipated change in suspended sediment concentration or bedload transport as described above. Therefore, anadromous fish are not expected to be affected by suspended sediment concentrations or transport of bedload materials.

*Other Water Quality Components*

Long-term dissolved oxygen levels under the Dams In Scenario would continue to exhibit seasonal variability and would not consistently meet California Basin Plan and Hoopa Valley Tribe water quality objectives for dissolved oxygen. They also would not consistently support designated beneficial uses in the lower Klamath River downstream of Iron Gate Dam.

Under the Dams In Scenario, continued high rates of algal photosynthesis in the reservoirs would result in high pH values in the lower Klamath River downstream of Iron Gate Dam. Under the Dams In Scenario, pH would

[52] Waters (1995).
[53] ibid.

continue to be elevated with high daily variability during summer and early fall months.

As a result, anadromous fish, under the Dams In Scenario, would continue to be impacted by poor dissolved oxygen levels, increased presence of algal toxins and pH, and other poor water quality conditions. Implementation of the TMDLs would ultimately result in long-term improvements; however, these improvements may be slightly offset by climate change.

*Disease and Parasites*
Fish diseases, specifically the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsula minibicornis* cause substantial adverse impacts on Klamath River salmonids, including coho salmon and Chinook salmon. *Ichthyophthirius multifi* (Ich) and *Flavobacterium columnare* (columnaris disease) may also affect fishes in the Klamath River basin. These parasites and diseases are found throughout the watershed, but appear to have the most severe effect in the lower Klamath River basin. The two myxozoan parasites are chronic and cause high rates of mortality during most years. Ich and columnaris disease are episodic and have occasional substantive effects (e.g., the 2002 fish kill of Chinook salmon adults and juveniles). The effects of these diseases generally are not as harmful to salmonids as the myxozoan parasites, although impacts on juvenile salmonids and other species have not been well studied.

The Dams In Scenario would continue to contribute to the stable, warm habitat conditions that are favorable for polychaetes and for *C. shasta* and *P. minibicornis*. The hatchery would continue to operate and discharge its nutrient-rich effluent into the river. Fishes would continue to concentrate below the Iron Gate Dam, where the polychaetes that serve as intermediate hosts for the parasites are abundant, facilitating the cross-infection between the fishes and the polychaetes.

**Estuarine Fish**
The estuary is the mixing zone for freshwater and ocean water. The balance of freshwater and saltwater changes over the course of the day with tides and is also strongly influenced by river flows. Because of this, both marine and freshwater species can often be found in different portions of the estuary at different times. All anadromous fish pass through the estuary during their migrations from freshwater to the sea and back again, and juvenile salmonids may rear in the estuary for varying periods of time, prior to moving into the ocean. Some of the fish species in the Klamath Estuary include northern anchovy, federally listed eulachon, state-listed longfin smelt, silversides, surf smelt, stickleback, and several gobies.

There are no anticipated changes to the Klamath Estuary as a result of the Dams In Scenario; therefore, no effects on the estuarine fisheries are anticipated.

**Aquatic Invertebrates**

Aquatic invertebrates are sensitive to water quality conditions because they either tend to have a small range or are sessile creatures. They are often treated as indicator species, meaning their populations and health are indicative of the ecosystem health.

Four species of native freshwater mussels have been observed in the Klamath River basin,[54] three of which are located along Klamath River reaches from the Keno Impoundment to the confluence of the Klamath and Shasta rivers, and one along the Klamath River from Iron Gate Dam to the confluence of the Klamath and Trinity rivers.

Benthic macroinvertebrates include immature, aquatic stages of insects, such as midges, mayflies, caddisflies, stoneflies, and aquatic beetles, as well as crustaceans, mollusks, aquatic worms, and other major invertebrate groups. Many benthic macroinvertebrates are the primary consumers in riverine food webs, feeding on primary producers—algae, aquatic plants, phytoplankton, bacteria, leaves and other materials from terrestrial plants, and detritus. By converting organic material into biomass available to a wide variety of consumers, these organisms form an important component of the aquatic food web.

Under the Dams In Scenario, aquatic invertebrates would continue to be affected by poor water quality conditions.

***Ecosystem Functionality/Effects***

Under the Dams In Scenario, fish and invertebrate populations will continue to be affected by loss of habitat, less suitable water temperature regimes, and blockage of substrate movement negatively affecting spawning habitat and creating poor water quality conditions and more suitable habitat conditions for the spread of disease and parasites. These reduced fish and invertebrate populations are indicative of an unhealthy ecosystem. It is not only fish and aquatic invertebrates that are affected by the altered Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are also affected by the heavily managed and modified Klamath River.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to remain low, with low viability of Klamath River populations. Efforts to improve habitat are underway, along with implementation of the TMDLs and the NMFS 2010 BO, if accepted. These efforts will help reduce the stress on the fish, but will not be sufficient to bring the species to recovery. Climate change is also expected to negatively affect the survival and propagation of fish species.

[54] Federal Energy Regulatory Commission (2007); Westover (2010).

Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the lower Klamath River basin. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat, unless fish passage is required under an accepted NMFS BO. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. The reduced numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have reduced food resources. Additionally, it has been shown that Chinook salmon carcasses are an important nutrient in the system, providing food for smaller and/or younger fish. The reduction in carcasses would result in reduced nutrient input.

Under the Dams In Scenario, flows will continue to be managed differently than would occur in a natural hydrograph. These managed flows will continue to change the geomorphology of the lower river, impact riparian vegetation recruitment, reduce river habitat heterogeneity, reduce instream fish habitat structures, decrease food web support, increase nutrient input, and continue to impact water quality as described above. Impacts to the Klamath River and to the habitat and terrestrial species dependent on the Klamath River will continue to occur.

The presence of upstream reservoirs and poor water quality result in increased amounts of toxic algae in the summer months. Implementation of the TMDLs and the accepted BOs will improve overall conditions for the fisheries; however, because of the lack of access to the upper watershed, where optimal spawning habitat previously occurred, anadromous fish populations will not be able to fully recover. Additionally, populations of coho salmon and spring-run Chinook salmon will continue to remain low, with a high risk of upgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

The Yurok Tribe has a reserved right to water in the Klamath River to support harvest of fishes that the Yurok require to maintain a moderate standard of living. The Yurok Tribe has commercial fishing rights for in-river Klamath River basin fishes up to an amount sufficient to support a moderate standard of living. The tribe also has subsistence and ceremonial fisheries.

Hydrology and water quality throughout the Klamath River are important for supporting the aquatic ecosystems on which these fishes depend. In addition, the Klamath River is central to many Yurok cultural activities such as bathing and religious ceremonies.

Under the Dams In Scenario, the Yurok fisheries are likely to remain insufficient for even a moderate standard of living. Anadromous fish are important to the Yurok people for ceremonial purposes, some of which are scheduled around fishing activities, such as past yearly construction of the fish dam at Cappell. The Yurok believe that without proper reverence for Chinook salmon, the salmon will not return in sufficient numbers. Under the Dams In

Scenario, these ceremonies will continue to be affected by reduced fish populations.

Effects of project reservoirs on water quality issues, such as the growth of toxin-producing nuisance algae, elevated water temperatures and modified temperature regimes, high pH, and increased toxicity, currently adversely impact the Yurok Tribe cultural values, which include conducting traditional ceremonies that require traditional boating and bathing in the river, fishing, and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem for the Yurok Tribe. The algae produce potent liver toxins at such a high level that warnings against contact with the water are posted along the river each summer. However, over time, successful implementation of the various TMDLs could result in Klamath River water quality trending toward compliance with water quality objectives and improved support of beneficial uses by the Yurok Tribe. Implementation of TMDLs would be expected to occur more slowly under the Dams In Scenario than under the Dams Out Scenario; and there is substantial uncertainty over when and whether TMDL targets would be achieved, especially given the potentially detrimental effect of climate change.[55]

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the Yurok people, so reduced availability of these fishes has contributed to impaired health of tribal members. Additionally, tribal health is integrally related to cultural values. Following the reduction of these fish species, there has been a continual rise in cardiovascular disease, diabetes, and, in many cases, depression. The loss of the Klamath River basin fisheries has led to less intergenerational transmission of traditional knowledge and an increase in the number of young people leaving the ancestral homeland in search of a higher standard of living. The loss of riparian vegetation has resulted in reduced ability to gather plants that might be used for such things as basket making, medicine, utensils, regalia, and structures. Under the Dams In Scenario, the effects of the continued operations of the Klamath Project, even with the implementation of the TMDLs and BOs, would likely preclude improvements in the cultural values of the Yurok Tribe because fish populations are not expected to recover to healthy populations.

[55] Hamilton et al. (2010).

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## Resighini Rancheria

### *Water Resources*

**Hydrology**

In the Hydroelectric Reach between Keno Dam and Iron Gate Dam, operation of the project dams, including peaking operations for hydropower production and diversion of water out of the channel, cause flow and water quality impairments that degrade habitat and other beneficial uses, both within the reach and downstream.[56] USGS records indicate that, relative to historical conditions, operation of the dams has slightly increased fall base flows downstream, while spring, summer, and winter base flows have dramatically decreased. USGS records for Iron Gate Dam also show a decrease in the magnitude of peak flows, a 2-month shift in timing of flow minimums from September to July, and a reduction in the total volume of discharge during the summer months.[57] By reducing variability in the range of flows that led to diverse life history strategies, changes in the annual hydrology have negatively impacted populations of fish that have evolved under the natural flow regime.

Under the Dams In Scenario, Klamath River flows would continue to be regulated at the USGS gage immediately downstream from Iron Gate Dam. Reduced flow variability relative to pre-dam conditions would continue. Evaporation in the reservoirs would continue, resulting in lower flows below Iron Gate Dam. However, water releases at Iron Gate Dam are expected to be consistent with the NMFS 2010 BO (as of this writing not accepted by PacifiCorp), which prescribes instantaneous minimum flows to increase fall and winter flow variability and increase spring discharge in select average and wetter flow conditions.[58]

As noted in Chapter 2, members of the Resighini Rancheria have asserted that as a result of the presence of the dams, flooding and erosion of rancheria lands occur at a higher rate and replenishment of gravel extraction beds has diminished. Under the Dams In Scenario, gravel replenishment, erosion, and flooding issues would not be expected to change relative to existing conditions. Any gravel inputs from tributaries and upstream processes will remain trapped in reservoirs.

**Groundwater**

Groundwater is an important resource/right for the Resighini Rancheria. The Yurok of the Resighini Rancheria have had groundwater wells since at least the 1960s. Currently, water supply for the rancheria is provided by a single 4-inch

[56] Hamilton et al. (2010).
[57] Ibid.
[58] National Marine Fisheries Service (2010).

groundwater well in the alluvial terrace of the Klamath River, but outside the 100-year floodplain. There are five additional wells awaiting improvements.[59] The wells have recently been assessed and are slated for improvements that would lead to better water distribution throughout the rancheria in support of several residences and the campground and for irrigating agricultural lands.

Although the rancheria leadership asserts that groundwater quality is adversely affected by the presence of the dams, this assertion is not substantiated by any studies. A 1975 Resighini Rancheria Water Resources Investigation Report states that samples were not taken of the water in an abandoned well. It also states that coliform was found in a sample taken from a stream running through the rancheria.[60] However, hydrogeologic information is currently not available for water-bearing formations, groundwater level trends, and groundwater storage for the lower Klamath River valley groundwater basin.[61] Under the Dams In Scenario, groundwater levels and water quality would be expected to remain consistent with historic values.

**Water Temperature**

The Klamath River, from River Mile 231.1 (about 23 miles upstream from the California-Oregon border) to the river mouth, has been listed as impaired for water temperature.[62] Based on modeled current conditions, the reservoirs alter the natural thermal regime of the river by delaying the rising of springtime water temperatures and the lowering of late summer and fall water temperatures in the lower Klamath River, with the largest effects occurring just downstream of Iron Gate Dam.[63] These effects diminish with distance downstream such that they are not discernible below the confluence of the Klamath River and the Scott River.

Under the Dams In Scenario, water temperatures would continue to shift temporally from natural conditions, with water temperatures that are 1ºC to 2.5ºC (1.8°F to 4.5 °F) cooler than natural conditions in the spring and 2ºC to 10ºC (3.6°F to 18°F) warmer than natural conditions in the summer and fall. These water temperatures would result in non-attainment of designated beneficial uses immediately downstream of Iron Gate Dam. Implementation of NMFS 2010 BO mandatory flows and CDFG Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River would increase seasonal stream flow and might moderately decrease water temperatures in the lower Klamath River, particularly during summer and fall months. Although full implementation of these mandatory flows and Oregon and California TMDLs would result in a long-term trend toward compliance with water temperature

[59] Sleeping Giant Environmental Consultants (2010).
[60] Winzler and Kelly Consulting Engineers (1975), 7, 17, 18.
[61] U.S. Bureau of Reclamation (2010), 3.
[62] State Water Resources Control Board (2006); Oregon Department of Environmental Quality (2002).
[63] PacifiCorp (2004); North Coast Regional Water Quality Control Board (2010).

objectives and unimpaired support of beneficial uses, this would require decades to achieve and may be offset by climate change, particularly during summer when water would be warmest.

**Suspended Sediments**

Under the Dams In Scenario, suspended sediment would continue to range from less than 5 mg/L during summer low flows to greater than 5,000 mg/L during winter high flows downstream from Iron Gate Dam. During large winter storms or following landslides in the Klamath River basin, extremely high concentrations of suspended sediments have been observed in the Klamath River mainstem and tributaries. The Dams In Scenario would not change suspended sediment transport relative to existing levels.

Ongoing interception and retention of suspended material with large seasonal increases in algae-derived suspended material from reservoir algal blooms would continue in the Hydroelectric Reach and downstream from Iron Gate Dam. Although full implementation of Oregon and California TMDLs would indirectly decrease algae-derived suspended sediment in the reservoirs, TMDLs would not eliminate the conditions that support episodic increases in downstream suspended sediment under the Dams In Scenario, and they would require decades to achieve. Additionally, some of these benefits may be offset by climate change.

Under the Dams In Scenario, the Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Reclamation[64] estimates that the four subject reservoirs would store 2.35 million cubic yards of fine and coarse sediment by 2061. The Klamath River would, however, continue to receive coarse sediment from the tributaries.[65] The Dams In Scenario would not change bedload transport to the Klamath Estuary or the Pacific Ocean relative to existing conditions.

**Nutrients**

On an annual basis, concentrations of nutrients in the lower Klamath River downstream from Iron Gate Dam tend to be lower than in upstream reaches because of the settling of particulate matter and associated nutrients in the larger Klamath Hydroelectric Project reservoirs, as well as dilution from large springs below J. C. Boyle Reservoir. Nutrient levels tend to decrease farther downstream in the mainstem lower Klamath River because of a combination of tributary dilution and in-river nutrient removal processes. Despite this, nutrient concentrations during late summer and early fall do not meet the relevant water quality objectives. On a seasonal basis, nutrients can increase downstream of the reservoirs because of release of phosphorus and ammonia to the water column during periods of anoxic conditions.

[64] U.S. Bureau of Reclamation (2011).
[65] Hetrick et al. (2009).

Under the Dams In Scenario, ongoing interception and retention of nutrients with seasonal releases of phosphorus and ammonia in the project reservoirs would continue. Although full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with nutrient objectives and unimpaired support of beneficial uses, this would require decades to achieve.

**Dissolved Oxygen**

Similar to current conditions, dissolved oxygen levels under the Dams In Scenario would continue to exhibit summer and fall levels substantially below water quality objectives. As long as Iron Gate and Copco reservoirs remain in place, they are likely to have water with low/zero oxygen in their depths during the summer months when the reservoirs are thermally stratified. Dissolved oxygen levels would not consistently support designated beneficial uses for decades into the future, when full implementation of Oregon and California TMDLs could be achieved. Resource management actions in the upper watershed, such as the Williamson River Delta Project and Agency Lake and Barnes Ranches Project, could contribute to long-term improvements in seasonally low dissolved oxygen in Upper Klamath Lake. These actions could decrease overall suspended sediment and nutrient inputs to Upper Klamath Lake and downstream reaches and correspondingly decrease oxygen demand in the Hydroelectric Reach.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with dissolved oxygen objectives and unimpaired support of beneficial uses in the Hydroelectric Reach, this would require decades to achieve. Improvements resulting from full implementation of TMDLs might be slightly offset by climate change, particularly during summer when water temperatures are highest.

**pH**

Currently, high rates of algal photosynthesis in Upper Klamath Lake and the project reservoirs result in pH values that do not consistently meet applicable water quality objectives and could adversely affect beneficial uses. Under the Dams In Scenario, ongoing seasonal and daily variability in pH would continue, with large daily fluctuations occurring in reservoir surface waters during periods of intense algal blooms in the Hydroelectric Reach and the lower Klamath River downstream from Iron Gate Dam.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with pH objectives and unimpaired support of beneficial uses, this would require decades to achieve. Improvements resulting from full implementation of TMDLs may be slightly offset by climate change, particularly during summer and early fall when rates of photosynthesis reach

maximum levels. In the meantime, although flow conditions exceeding the pH objective would occur during periods of high photosynthesis, they would not be expected to adversely affect beneficial uses substantially.

**Algal Toxins and Chlorophylls**

The Klamath Hydroelectric Project reservoirs currently create favorable growth conditions for toxin-producing nuisance algal species and produce high seasonal concentrations of cyanotoxins (e.g., microcystin >8 µg/L) and chlorophyll-a (>15 µg/L). Under the Dams In Scenario, continued impoundment of water in the project reservoirs would substantially impact seasonal algal toxins and chlorophyll-a in the Hydroelectric Reach for decades into the future, when full implementation of the Oregon and California TMDLs can be achieved. TMDL implementation is highly dependent on improvements in nutrients in upstream reaches. Improvements resulting from full implementation of TMDLs may be slightly offset by climate change, particularly during summer and early fall when photosynthesis is greatest.

**Inorganic and Organic Contaminants**

Low levels of organic and inorganic contaminants have been identified in the sediment deposits trapped behind the dams in the Hydroelectric Reach.[66] Benthic uptake and subsequent transfer through the food web is one potential pathway of contaminant exposure for aquatic organisms in the Hydroelectric Reach; exposure to water column contaminants is also a possible pathway. For contaminants influenced by pH or dissolved oxygen, concentrations at the sediment-water interface, such as methylmercury, could be transported to the water column via low redox conditions supported by reservoir stratification and seasonal anoxia. Human exposure to methylmercury and organic contaminants associated with reservoir sediments could occur through consumption of contaminated reservoir fish or shellfish.

Existing data from the 2004 to 2005 and 2009 to 2010 sediment chemistry analyses, results of the 2009 to 2010 sediment bioassay tests, and fish tissue concentrations from a 2003 screening level study by PacifiCorp indicate that, for the most part, continued retention of sediments behind the KHP dams under the Dams In Scenario would not result in concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses, are toxic to humans, are toxic to national benchmark toxicity species, or result in bioaccumulation in the Hydroelectric Reach. Exceptions to this include possible exposure to low-level bioaccumulation of arsenic and mercury in fishes residing in the lacustrine environment of the project reservoirs. Effects of the Dams In Scenario on inorganic and organic contaminants in the lower Klamath River basin could be assessed because of a lack of information.

[66] North Coast Regional Water Quality Control Board (2010).

### *Aquatic Resources*

Aquatic resources in the Klamath River basin are currently considered to be in poor condition relative to historic conditions. Fish, both anadromous and native resident, are considered to have low populations, and some have been listed under the ESA and CESA. Various environmental conditions can have strong effects on the survival of aquatic resources in the Klamath River that are important to the Resighini Rancheria because they are considered other resources traditionally used by the rancheria. The following evaluation examines the aquatic resources in the Klamath River basin and considers how any potential changes (or lack thereof) resulting from the Dams In Scenario would affect the aquatic resources.

#### Anadromous Fish

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Resighini Rancheria. These fisheries are affected by riverine conditions such as water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) are described in the previous section, and this section describes how the water resource conditions affect the fisheries of the Klamath River.

*Habitat Area*

The quantity and quality of aquatic and riparian habitats affect aquatic resource growth and survival. In-channel and floodplain habitat are important for spawning and rearing life stages. Habitat quality is affected directly and indirectly by changes in geomorphic processes, in-channel connectivity, food resources, and predation.

Studies conducted by the Yurok Tribe and the Resighini Rancheria reflect that coho salmon use the rancheria's creeks and Junior Pond for winter refugia. These tributaries are affected by the altered flows in the Klamath River, thus affecting the overwintering coho salmon.

Under the Dams In Scenario, hydrology of the Klamath River from its headwaters to the estuary would generally remain the same as under current conditions, subject to the influence of climate change. Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the Klamath River (i.e., downstream from Iron Gate Dam) unless the NMFS BO is accepted by PacifiCorp, and fish passage is required. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. In addition, the structures not only block fish passage, but also alter bedload movement. The dams on the Klamath River have reduced the amount of available spawning habitat for fish in the Klamath River downstream from Iron Gate Dam. These contribute to the impacts to the anadromous fish populations. Recovery actions under the

Klamath River Coho Salmon Recovery Plan would continue, depending on available funding. These actions would improve habitat conditions over time relative to current conditions.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[67] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to infections by stressing their immune systems.[68]

Anadromous fish currently experience increased water temperatures, and water temperature regimes have altered the migration timing for both juveniles and adults. Climate change is expected to result in further water temperature increases and changes in the flow hydrograph; that is, flow peaks and lows will occur at different times of the year than currently. Implementation of the TMDLs and the NMFS 2010 BO as described above will work toward reduced water temperature; however, the progression of climate change is expected to reduce those benefits. The resulting water temperatures under the Dams In Scenario are expected to remain similar to present conditions.

*Suspended and Bedload Sediments*

The success of fish populations has been linked to levels of turbidity and siltation in a watershed. Prolonged exposure to high levels of suspended sediment can create a loss of visual capability, leading to a reduction in feeding and growth rates; a thickening of the gill epithelium, potentially causing the loss of respiratory function; clogging and abrasion of gill filaments; and increases in stress levels, reducing the tolerance of fishes to disease and toxicants.[69]

In addition, high suspended sediment levels cause the movement and redistribution of fish populations and can affect physical habitat. After the suspended sediment is deposited, it can reduce water depth in pools, decreasing the water's physical carrying capacity for juvenile and adult fish.[70] Increased sediment loading can also degrade food-producing habitat downstream of the project area. Sediment loading can interfere with photosynthesis of aquatic flora and result in the displacement of aquatic fauna.

Many fish, including juvenile salmonids, are sight feeders. Turbid waters reduce the fish's efficiency in locating and feeding on prey. Some fish,

[67] Hamilton et al. (2010).
[68] Wood et al. (2006).
[69] Waters (1995).
[70] Ibid.

particularly juveniles, can become disoriented and leave areas where their main food sources are located, which can result in reduced growth rates.

Sediment transport processes on bed elevation and bed substrate have the potential to affect riverine spawning habitat, as well as habitat for macroinvertebrates.

Under the Dams In Scenario, there is no anticipated change in suspended sediment concentration or bedload transport as described above. Therefore, anadromous fish are not expected to be affected by suspended sediment concentrations or transport of bedload materials.

*Other Water Quality Components*

Long-term dissolved oxygen levels under the Dams In Scenario would continue to exhibit seasonal variability and would not consistently meet California Basin Plan and Hoopa Valley Tribe water quality objectives for dissolved oxygen. They would not consistently support designated beneficial uses in the lower Klamath River downstream of Iron Gate Dam.

Under the Dams In Scenario, continued high rates of algal photosynthesis in the reservoirs would result in high pH values in the lower Klamath River downstream of Iron Gate Dam. Under the Dams In Scenario, pH would continue to be elevated with high daily variability during summer and early fall months.

As a result, anadromous fish, under the Dams In Scenario, would continue to be impacted by poor dissolved-oxygen levels, increased presence of algal toxins and pH, and other poor water quality conditions. Implementation of the TMDLs would ultimately result in long-term improvements; however, these improvements could be slightly offset by climate change.

*Disease and Parasites*

Fish diseases, specifically the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsula minibicornis,* cause substantial adverse impacts on Klamath River salmonids, including coho salmon and Chinook salmon. *Ichthyophthirius multifi* (Ich) and *Flavobacterium columnare* (columnaris disease) may also affect fishes in the Klamath River basin. These parasites and diseases occur throughout the watershed, but appear to have the most severe effect in the lower Klamath River basin. The two myxozoan parasites are chronic and cause high rates of mortality during most years. Ich and columnaris disease are episodic and have occasional substantive effects (e.g., the 2002 fish kill of Chinook salmon adults and juveniles). The effects of these diseases generally are not as harmful to salmonids as the myxozoan parasites, although impacts on juvenile salmonids and other species have not been well studied.

The Dams In Scenario would continue to contribute to the stable, warm habitat conditions that are favorable for polychaetes and for *C. shasta* and *P.*

*minibicornis*. The hatchery would continue to operate and discharge its nutrient-rich effluent into the river. Fishes would continue to concentrate below the Iron Gate Dam, where the polychaetes that serve as intermediate hosts for the parasites are abundant, facilitating cross infection between the fishes and the polychaetes.

**Estuarine Fish**

The estuary is the mixing zone for freshwater and ocean water. The balance of freshwater and saltwater changes over the course of the day with tides and is also strongly influenced by river flows. Because of this, both marine and freshwater species can often be found in different portions of the estuary at different times. All anadromous fish pass through the estuary during their migrations from freshwater to the sea and back again, and juvenile salmonids may rear in the estuary for varying periods of time prior to moving into the ocean. Some of the fish species in the Klamath Estuary include northern anchovy, federally listed eulachon, state-listed longfin smelt, silversides, surf smelt, stickleback, and several gobies.

There are no anticipated changes to the Klamath Estuary as a result of the Dams In Scenario; therefore, no effects on the estuarine fisheries are anticipated.

**Aquatic Invertebrates**

Aquatic invertebrates are sensitive to water quality conditions because they either tend to have a small range or are sessile creatures. They are often treated as indicator species, meaning their populations and health are indicative of the ecosystem health.

Four species of native freshwater mussels have been observed in the Klamath River basin, three of which are located along Klamath River reaches from the Keno Impoundment to the confluence of the Klamath and Shasta rivers, and one along the Klamath River from Iron Gate Dam to the confluence of the Klamath and Trinity rivers. [71]

Benthic macroinvertebrates include immature, aquatic stages of insects such as midges, mayflies, caddisflies, stoneflies, and aquatic beetles, as well as crustaceans, mollusks, aquatic worms and other major invertebrate groups. Many benthic macroinvertebrates are the primary consumers in riverine food webs, feeding on primary producers—algae, aquatic plants, phytoplankton, bacteria, leaves and other materials from terrestrial plants, and detritus. By converting organic material into biomass available to a wide variety of consumers, these organisms form an important component of the aquatic food web.

[71] Federal Energy Regulatory Commission (2007); Westover (2010).

Under the Dams In Scenario, aquatic invertebrates would continue to be affected by poor water quality conditions.

***Ecosystem Functionality/Effects***

Under the Dams In Scenario, fish and invertebrate populations will continue to be affected by loss of habitat, less suitable water temperature regimes, and blockage of substrate movement negatively affecting spawning habitat and creating poor water quality conditions and more suitable habitat conditions for the spread of disease and parasites. These reduced fish and invertebrate populations are indicative of an unhealthy ecosystem. It is not only fish and aquatic invertebrates that are affected by the altered Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are also affected by the heavily managed and modified Klamath River.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to remain low, with low viability of Klamath River populations. Efforts to improve habitat are underway, along with implementation of the TMDLs and the NMFS 2010 BO, if accepted. These efforts will help reduce the stress on the fish, but will not be sufficient to bring the species to recovery. Climate change is also expected to negatively affect the survival and propagation of fish species.

Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the lower Klamath River basin. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat unless fish passage is required under an accepted NMFS BO. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. The reduced numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have reduced food resources. Additionally, it has been shown that Chinook salmon carcasses are an important source of nutrients for the system, providing food for smaller and/or younger fishes. The reduction in carcasses would result in reduced nutrient input.

Under the Dams In Scenario, flows will continue to be managed differently than would occur in a natural hydrograph. These managed flows will continue to change the geomorphology of the lower river, impact riparian vegetation recruitment, reduce river habitat heterogeneity, reduce instream fish habitat structures, decrease food web support, increase nutrient input, and continue to impact water quality as described above. Impacts to the Klamath River and to the habitat and terrestrial species dependent on the Klamath River will continue to occur.

The presence of upstream reservoirs and poor water quality result in increased amounts of toxic algae in the summer months. Implementation of the TMDLs and the accepted BOs will improve overall conditions for the fisheries because of the lack of access to the upper watershed, where optimal spawning habitat

previously occurred, anadromous fish populations will not be able to fully recover. Additionally, populations of coho salmon and spring-run Chinook salmon will continue to remain low, with a high risk of upgraded listing under the ESA and CESA.

***Effects on Cultural Values***

Hydrology and water quality throughout the Klamath River are important for supporting the aquatic ecosystems on which these fishes depend. In addition, the Klamath River is central to many Resighini Rancheria cultural activities such as bathing and religious ceremonies.

Anadromous fish are important to the rancheria members for ceremonial purposes, some of which are scheduled around fishing activities. Under the Dams In Scenario, these ceremonies will continue to be affected by reduced fish populations.

Effects of project reservoirs on water quality issues, such as the growth of toxin-producing nuisance algae, elevated water temperatures and modified temperature regimes, high pH, and increased toxicity, currently adversely impact Resighini Rancheria cultural values, such as conducting traditional bathing ceremonies, fishing, and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem. The algae produce potent liver toxins at such a high level that warnings against contact with the water are posted along the river each summer. However, over time, successful implementation of the various TMDLs could result in Klamath River water quality trending toward compliance with water quality objectives and improved support of beneficial uses by the Resighini Rancheria. Implementation of TMDLs would be expected to occur more slowly under the Dams In Scenario than under the Dams Out Scenario; and there is substantial uncertainty over when and whether TMDL targets would be achieved, especially given the potentially detrimental effect of climate change.[72]

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the rancheria, so reduced availability of these fishes has contributed to impaired health of tribal members. Additionally, tribal health is integrally related to cultural values. Following the reduction of these fish species, there has been a continual rise in cardiovascular disease, diabetes, and, in many cases, depression. The loss of the Klamath River basin fisheries has led to lost opportunities for intergenerational transmission of traditional knowledge and an increase in the number of young people leaving the ancestral homeland in search of a higher standard of living. The loss of riparian vegetation has resulted in reduced ability for gathering plants that might be used for such things as basket making, medicine, utensils, regalia, and structures. Under the Dams In Scenario, the effects of the continued operations

[72] Hamilton et al. (2010).

of the Klamath Project, even with the implementation of the TMDLs and BOs, would likely preclude improvements to the cultural values of the Resighini Rancheria because fish populations are not expected to recover to healthy populations.

## Hoopa Valley Indian Tribe

### *Water Resources*

The Trinity River is of prime importance to the Hoopa Valley Indian Tribe because it is the river that runs the greatest distance through the Hoopa Valley Indian Reservation and the river that Hoopa tribal members interact with the most. However, fishes destined for the Trinity River must pass through the lower Klamath River and are, therefore, affected by Klamath River conditions. Instream flow in the lower Klamath River affects the tribe's right to take fish to the extent that it affects fishes destined for the Trinity River. Poor conditions in the upper Klamath River also reduce the fishes available to Hoopa Valley tribe members in the Klamath River portion of the reservation, which is some distance upstream of its confluence with the Trinity River.

### Hydrology

In the Hydroelectric Reach between Keno Dam and Iron Gate Dam, operation of the project dams, including peaking operations for hydropower production and diversion of water out of the channel, cause flow and water quality impairments that degrade habitat and other beneficial uses, both within the reach and downstream.[73] USGS records indicate that, relative to historical conditions, operation of the dams has slightly increased fall base flows downstream, while spring, summer, and winter base flows have dramatically decreased. USGS records for Iron Gate Dam also show a decrease in the magnitude of peak flows, a 2-month shift in timing of flow minimums from September to July, and a reduction in the total volume of discharge during the summer months.[74] By reducing variability in the range of flows that led to diverse life history strategies, changes in the annual hydrology have negatively impacted populations of fish that have evolved under the natural flow regime.

Under the Dams In Scenario, Klamath River flows would continue to be regulated at the USGS gage immediately downstream from Iron Gate Dam. Reduced flow variability relative to pre-dam conditions would continue. Evaporation in the reservoirs would continue, resulting in lower flows below Iron Gate Dam. However, water releases at Iron Gate Dam are expected to be consistent with the NMFS 2010 BO (as of the date of this document not accepted by PacifiCorp), which prescribes instantaneous minimum flows to increase fall and winter flow variability and increase spring discharge in select average and wetter flow conditions.[75]

[73] Hamilton et al. (2010)
[74] Ibid.
[75] National Marine Fisheries Service (2010).

**Water Temperature**

The Klamath River, from River Mile 231.1 (about 23 miles upstream from the California-Oregon border) to the river mouth, has been listed as impaired for water temperature.[76] Based on modeled current conditions, the reservoirs alter the natural thermal regime of the river by delaying the warming of water in the spring and the cooling of water in the late summer and fall in the lower Klamath River, with the largest effects occurring just downstream of Iron Gate Dam.[77] These effects diminish with distance downstream such that they are not discernible below the confluence of the Klamath River and the Scott River.

Under the Dams In Scenario, water temperatures downstream from Iron Gate Dam would continue the temporal shift from natural conditions, with water temperatures that are 1ºC to 2.5ºC (1.8°F to 4.5 °F) cooler than natural conditions in the spring and 2ºC to 10ºC (3.6°F to 18°F) warmer than natural conditions in the summer and fall. These water temperatures would result in non-attainment of designated beneficial uses immediately downstream of Iron Gate Dam. Implementation of NMFS 2010 BO mandatory flows and the CDFG Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River would increase seasonal stream flow and might moderately decrease water temperatures in the lower Klamath River, particularly during summer and fall months. Although full implementation of these mandatory flows and Oregon and California TMDLs would result in a long-term trend toward compliance with water temperature objectives and unimpaired support of beneficial uses, this would require decades to achieve and may be offset by climate change, particularly during summer when water would be the warmest.

**Suspended Sediments**

Under the Dams In Scenario, suspended sediment would continue to range from less than 5 mg/L during summer low flows to greater than 5,000 mg/L during winter high flows downstream from Iron Gate Dam. During large winter storms or following landslides in the Klamath River basin, extremely high concentrations of suspended sediments have been observed in the Klamath River mainstem and tributaries. The Dams In Scenario would not change suspended sediment transport relative to existing conditions.

Ongoing interception and retention of suspended material with large seasonal increases in algae-derived suspended material from reservoir algal blooms would continue in the Hydroelectric Reach and downstream from Iron Gate Dam. Although full implementation of Oregon and California TMDLs would indirectly decrease algae-derived suspended sediment in the reservoirs, this would not eliminate the conditions that support episodic increases in downstream suspended sediment under the Dams In Scenario, and they would

[76] State Water Resources Control Board (2006); Oregon Department of Environmental Quality (2002).
[77] PacifiCorp (2004); North Coast Regional Water Quality Control Board (2010).

require decades to achieve. Additionally, some of these benefits could be offset by climate change.

Under the Dams In Scenario, the Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Reclamation estimates that the four subject reservoirs would store 2.35 million cubic yards of fine and coarse sediment by 2061.[78] The Klamath River would, however, continue to receive coarse sediment from the tributaries.[79] The Dams In Scenario would not change bedload transport to the Klamath Estuary or the Pacific Ocean relative to existing conditions.

**Nutrients**

On an annual basis, concentrations of nutrients in the lower Klamath River downstream from Iron Gate Dam tend to be lower than in upstream reaches because of the settling of particulate matter and associated nutrients in the larger Klamath Hydroelectric Project reservoirs, as well as dilution from large springs below J. C. Boyle Reservoir. Nutrient levels tend to decrease farther downstream in the mainstem lower Klamath River because of a combination of tributary dilution and in-river nutrient removal processes. Despite this, nutrient concentrations during late summer/early fall do not meet the relevant water quality objectives. On a seasonal basis, nutrients can increase downstream of the reservoirs at the reservoirs because of the release of phosphorus and ammonia to the water column during periods of anoxic conditions.

Under the Dams In Scenario, ongoing interception and retention of nutrients with seasonal releases of phosphorus and ammonia in the project reservoirs would continue. Although full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with nutrient objectives and unimpaired support of beneficial uses, this would require decades to achieve.

**Dissolved Oxygen**

Similar to current conditions, dissolved oxygen levels under the Dams In Scenario would continue to exhibit summer and fall levels substantially below water quality objectives. As long as Iron Gate and Copco reservoirs remain in place, they are likely to have water with low/zero oxygen in their depths during the summer months when the reservoirs are thermally stratified. Dissolved oxygen levels would not consistently support designated beneficial uses for decades into the future, when full implementation of Oregon and California TMDLs could be achieved. Resource management actions in the upper watershed, such as the Williamson River Delta Project and Agency Lake and Barnes Ranches Project, could contribute to long-term improvements in seasonally low dissolved oxygen in Upper Klamath Lake. These actions could

[78] U.S. Bureau of Reclamation (2011).
[79] Hetrick et al. (2009).

decrease overall suspended sediment and nutrient inputs to Upper Klamath Lake and downstream reaches, and correspondingly decrease oxygen demand in the Hydroelectric Reach.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with dissolved oxygen objectives and unimpaired support of beneficial uses in the Hydroelectric Reach, this would require decades to achieve. Improvements resulting from full implementation of TMDLs might be slightly offset by climate change, particularly during summer when water temperatures are highest.

**pH**

Currently, high rates of algal photosynthesis in Upper Klamath Lake and the project reservoirs result in pH values that do not consistently meet applicable water quality objectives and could adversely affect beneficial uses. Under the Dams In Scenario, ongoing seasonal and daily variability in pH would continue, with large daily fluctuations occurring in reservoir surface waters during periods of intense algal blooms in the Hydroelectric Reach and the lower Klamath River downstream from Iron Gate Dam.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with pH objectives and unimpaired support of beneficial uses, this would require decades to achieve. Improvements resulting from full implementation of TMDLs may be slightly offset by climate change, particularly during summer and early fall when rates of photosynthesis reach maximum levels. In the meantime, flow conditions exceeding the pH objective would occur during periods of high photosynthesis, but they would not be expected to substantially adversely affect beneficial uses.

**Algal Toxins and Chlorophylls**

The Klamath Hydroelectric Project reservoirs currently create favorable growth conditions for toxin-producing nuisance algal species and produce high seasonal concentrations of cyanotoxins (e.g., microcystin >8 µg/L) and chlorophyll-a (>15 µg/L). Under the Dams In Scenario, continued impoundment of water in the project reservoirs would substantially impact seasonal algal toxins and chlorophyll-a in the Hydroelectric Reach for decades into the future, when full implementation of the Oregon and California TMDLs can be achieved. TMDL implementation is highly dependent on improvements in nutrients in upstream reaches. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer and early fall when photosynthesis is greatest.

**Inorganic and Organic Contaminants**

Low levels of organic and inorganic contaminants have been identified in the sediment deposits trapped behind the dams in the Hydroelectric Reach.[80] Benthic uptake and subsequent transfer through the food web is one potential pathway of contaminant exposure for aquatic organisms in the Hydroelectric Reach; exposure to water column contaminants is also a possible pathway. For contaminants influenced by pH or dissolved oxygen, concentrations at the sediment-water interface, such as methylmercury, could be transported to the water column via low redox conditions supported by reservoir stratification and seasonal anoxia. Human exposure to methylmercury and organic contaminants associated with reservoir sediments could occur through consumption of contaminated reservoir fishes or shellfish.

Existing data from the 2004 to 2005 and 2009 to 2010 sediment chemistry analyses, results of the 2009 to 2010 sediment bioassay tests, and fish tissue concentrations from a 2003 screening level study by PacifiCorp indicate that, for the most part, continued retention of sediments behind the KHP dams under the Dams In Scenario would not result in concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses, are toxic to humans, are toxic to national benchmark toxicity species, or result in bioaccumulation in the Hydroelectric Reach. Exceptions to this include possible exposure to low-level bioaccumulation of arsenic and mercury in fishes residing in the lacustrine environment of the project reservoirs. Effects of the Dams In Scenario on inorganic and organic contaminants in the lower Klamath River basin could be assessed because of a lack of information.

***Aquatic Resources***

Aquatic resources in the Klamath River basin are currently considered to be in poor condition relative to historic conditions. Fish, both anadromous and native resident, are considered to have low populations, and some have been listed under the ESA and CESA. Various environmental conditions can have strong effects on the survival of aquatic resources in the Klamath River that are important to the Hoopa Valley Indian Tribe because they are either trust resources or other resources traditionally used by the Hupa people. The following evaluation examines the aquatic resources in the Klamath River basin, and how any potential changes (or lack thereof) resulting from the Dams In Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries for the Hoopa Valley Indian Tribe. These fisheries are affected by riverine conditions such as water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on

[80] North Coast Regional Water Quality Control Board (2008); Shannon & Wilson, Inc. (2006); U.S. Department of the Interior (2010); Block Environmental Services (2010a–2010d).

water resources (temperature, sediment, pH, nutrients, etc.) are described in the previous section, and this section describes how the water resource conditions affect the fisheries of the Klamath River.

*Habitat Area*

The quantity and quality of aquatic and riparian habitats affect aquatic resource growth and survival. In-channel and floodplain habitat are important for spawning and rearing life stages. Habitat quality is affected directly and indirectly by changes in geomorphic processes, in-channel connectivity, food resources, and predation.

Under the Dams In Scenario, hydrology of the Klamath River from its headwaters to the estuary would generally remain the same as under current conditions, subject to the influence of climate change. Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the Klamath River (i.e., downstream from Iron Gate Dam) unless the NMFS BO is accepted by PacifiCorp, and fish passage is required. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. In addition, the structures not only block fish passage, but also alter bedload movement. The dams on the Klamath River have reduced the amount of available spawning habitat for fish in the Klamath River downstream from Iron Gate Dam. These contribute to the impacts to the anadromous fish populations. Recovery actions under the Klamath River Coho Salmon Recovery Plan would continue, depending on available funding. These actions would improve habitat conditions over time relative to current conditions.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[81] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to infections by stressing their immune systems. [82]

Anadromous fish currently experience increased water temperatures and water temperature regimes that have altered the migration timing for both juveniles and adults. Climate change is expected to result in further water temperature increases and changes in the flow hydrograph; that is, flow peaks and lows will occur at different times of the year than currently. Implementation of the TMDLs and the NMFS 2010 BO as described above will work toward reduced water temperature; however, the progression of climate change is expected to

[81] Hamilton et al. (2010).
[82] Wood et al. (2006).

reduce those benefits. The resulting water temperatures under the Dams In Scenario are expected to remain similar present conditions.

*Suspended and Bedload Sediments*

The success of fish populations has been linked to levels of turbidity and siltation in a watershed. Prolonged exposure to high levels of suspended sediment can create a loss of visual capability, leading to a reduction in feeding and growth rates; a thickening of the gill epithelium, potentially causing the loss of respiratory function; clogging and abrasion of gill filaments; and increases in stress levels, reducing the tolerance of fishes to disease and toxicants.[83]

In addition, high suspended sediment levels cause the movement and redistribution of fish populations and can affect physical habitat. After the suspended sediment is deposited, it can reduce water depth in pools, decreasing the water's physical carrying capacity for juvenile and adult fish.[84] Increased sediment loading can also degrade food-producing habitat downstream of the project area. Sediment loading can interfere with photosynthesis of aquatic flora and result in the displacement of aquatic fauna.

Many fish, including juvenile salmonids, are sight feeders. Turbid waters reduce the fish's efficiency in locating and feeding on prey. Some fish, particularly juveniles, can get disoriented and leave areas where their main food sources are located, which can result in reduced growth rates.

Sediment transport processes on bed elevation and bed substrate have the potential to affect riverine spawning habitat, as well as habitat for macroinvertebrates.

Under the Dams In Scenario, there is no anticipated change in suspended sediment concentration or bedload transport as described above. Therefore, anadromous fish are not expected to be affected by suspended sediment concentrations or transport of bedload materials.

*Other Water Quality Components*

Long-term dissolved oxygen levels under the Dams In Scenario would continue to exhibit seasonal variability and would not consistently meet California Basin Plan and Hoopa Valley Tribe water quality objectives for dissolved oxygen, and they would not consistently support designated beneficial uses in the Klamath River downstream of Iron Gate Dam.

Under the Dams In Scenario, continued high rates of algal photosynthesis in the reservoirs would result in high pH values in the lower Klamath River downstream of Iron Gate Dam. Under the Dams In Scenario, pH would

[83] Waters (1995).
[84] Waters (1995).

continue to be elevated with high daily variability during summer and early fall months

As a result, anadromous fish, under the Dams In Scenario, would continue to be impacted by poor dissolved oxygen levels, increased presence of algal toxins and pH, and other poor water quality conditions. Implementation of the TMDLs would ultimately result in long-term improvements; however, these improvements could be slightly offset by climate change.

*Disease and Parasites*
Fish diseases, specifically the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsula minibicornis,* cause substantial adverse impacts to Klamath River salmonids, including coho salmon and Chinook salmon. *Ichthyophthirius multifi* (Ich) and *Flavobacterium columnare* (columnaris disease) may also affect fishes in the Klamath River basin. These organisms occur throughout the watershed, but appear to have the most severe effect in the lower Klamath River basin. The two myxozoan parasites are chronic and cause high rates of mortality during most years. Ich and columnaris disease are episodic and have occasional substantive effects (e.g., the 2002 fish kill of Chinook salmon adults and juveniles). The effects of these diseases generally are not as harmful to salmonids as the myxozoan parasites, although impacts on juvenile salmonids and other species have not been well studied.

The Dams In Scenario would continue to contribute to the stable, warm habitat conditions that are favorable for polychaetes and for *C. shasta* and *P. minibicornis*. The hatchery would continue to operate and discharge its nutrient-rich effluent into the river. Fishes would continue to concentrate below Iron Gate Dam, where the polychaetes that serve as intermediate hosts for the parasites are abundant, facilitating cross infection between the fishes and the polychaetes.

**Estuarine Fish**
The estuary is the mixing zone for freshwater and ocean water. The balance of freshwater and saltwater changes over the course of the day with tides and is also strongly influenced by river flows. Because of this, both marine and freshwater species can often be found in different portions of the estuary at different times. All anadromous fish pass through the estuary during their migrations from freshwater to the sea and back again, and juvenile salmonids may rear in the estuary for varying periods of time, prior to moving into the ocean. Some of the fish species in the Klamath Estuary include northern anchovy, federally listed eulachon, state-listed longfin smelt, silversides, surf smelt, stickleback, and several gobies.

There are no anticipated changes to the Klamath Estuary as a result of the Dams In Scenario; therefore, no effects on the estuarine fisheries are anticipated.

**Aquatic Invertebrates**

Aquatic invertebrates are sensitive to water quality conditions because they either tend to have a small range or are sessile creatures. They are often treated as indicator species, meaning their populations and health are indicative of the health of the ecosystem.

Four species of native freshwater mussels have been observed in the Klamath River basin, three of which are located along Klamath River reaches from the Keno Impoundment to the confluence of the Klamath and Shasta rivers, and one along the Klamath River from Iron Gate Dam to the confluence of the Klamath and Trinity rivers. [85]

Benthic macroinvertebrates include immature, aquatic stages of insects, such as midges, mayflies, caddisflies, stoneflies, and aquatic beetles, as well as crustaceans, mollusks, aquatic worms, and other major invertebrate groups. Many benthic macroinvertebrates are the primary consumers in riverine food webs, feeding on primary producers—algae, aquatic plants, phytoplankton, bacteria, leaves and other materials from terrestrial plants, and detritus. By converting organic material into biomass available to a wide variety of consumers, these organisms form an important component of the aquatic food web.

Under the Dams In Scenario, aquatic invertebrates would continue to be affected by poor water quality conditions.

***Ecosystem Functionality/Effects***

Under the Dams In Scenario, fish and invertebrate populations will continue to be affected by loss of habitat, less suitable water temperature regimes, and blockage of substrate movement negatively affecting spawning habitat and creating poor water quality conditions and more suitable habitat conditions for the spread of disease and parasites. These reduced fish and invertebrate populations are indicative of an unhealthy ecosystem. It is not only fish and aquatic invertebrates that are affected by the altered Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are also affected by the heavily managed and modified Klamath River.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to remain low, with low viability of Klamath River populations. Efforts to improve habitat are underway, along with implementation of the TMDLs and the NMFS 2010 BO, if accepted. These efforts will help reduce the stress on the fish, but will not be sufficient to bring the species to recovery. Climate change is also expected to negatively affect the survival and propagation of fish species.

[85] Federal Energy Regulatory Commission, 2007; Westover (2010).

Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the Lower Klamath River basin; however, under the FERC relicensing process, NMFS could prescribe fish passage at these structures. But if this passage does not occur, this restriction will prevent the fishes from accessing approximately 350 miles of spawning and rearing habitat unless fish passage is required under an accepted NMFS BO. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. Fewer anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have reduced food resources. Additionally, it has been shown that Chinook salmon carcasses are an important nutrient in the system, providing increased food resources for smaller and/or younger fishes. The reduction in carcasses would result in reduced nutrient input.

Under the Dams In Scenario, flows will continue to be managed differently than would occur in a natural hydrograph. These managed flows will continue to change the geomorphology of the lower river, impact riparian vegetation recruitment, reduce river habitat heterogeneity, reduce instream fish habitat structures, decrease food web support, increase nutrient input, and continue to impact water quality as described above. Impacts to the Klamath River and to the habitat and terrestrial species dependent on the Klamath River will continue to occur.

The presence of upstream reservoirs and poor water quality result in increased amounts of toxic algae in the summer months. Implementation of the TMDLs and the accepted BOs will improve overall conditions for the fisheries; however, because of the lack of access to the upper watershed, where optimal spawning habitat previously occurred, anadromous fish populations will not be able to fully recover. Additionally, populations of coho salmon and spring-run Chinook salmon will continue to remain low, with a high risk of upgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

The Hoopa Valley Indian Tribe has fishing rights for in-river Klamath River basin fishes that use the Trinity River or the approximately 1/3 mile of the Klamath River that is within the Hoopa Indian Valley Reservation for migration and spawning in an amount sufficient to support a moderate standard of living. The tribe also has subsistence and ceremonial fisheries.

Hydrology and water quality throughout the Klamath River are important to support the aquatic ecosystems on which these fishes depend. In addition, the Klamath River is central to many Hupa cultural activities such as bathing and religious ceremonies.

Under the Dams In Scenario, the Hoopa Valley Indian Tribe fisheries are likely to remain insufficient for even a moderate standard of living. Anadromous fish

are important to the Hupa people for ceremonial purposes, some of which are scheduled around fishing activities. Under the Dams In Scenario, these ceremonies will continue to be affected by reduced fish populations.

Effects of project reservoirs on water quality issues, such as the growth of toxin-producing nuisance algae, elevated water temperatures and modified temperature regimes, high pH, and increased toxicity, currently adversely impact the Hoopa Valley Indian Tribe cultural values. These cultural values include conducting traditional bathing ceremonies and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem for the Hoopa Valley Indian Tribe as it degrades water for contact recreational and ceremonial uses and can produce toxins hazardous to fishes and humans. However, over time, successful implementation of the various TMDLs could result in Klamath River water quality trending toward compliance with water quality objectives and improved support of beneficial uses by the Hoopa Valley Indian Tribe. Implementation of TMDLs would be expected to occur more slowly under the Dams In Scenario than under the Dams Out Scenario; and there is substantial uncertainty over when and whether TMDL targets would be achieved, especially given the potentially detrimental effect of climate change.[86]

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the Hupa people, and reduced availability of these fishes has contributed to impaired health of tribal members. Additionally, tribal health is integrally related to cultural values. Following the reduction of these fish species, there has been a continual rise in cardiovascular disease, diabetes, and, in many cases, depression. The loss of the Klamath River basin fisheries has led to lost opportunities for intergenerational transmission of traditional knowledge and an increase in the number of young people leaving the ancestral homeland in search of a higher standard of living. The loss of riparian vegetation has resulted in reduced ability to gather plants that might be used for such things as basket making, medicine, utensils, regalia, and structures. Under the Dams In Scenario, the effects of the continued operations of the Klamath Project, even with the implementation of the TMDLs and BOs, would likely preclude improvements to the cultural values of the Hoopa Valley Indian Tribe because fish populations are not expected to recover to healthy populations.

[86] Hamilton et al. (2010).

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## Karuk Tribe

### *Water Resources*

**Hydrology**

USGS records indicate that, relative to historical conditions, operation of the dams has slightly increased fall base flows, while spring, summer, and winter base flows have dramatically decreased. USGS records for Iron Gate Dam also show a decrease in the magnitude of peak flows, a 2-month shift in timing of flow minimums from September to July, and a reduction in the total volume of discharge during the summer months.[87] By reducing variability in the range of flows that led to diverse life history strategies, changes in the annual hydrology have negatively impacted populations of fish that have evolved under the natural flow regime.

Under the Dams In Scenario, Klamath River flows would continue to be regulated at the USGS gage immediately downstream from Iron Gate Dam. Reduced flow variability relative to pre-dam conditions would continue. Evaporation in the reservoirs would continue, resulting in lower flows below Iron Gate Dam. However, water releases at Iron Gate Dam are expected to be consistent with the NMFS 2010 BO (as of the date of this document not accepted by PacifiCorp), which prescribes instantaneous minimum flows to increase fall and winter flow variability and increase spring discharge in select average and wetter flow conditions.[88] Alternatively, the flow plan developed under the KBRA takes a more holistic, ecosystem-wide approach to river flows.

**Water Temperature**

The Klamath River, from River Mile 231.1 (about 23 miles upstream from the California-Oregon border) to the river mouth, has been listed as impaired for water temperature.[89] Based on modeled current conditions, the reservoirs alter the natural thermal regime of the river by delaying the warming of water in the spring and the cooling of water in the late summer and fall in the lower Klamath River, with the largest effects occurring just downstream of Iron Gate Dam.[90] These effects diminish with distance downstream such that they are not discernible below the confluence of the Klamath River and the Scott River.

Under the Dams In Scenario, water temperatures would continue the temporal shift from natural conditions, with water temperatures that are 1ºC to 2.5ºC (1.8°F to 4.5 °F) cooler than natural conditions in the spring and 2ºC to 10ºC (3.6°F to 18°F) warmer than natural conditions in the summer and fall. These water temperatures would result in non-attainment of designated beneficial uses

[87] Hamilton et al. (2010).
[88] National Marine Fisheries Service (2010).
[89] State Water Resources Control Board (2006); Oregon Department of Environmental Quality (2002).
[90] PacifiCorp (2004), North Coast Regional Water Quality Control Board (2010).

immediately downstream of Iron Gate Dam. Implementation of NMFS 2010 BO mandatory flows and the CDFG Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River would increase seasonal stream flow and might moderately decrease water temperatures in the lower Klamath River, particularly during summer and fall months. Although full implementation of these mandatory flows and Oregon and California TMDLs would result in a long-term trend toward compliance with water temperature objectives and unimpaired support of beneficial uses, this would require decades to achieve and could be offset by climate change, particularly during summer when water temperatures would be highest.

**Suspended Sediments**

Under the Dams In Scenario, suspended sediment would continue to range from less than 5 mg/L during summer low flows to greater than 5,000 mg/L during winter high flows downstream from Iron Gate Dam. During heavy winter storms or following landslides in the Klamath River basin, extremely high concentrations of suspended sediments have been observed in the Klamath River mainstem and tributaries. The Dams In Scenario would not change suspended sediment transport relative to existing conditions.

Ongoing interception and retention of suspended material with large seasonal increases in algae-derived suspended material from reservoir algal blooms would continue in the Hydroelectric Reach and downstream from Iron Gate Dam. Although full implementation of Oregon and California TMDLs would indirectly decrease algae-derived suspended sediment in the reservoirs, this would not eliminate the conditions that support episodic increases in downstream suspended sediment under the Dams In Scenario and it would require decades to achieve. Additionally, some of these benefits could be offset by climate change.

Under the Dams In Scenario, the Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Reclamation estimates that the four subject reservoirs would store 2.35 million cubic yards of fine and coarse sediment by 2061.[91] The Klamath River would, however, continue to receive coarse sediment from the tributaries.[92] The Dams In Scenario would not change bedload transport to the Klamath Estuary or the Pacific Ocean relative to existing conditions.

**Nutrients**

On an annual basis, concentrations of nutrients in the Klamath River downstream from Iron Gate Dam tend to be lower than in upstream reaches because of the settling of particulate matter and associated nutrients in the larger Klamath Hydroelectric Project reservoirs, as well as dilution from large springs

[91] U.S. Bureau of Reclamation (2011).
[92] Hetrick et al. (2009).

below J. C. Boyle Reservoir. Nutrient levels tend to decrease farther downstream in the mainstem lower Klamath River because of a combination of tributary dilution and in-river nutrient removal processes. Regardless, nutrient concentrations during late summer and early fall do not meet the relevant water quality objectives. On a seasonal basis, nutrients can increase downstream of the reservoirs at the reservoirs because of release of phosphorus and ammonia to the water column during periods anoxic conditions.

Under the Dams In Scenario, ongoing interception and retention of nutrients with seasonal releases of phosphorus and ammonia in the project reservoirs would continue. Although full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with nutrient objectives and unimpaired support of beneficial uses, this would require decades to achieve.

**Dissolved Oxygen**

Similar to current conditions current conditions, dissolved oxygen levels under the Dams In Scenario would continue to exhibit summer and fall levels substantially below water quality objectives. As long as Iron Gate and Copco reservoirs remain in place, they are likely to have water with low/zero oxygen in their depths during the summer months when the reservoirs are thermally stratified. Dissolved oxygen levels would not consistently support designated beneficial uses for decades into the future, when full implementation of Oregon and California TMDLs could be achieved. Resource management actions in the upper watershed, such as the Williamson River Delta Project and Agency Lake and Barnes Ranches Project, could contribute to long-term improvements in seasonally low dissolved oxygen in Upper Klamath Lake. These actions could decrease overall suspended sediment and nutrient inputs to Upper Klamath Lake and downstream reaches, and correspondingly decrease oxygen demand in the Hydroelectric Reach.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with dissolved oxygen objectives and unimpaired support of beneficial uses in the Hydroelectric Reach, this would require decades to achieve. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer when water temperatures are highest.

**pH**

Currently, high rates of algal photosynthesis in Upper Klamath Lake and the project reservoirs result in pH values that do not consistently meet applicable water quality objectives and could adversely affect beneficial uses. Under the Dams In Scenario, ongoing seasonal and daily variability in pH would continue, with large daily fluctuations occurring in reservoir surface waters during periods

of intense algal blooms in the Hydroelectric Reach and the lower Klamath River downstream from Iron Gate Dam.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with pH objectives and unimpaired support of beneficial uses, this would require decades to achieve. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer and early fall when rates of photosynthesis reach maximum levels. In the meantime, although flow conditions exceeding the pH objective would occur during periods of high photosynthesis, they would not be expected to adversely affect beneficial uses substantially.

**Algal Toxins and Chlorophylls**

The Klamath Hydroelectric Project reservoirs currently create favorable growth conditions for toxin-producing nuisance algal species and produce high seasonal concentrations of cyanotoxins (e.g., microcystin >8 µg/L) and chlorophyll-a (>15 µg/L). Under the Dams In Scenario, continued impoundment of water in the project reservoirs would substantially impact seasonal blooms of algal toxins and chlorophyll-a in the Hydroelectric Reach for decades into the future, when full implementation of the Oregon and California TMDLs can be achieved. TMDL implementation is highly dependent on improvements in nutrients in upstream reaches. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer and early fall when photosynthesis is greatest.

**Inorganic and Organic Contaminants**

Low levels of organic and inorganic contaminants have been identified in the sediment deposits trapped behind the dams in the Hydroelectric Reach.[93] Benthic uptake and subsequent transfer through the food web is one potential pathway of contaminant exposure for aquatic organisms in the Hydroelectric Reach; exposure to water column contaminants is another possible pathway. For contaminants influenced by pH or dissolved oxygen, concentrations at the sediment-water interface, such as methylmercury, could be transported to the water column via low redox conditions supported by reservoir stratification and seasonal anoxia. Human exposure to methylmercury and organic contaminants associated with reservoir sediments could occur through consumption of contaminated reservoir fishes or shellfish.

Existing data from the 2004 to 2005 and 2009 to 2010 sediment chemistry analyses, results of the 2009 to 2010 sediment bioassay tests, and fish tissue concentrations from a 2003 screening level study by PacifiCorp indicate that, for the most part, continued retention of sediments behind the KHP dams under

[93] North Coast Regional Water Quality Control Board (2008); Shannon & Wilson, Inc. (2006); U.S. Department of the Interior (2010); Block Environmental Services (2010a–2010d).

the Dams In Scenario would not result in concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses, are toxic to humans, are toxic to national benchmark toxicity species, or result in bioaccumulation in the Hydroelectric Reach. Exceptions to this include possible exposure to low-level bioaccumulation of arsenic and mercury in fishes residing in the lacustrine environment of the project reservoirs. Effects of the Dams In Scenario on inorganic and organic contaminants in the lower Klamath River basin could not be assessed because of a lack of information.

#### *Aquatic Resources*

Aquatic resources in the Klamath River basin are currently considered to be in poor condition relative to historic conditions. Fish, both anadromous and native resident, are considered to have low populations, and some have been listed under the ESA and CESA. Various environmental conditions can have strong effects on the survival of aquatic resources in the Klamath River that are important to the Karuk Tribe because they are either trust resources or other resources traditionally used by the Karuk people. The following evaluation examines the aquatic resources in the Klamath River basin and how any potential changes (or lack thereof) resulting from the Dams In Scenario would affect the aquatic resources.

#### Anadromous Fish

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Karuk Tribe. These fisheries are affected by riverine conditions including water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) are described in the previous section, and this section describes how the water resource conditions affect the fisheries of the Klamath River. Ishi Pishi Falls is a sacred fishery that is also used for subsistence needs. It is believed that the thermal lag from Iron Gate Dam in the fall delays the fall Chinook migration up to 2 weeks in low-water years. The Iron Gate Fish Hatchery has dramatically reduced the Chinook harvest rates for Karuk fishers. It is believed that eight pulses of Chinook migrated through the falls during a fishing season beginning in July (dictated ceremonially) and ending in November. Now only remnants of those populations remain, with a majority of fishes caught each year originating in the hatchery. The peak harvest rates of this fishery have dwindled from approximately 3 months (August through October) to approximately 3 weeks. The Karuk Tribe has a state fishing right for dip-net fishing at Ishi Pishi Falls. This fishery is expected to continue to suffer as a result of the Dams In Scenario because Chinook salmon populations would remain low.

*Habitat Area*

The quantity and quality of aquatic and riparian habitats affect growth and survival of aquatic resources. In-channel and floodplain habitat are important for spawning and rearing life stages. Habitat quality is affected directly and

indirectly by changes in geomorphic processes, in-channel connectivity, food resources, and predation.

Under the Dams In Scenario, hydrology of the Klamath River from its headwaters to the estuary would generally remain the same as under current conditions, subject to the influence of climate change. Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the Lower Klamath River basin unless the NMFS BO is accepted by PacifiCorp, and fish passage is required. But if this passage does not occur, this restriction will prevent the fishes from accessing approximately 350 miles of spawning and rearing habitat. Because salmon no longer populate the upper basin, the "Achiipiich" (large out-migrants that reared in the upper basin) are no longer in the system. These fishes were a key feature of certain ceremonies. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. In addition, the structures not only block fish passage, but also alter bedload movement. The dams on the Klamath River have reduced the amount of available spawning habitat for fish in the Klamath River downstream from Iron Gate Dam. These contribute to the impacts to the anadromous fish populations. Recovery actions under the Klamath River Coho Salmon Recovery Plan would continue, depending on available funding. These actions would improve habitat conditions over time relative to current conditions.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[94] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to infections by stressing their immune systems.[95]

Anadromous fish currently experience increased water temperatures and water temperature regimes that have altered the migration timing for both juveniles and adults. Climate change is expected to result in further water temperature increases and changes in the flow hydrograph; that is, flow peaks and lows will occur at different times of the year than currently. Implementation of the TMDLs and the NMFS 2010 BO as described above will work toward reduced water temperature; however, the progression of climate change is expected to reduce those benefits. The resulting water temperatures under the Dams In Scenario are expected to remain similar to current conditions.

[94] Hamilton et al. (2010).
[95] Wood et al. (2006).

*Suspended and Bedload Sediments*

The success of fish populations has been linked to levels of turbidity and siltation in a watershed. Prolonged exposure to high levels of suspended sediment can create a loss of visual capability, leading to a reduction in feeding and growth rates; a thickening of the gill epithelium, potentially causing the loss of respiratory function; clogging and abrasion of gill filaments; and increases in stress levels, reducing the tolerance of fishes to disease and toxicants.[96]

In addition, high suspended sediment levels cause the movement and redistribution of fish populations and can affect physical habitat. After the suspended sediment is deposited, it can reduce water depth in pools, decreasing the water's physical carrying capacity for juvenile and adult fish.[97] Increased sediment loading can also degrade food-producing habitat downstream of the project area. Sediment loading can interfere with photosynthesis of aquatic flora and result in the displacement of aquatic fauna.

Many fish, including juvenile salmonids, are sight feeders. Turbid waters reduce the fishes' efficiency in locating and feeding on prey. Some fish, particularly juveniles, can get disoriented and leave areas where their main food sources are located, which can result in reduced growth rates.

Sediment transport processes on bed elevation and bed substrate have the potential to affect riverine spawning habitat, as well as habitat for macroinvertebrates.

Under the Dams In Scenario, no change is anticipated in suspended sediment concentration or in bedload transport, as described above. Therefore, anadromous fish are not expected to be affected by suspended sediment concentrations or transport of bedload materials.

*Other Water Quality Components*

Long-term dissolved oxygen levels under the Dams In Scenario would continue to exhibit seasonal variability and would not consistently meet California Basin Plan and Hoopa Valley Tribe water quality objectives for dissolved oxygen. In addition, these levels would not consistently support designated beneficial uses in the Klamath River downstream of Iron Gate Dam.

Under the Dams In Scenario, continued high rates of algal photosynthesis in the reservoirs would result in high pH values in the lower Klamath River downstream of Iron Gate Dam. Under the Dams In Scenario, pH would continue to be elevated with high daily variability during summer and early fall months.

[96] Waters (1995).
[97] Ibid.

As a result, anadromous fish, under the Dams In Scenario, would continue to be impacted by poor dissolved oxygen levels, increased presence of algal toxins and pH, and other poor water quality conditions. Implementation of the TMDLs would ultimately result in long-term improvements; however, these improvements could be slightly offset by climate change.

*Disease and Parasites*
Fish diseases, specifically the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsula minibicornis,* cause substantial adverse impacts to Klamath River salmonids, including coho salmon and Chinook salmon. *Ichthyophthirius multifi* (Ich) and *Flavobacterium columnare* (columnaris disease) may also affect fishes in the Klamath River basin. These organisms are found throughout the watershed, but appear to have the most severe impact in the lower Klamath River basin. The two myxozoan parasites are chronic and cause high rates of mortality during most years. Ich and columnaris disease are episodic and have occasional substantive effects (e.g., the 2002 fish kill of Chinook salmon adults and juveniles). The effects of these diseases generally are not as harmful to salmonids as the myxozoan parasites, although impacts on juvenile salmonids and other species have not been well studied.

The Dams In Scenario would continue to contribute to the stable, warm habitat conditions that are favorable for polychaetes and for *C. shasta* and *P. minibicornis*. The hatchery would continue to operate and discharge its nutrient-rich effluent into the river. Fishes would continue to concentrate below the Iron Gate Dam, where the polychaetes that serve as intermediate hosts for the parasites are abundant, facilitating cross infection between the fishes and the polychaetes.

**Estuarine Fish**
The estuary is the mixing zone for freshwater and ocean water. The balance of freshwater and saltwater changes over the course of the day with tides and is also strongly influenced by river flows. Because of this, both marine and freshwater species can often be found in different portions of the estuary at different times. All anadromous fish pass through the estuary during their migrations from freshwater to the sea and back again, and juvenile salmonids may rear in the estuary for varying periods of time prior to moving into the ocean. Some of the fish species in the Klamath Estuary include northern anchovy, federally listed eulachon, state-listed longfin smelt, silversides, surf smelt, stickleback, and several gobies.

There are no anticipated changes to the Klamath Estuary as a result of the Dams In Scenario; therefore, no effects on the estuarine fisheries are anticipated.

**Aquatic Invertebrates**
Aquatic invertebrates are sensitive to water quality conditions because they either tend to have a small range or are sessile creatures. They are often treated

as indicator species, meaning their populations and health are indicative of the ecosystem health.

Four species of native freshwater mussels have been observed in the Klamath River basin, three of which are located along Klamath River reaches from the Keno Impoundment to the confluence of the Klamath and Shasta rivers, and one along the Klamath River from Iron Gate Dam to the confluence of the Klamath and Trinity rivers. [98]

Benthic macroinvertebrates include immature, aquatic stages of insects such as midges, mayflies, caddisflies, stoneflies, and aquatic beetles, as well as crustaceans, mollusks, aquatic worms, and other major invertebrate groups. Many benthic macroinvertebrates are the primary consumers in riverine food webs, feeding on primary producers—algae, aquatic plants, phytoplankton, bacteria, leaves and other materials from terrestrial plants, and detritus. By converting organic material into biomass available to a wide variety of consumers, these organisms form an important component of the aquatic food web.

Under the Dams In Scenario, aquatic invertebrates would continue to be affected by poor water quality conditions.

#### *Ecosystem Functionality/Effects*

Under the Dams In Scenario, fish and invertebrate populations will continue to be affected by loss of habitat, less suitable water temperature regimes, and blockage of substrate movement negatively affecting spawning habitat, poor water quality conditions, and more suitable habitat conditions for the spread of disease and parasites. These reduced fish and invertebrate populations are indicative of an unhealthy ecosystem. It is not only fish and aquatic invertebrates that are affected by the altered Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are also affected by the heavily managed and modified Klamath River.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to remain low, with low viability of Klamath River populations. Efforts to improve habitat are underway, along with implementation of the TMDLs and the NMFS 2010 BO, if accepted. These efforts will help reduce the stress on the fish, but will not be sufficient to bring the species to recovery. Climate change is also expected to negatively affect the survival and propagation of fish species.

Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the lower Klamath River basin. This restriction prevents these fishes from accessing approximately 350 miles of spawning and rearing

[98] Federal Energy Regulatory Commission (2007); Westover (2010).

habitat unless fish passage is required under an accepted NMFS BO. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. The reduced numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have reduced food resources. Additionally, it has been shown that Chinook salmon carcasses are an important nutrient in the system, providing increased food resources for smaller and/or younger fishes. The reduction in carcasses would result in reduced nutrient input.

Under the Dams In Scenario, flows will continue to be managed differently than would occur in a natural hydrograph. These managed flows will continue to change the geomorphology of the lower river, impact riparian vegetation recruitment, reduce river habitat heterogeneity, reduce instream fish habitat structures, decrease food web support, increase nutrient input, and continue to impact water quality as described above. Impacts to the Klamath River and to the habitat and terrestrial species dependent on the Klamath River will continue to occur.

The presence of upstream reservoirs and poor water quality result in increased amounts of toxic algae in the summer months. Implementation of the TMDLs and the accepted BOs will improve overall conditions for the fisheries; however, because of the lack of access to the upper watershed, where optimal spawning habitat previously as found, anadromous fish populations will not be able to fully recover. Additionally, populations of coho salmon and spring-run Chinook salmon will remain low, with a high risk of upgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

Hydrology and water quality throughout the Klamath River are important to support the aquatic ecosystems on which these fishes depend. In addition, the Klamath River is central to many Karuk cultural activities such as bathing and religious ceremonies. During Pikiawish, the medicine man and key participants go through a spiritual purification process that is symbolized by bathing in the Klamath River numerous times throughout the ceremony. Three out of the four Pikiawish ceremonies are held in July, August, and September with the lone exception being the first salmon ceremony, which is held in April.

Anadromous fish are important to the Karuk people for subsistence and ceremonial purposes, some of which are scheduled around fishing activities. Without fishes there will be no fishers. In order to become a fisher, a person must understand the holistic connection of people, the earth, spirituality, and the management prescriptions of the creator that are the basis of Karuk ceremonies. Karuk moral and social values are taught to people as they learn these connections. Without fish, this part of Karuk culture ceases to exist. As a result, social and health problems run rampant in Karuk country. Under the

Dams In Scenario, these ceremonies will continue to be affected by reduced fish populations.

Effects of project reservoirs on water quality issues, such as the growth of toxin-producing nuisance algae, elevated water temperatures and modified temperature regimes, high pH, and increased toxicity, currently adversely impact the Karuk Tribe cultural values, such as conducting traditional bathing ceremonies, fishing, and enjoying the aesthetic qualities of the river. Algae from the reservoirs in particular are a major problem for the Karuk Tribe. The algae produce potent liver toxins at such a high level that warnings against contact with the water are posted along the river each summer. However, over time, successful implementation of the various TMDLs could result in Klamath River water quality trending toward compliance with water quality objectives and improved support of beneficial uses by the Karuk Tribe. Implementation of TMDLs would be expected to occur more slowly under the Dams In Scenario than under the Dams Out Scenario; and there is substantial uncertainty over when and whether TMDL targets would be achieved, especially given the potentially detrimental effect of climate change.[99]

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the Karuk people, and reduced availability of these fishes has contributed to impaired health of tribal members. Additionally, tribal health is integrally related to cultural values. Following the reduction of these fish species, there has been a continual rise in cardiovascular disease, diabetes, and, in many cases, depression. The loss of the Klamath River basin fisheries has led to lost opportunities for intergenerational transmission of traditional knowledge and an increase in the number of young people leaving the ancestral homeland in search of a higher standard of living. The loss of riparian vegetation has resulted in reduced opportunities to gather plants that might be used for such things as basket making, medicine, utensils, regalia, and structures. Under the Dams In Scenario, the effects of the continued operations of the Klamath Project, even with the implementation of the TMDLs and BOs, would likely preclude improvements in the cultural values of the Karuk Tribe because fish populations are not expected to recover to healthy populations.

Degraded water quality in the Klamath River basin, including the seasonal presence of algal toxins in the Klamath River and reservoirs, has impaired the ability of the Karuk to use the water for cultural purposes. The fact that algal toxin concentrations generally decline with distance downstream of Iron Gate Dam, and that the Karuk are located closer to Iron Gate Dam than the other tribes, suggests that the Karuk likely experience higher exposure to algal toxins than downstream tribes. Known and/or perceived health risks associated with degraded water quality have resulted in the alteration of cultural ceremonies to

[99] Hamilton et al. (2010).

exclude or limit ingestion of river water. Additionally, known or perceived risk of exposure to degraded water quality conditions during ceremonial bathing and traditional cultural activities such as gathering and preparing basket materials and plants for other purposes has resulted in an impairment of cultural use. Bathing in the river is an important part of most ceremonies and cultural activities throughout the year, such as the Pikiawish World Renewal Ceremonies (which include the First Salmon Ceremony and ceremonies at Inaam, Tishanik, and Ka'tim'îin), the Brush Dance Ceremony, funeral services, subsistence practices, recreational swimming, courtship, and individual hygiene.[100] The Karuk Tribe historically bathed in the Klamath River; however, in more recent years, degraded water quality conditions during the summer have forced them to take precautionary steps and avoid contact with the water.[101]

Under the Dams In Scenario, continued impoundment of water in the project reservoirs would support growth conditions for toxin-producing nuisance algal species such as *Microcystis aeruginosa,* resulting in periodically high levels of algal toxins transported into the Klamath River downstream of Iron Gate Dam during summer and fall months. These levels would not meet applicable water quality objectives, and would thus adversely affect Karuk cultural uses. However, given full successful implementation of the TMDLs addressing water quality impairments in the lower Klamath River basin (as well as those in the upper Klamath River basin that would influence water quality farther downstream, as discussed in the Klamath Tribes section), the long-term anticipated effect on algal toxin levels and other water quality constituents in the Klamath River in the Karuk Reservation under the Dams In Scenario is a trend toward compliance with water quality objectives and support of cultural values associated with high quality water. Regardless, the pace and extent of TMDL implementation are not entirely certain and would be expected to be slower under the Dams In Scenario relative to the Dams Out Scenario; in addition, there is substantial uncertainty over when and whether TMDL targets would be achieved, especially given the potentially detrimental effect of climate change.[102] Also, the anticipated effects of climate change could negate some of the benefits of TMDL implementation.

[100] Reed (2007), as cited in Salter (2010).
[101] Ibid.
[102] Hamilton et al. (2010)

## Quartz Valley Indian Community

There are no trust resources, tribal rights, or other resources traditionally used by the Quartz Valley Indian Community associated with water or fishes that are affected by the Dams In Scenario.

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## Klamath Tribes

### *Water Resources*

**Hydrology**

Surface elevations in Upper Klamath Lake are regulated at Link River Dam, owned by Reclamation, at the southern outlet of the lake. Upper Klamath Lake is fed by groundwater and inflows from the Wood River and the Williamson River (and its tributary, the Sprague River). Reclamation operates Upper Klamath Lake to meet multiple requirements, including Reclamation contract needs and the requirements of the USFWS and NMFS BOs (if accepted by PacifiCorp) to meet minimum lake elevations required for endangered suckers and minimum instream flows in the Klamath River downstream from Iron Gate Dam for coho salmon.[103] Under the Dams In Scenario, hydrology and lake levels in Upper Klamath Lake and its tributaries would generally remain the same as existing conditions, regulated by requirements of the BOs, subject to the influence of climate change. Higher air temperatures associated with climate change are expected to increase agricultural water demand, reduce snowpack and water availability, and increase evapotranspiration rates.

In the Hydroelectric Reach between Keno Dam and Iron Gate Dam, operation of the project dams, including peaking operations for hydropower production and diversion of water out of the channel, causes flow and water quality impairments that degrade habitat and other beneficial uses, both within the reach and downstream.[104] In the lower Klamath River basin, USGS records indicate that, relative to historical conditions, operation of the dams has slightly increased fall base flows, while spring, summer, and winter base flows have dramatically decreased. USGS records for Iron Gate Dam also show a decrease in the magnitude of peak flows, a 2-month shift in timing of flow minimums from September to July, and a reduction in the total volume of discharge during the summer.[105] By reducing variability in the range of flows that have led to diverse life history strategies, changes in the annual hydrology have negatively impacted populations of fish that have evolved under the natural flow regime.

Under the Dams In Scenario, Klamath River flows would continue to be regulated at the USGS gage immediately downstream from Iron Gate Dam. Reduced flow variability relative to pre-dam conditions would continue. Evaporation in the reservoirs would continue, resulting in lower flows below Iron Gate Dam. However, water releases at Iron Gate Dam are expected to be consistent with the NMFS 2010 BO (as of the date of this document not accepted by PacifiCorp), which prescribes instantaneous minimum flows to

[103] Hamilton et al. (2010).
[104] Ibid.
[105] Ibid.

increase fall and winter flow variability and increase spring discharge in select average and wetter flow conditions.[106]

**Water Temperature**

The Klamath River, from River Mile 231.1 (about 23 miles upstream from the California-Oregon border) to the river mouth, has been listed as impaired for water temperature.[107]

Under the Dams In Scenario, several ongoing resource management actions, such as the Williamson River Delta Project and the Agency Lake and Barnes Ranches Project, could improve springtime water temperatures for spawning and rearing of fishes in Upper Klamath Lake its tributaries. Additional ongoing resource management actions related to spring, summer, and fall water temperatures in tributaries to Upper Klamath Lake include floodplain rehabilitation, large woody debris replacement, riparian vegetation planting, and purchase of conservation easements and/or land. Although these resource management actions would improve water temperatures in the upper Klamath River basin under the Dams In Scenario, the effects would be only local and would not measurably improve water temperatures below Keno Dam. Assuming eventual full implementation of the Oregon and California TMDLs in the upper Klamath River basin, water temperature objectives can be met; however, the timeframes for achieving water temperature allocations required under these TMDLs will depend on the measures taken to improve water quality conditions. Continued impoundment of water at the Klamath Hydroelectric project reservoirs would have a significant impact on seasonal water temperatures in the Hydroelectric Reach for decades to come, when full implementation of the Oregon and California TMDLs can be achieved.

In the lower Klamath River basin, based on modeled current conditions, the reservoirs alter the natural thermal regime of the river by delaying the warming of water in the spring and the cooling of water in the late summer and fall in the lower Klamath River, with the largest effects occurring just downstream from Iron Gate Dam.[108] These effects diminish with distance downstream such that they are not discernible below the confluence of the Klamath River and the Scott River.

Under the Dams In Scenario, water temperatures would continue the temporal shift from natural conditions, with water temperatures that are 1ºC to 2.5ºC (1.8°F to 4.5 °F) cooler than natural conditions in the spring and 2ºC to 10ºC (3.6°F to 18°F) warmer than natural conditions in the summer and fall. These water temperatures would result in non-attainment of designated beneficial uses immediately downstream of Iron Gate Dam. Implementation of NMFS 2010

[106] National Marine Fisheries Service (2010).
[107] State Water Resources Control Board (2006); Oregon Department of Environmental Quality (2002).
[108] PacifiCorp (2004); North Coast Regional Water Quality Control Board (2010).

BO mandatory flows and the CDFG Code Section 5937 instream flow mandate for tributaries to the mainstem Klamath River would increase seasonal stream flow and might moderately decrease water temperatures in the lower Klamath River, particularly during summer and fall months. Although full implementation of these mandatory flows and Oregon and California TMDLs would result in a long-term trend toward compliance with water temperature objectives and unimpaired support of beneficial uses, this would require decades to achieve and could be offset by climate change, particularly during summer when water temperatures would be highest.

**Suspended Sediments**

Under the Dams In Scenario, suspended sediment would continue to range from less than 5 mg/L during summer low flows to greater than 5,000 mg/L during winter high flows downstream from Iron Gate Dam. During large winter storms or following landslides in the Klamath River basin, extremely high concentrations of suspended sediments have been observed in the Klamath River mainstem and tributaries. The Dams In Scenario would not change suspended sediment transport relative to existing conditions. Ongoing interception and retention of suspended material, with large seasonal increases in algae-derived suspended material from reservoir algal blooms, would continue in the Hydroelectric Reach and downstream from Iron Gate Dam.

Although full implementation of Oregon and California TMDLs and ongoing resource management actions in the upper Klamath River basin would indirectly decrease algae-derived suspended sediment in the reservoirs, this would not eliminate the conditions that support episodic increases in downstream suspended sediment under the Dams In Scenario. Furthermore, it would require decades to achieve. Additionally, some of these benefits could be offset by climate change.

Under the Dams In Scenario, the Klamath Hydroelectric Project dams would continue to trap fine and coarse sediment and reduce the storage capacity of the reservoirs. Reclamation estimates that the four subject reservoirs would store 2.35 million cubic yards of fine and coarse sediment by 2061.[109] The Klamath River would, however, continue to receive coarse sediment from the tributaries.[110] The Dams In Scenario would not change bedload transport to the Klamath Estuary or the Pacific Ocean relative to existing conditions.

**Nutrients**

Under the Dams In Scenario, the ongoing Williamson River Delta Project, Agency Lake and Barnes Ranches Project, full TMDL implementation, and other resource management actions would provide long-term reductions in nutrients transported to Upper Klamath Lake. Short-term releases of nutrients

[109] Reclamation (2011).
[110] Hetrick et al. (2009).

are possible during project construction; at a programmatic level, these activities could decrease overall nutrient inputs to Upper Klamath Lake and downstream reaches, and indirectly reduce nutrient concentrations in the Hydroelectric Reach. Although full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with nutrient objectives and unimpaired support of beneficial uses, this would require decades to achieve.

On an annual basis, concentrations of nutrients in the lower Klamath River downstream from Iron Gate Dam tend to be less than in upstream reaches because of the settling of particulate matter and associated nutrients in the larger Klamath Hydroelectric Project reservoirs, as well as dilution from large springs below J. C. Boyle Reservoir. However, on a seasonal basis, nutrients can increase downstream of the reservoirs at the reservoirs because of release of phosphorus and ammonia to the water column during periods of anoxic conditions. Nutrient levels tend to decrease farther downstream in the mainstem lower Klamath River because of a combination of tributary dilution and in-river nutrient removal processes. Despite this, nutrient concentrations during late summer and early fall do not meet the relevant water quality objectives.

Under the Dams In Scenario, ongoing interception and retention of nutrients with seasonal releases of phosphorus and ammonia in the project reservoirs would continue. Although full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with nutrient objectives and unimpaired support of beneficial uses, this would require decades to achieve.

**Dissolved Oxygen**

Similar to current conditions, dissolved oxygen levels under the Dams In Scenario would continue to exhibit summer and fall levels substantially below water quality objectives. As long as Iron Gate and Copco reservoirs remain in place, they are likely to have water with low or zero oxygen in their depths during the summer months when the reservoirs are thermally stratified. Dissolved oxygen levels are particularly low during the summer in the reach from Link River Dam to upstream of J. C. Boyle Reservoir, with typical levels ranging from less than 1 mg/L to 5 mg/L.

Resource management actions in the upper watershed, such as the Williamson River Delta Project and Agency Lake and Barnes Ranches Project, could contribute to long-term improvements in seasonally low dissolved oxygen in Upper Klamath Lake. These actions could decrease overall suspended sediment and nutrient inputs to Upper Klamath Lake and downstream reaches and correspondingly decrease oxygen demand in the Hydroelectric Reach. Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with dissolved oxygen objectives and unimpaired support of

beneficial uses in the Hydroelectric Reach, this would require decades to achieve. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer when water temperatures are highest.

**pH**

Currently, high rates of algal photosynthesis in Upper Klamath Lake and the project reservoirs result in elevated pH values that do not consistently meet applicable water quality objectives and could adversely affect beneficial uses. Under the Dams In Scenario, ongoing elevated pH concentrations and seasonal and daily variability in pH would continue, with large daily fluctuations occurring in reservoir surface waters during periods of intense algal blooms in Hydroelectric Reach and the lower Klamath River downstream from Iron Gate Dam.

Although ongoing resource management actions and full implementation of Oregon and California TMDLs would result in a long-term trend toward compliance with pH objectives and unimpaired support of beneficial uses, this would require decades to achieve. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer and early fall when rates of photosynthesis reach maximum levels. In the meantime, although flow conditions exceeding the pH objective would occur during periods of high photosynthesis, they would not be expected to adversely affect beneficial uses substantially.

**Algal Toxins and Chlorophylls**

The Klamath Hydroelectric Project reservoirs currently create favorable growth conditions for toxin-producing nuisance algal species and produce high seasonal concentrations of cyanotoxins (e.g., microcystin >8 µg/L) and chlorophyll-a (>15 µg/L).

The ongoing Williamson River Delta Project, Wood River Wetland Restoration, and other resource management actions are intended to eventually reduce nutrient inputs to Upper Klamath Lake, which could help decrease the incidence of toxic cyanobacterial algal blooms and high chlorophyll-a levels and cyanotoxins in Upper Klamath Lake and those transported to downstream reaches. However, under the Dams In Scenario, continued impoundment of water in the project reservoirs would substantially impact seasonal algal toxins and chlorophyll-a in the Hydroelectric Reach for decades into the future, when full implementation of the Oregon and California TMDLs can be achieved. TMDL implementation is highly dependent on improvements in nutrients in upstream reaches. Improvements resulting from full implementation of TMDLs could be slightly offset by climate change, particularly during summer and early fall when photosynthesis is greatest.

**Inorganic and Organic Contaminants**

Low levels of organic and inorganic contaminants have been identified in the sediment deposits trapped behind the dams in the Hydroelectric Reach.[111] Benthic uptake and subsequent transfer through the food web is one potential pathway of contaminant exposure for aquatic organisms in the Hydroelectric Reach; exposure to water column contaminants is another possible pathway. For contaminants influenced by pH or dissolved oxygen, concentrations at the sediment-water interface, such as methylmercury, could be transported to the water column via low redox conditions supported by reservoir stratification and seasonal anoxia. Human exposure to methylmercury and organic contaminants associated with reservoir sediments could occur through consumption of contaminated reservoir fish or shellfish.

Existing data from the 2004 to 2005 and 2009 to 2010 sediment chemistry analyses, results of the 2009 to 2010 sediment bioassay tests, and fish tissue concentrations from a 2003 screening-level study by PacifiCorp indicate that, for the most part, continued retention of sediments behind the KHP dams under the Dams In Scenario would not result in concentrations of inorganic and organic contaminants at levels that adversely affect beneficial uses, are toxic to humans, are toxic to national benchmark toxicity species, or result in bioaccumulation in the Hydroelectric Reach. Exceptions to this include possible exposure to low-level bioaccumulation of arsenic and mercury in fishes residing in the lacustrine environment of the project reservoirs. Effects of the Dams In Scenario on inorganic and organic contaminants in the lower Klamath River basin could not be assessed because of a lack of information.

***Aquatic Resources***

Aquatic resources in the Klamath River basin are currently considered to be in poor condition relative to historic conditions. Fish, both anadromous and native resident, are considered to have low populations, and some have been listed under the ESA and CESA. Various environmental conditions can have strong effects on the survival of aquatic resources in the Klamath River that are important to the Klamath Tribes because they are either trust resources or other resources traditionally used by the Klamath Tribes people. The following evaluation examines the aquatic resources in the Klamath River basin and how any potential changes (or lack thereof) resulting from the Dams In Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, steelhead, Pacific lamprey, and possibly coho salmon have been important anadromous fisheries to the Klamath Tribes. However, the presence of the four dams has resulted in loss of access of the anadromous fish to the upper watershed; consequently, the Klamath Tribes have not had access

[111] North Coast Regional Water Quality Control Board (2008); Shannon and Wilson, Inc. (2006); U.S. Department of the Interior (2010); Block Environmental Services (2010a–2010d).

to these fish. Under the Dams In Scenario, Chinook salmon, steelhead, Pacific lamprey, and coho salmon will continue to be excluded/absent from waters available for Klamath Tribes fishing and diminish the likelihood that these fishes could ever be restored to the upper watershed.

**Resident Fish**

The sucker species in the upper watershed—particularly Lost River, shortnose, Klamath smallscale, and Klamath largescale suckers, resident lamprey species, and redband trout—are important to the Klamath Tribes. Under the Dams In Scenario, no improvement is anticipated in sucker populations because there is less opportunity for improvements to habitat and overall ecosystem functionality and health. Additionally, although TMDLs will be in place, improvements in water quality are not anticipated to the extent that they would result in improved conditions for population increases.

**Aquatic Invertebrates**

Aquatic invertebrates are sensitive to water quality conditions because they either tend to have a small range or are sessile creatures. They are often treated as indicator species, meaning their populations and health are indicative of the ecosystem health.

Three species of native freshwater mussels have been observed within the Klamath River basin upstream from the Keno Impoundment.[112] Benthic macroinvertebrates include immature aquatic stages of insects such as midges, mayflies, caddisflies, stoneflies, and aquatic beetles, as well as crustaceans, mollusks, aquatic worms, and other major invertebrate groups. Many benthic macroinvertebrates are the primary consumers in riverine food webs, feeding on primary producers—algae, aquatic plants, phytoplankton, bacteria, leaves and other materials from terrestrial plants, and detritus. By converting organic material into biomass available to a wide variety of consumers, these organisms form an important component of the aquatic food web.

Under the Dams In Scenario, aquatic invertebrates would continue to be affected by poor water quality conditions.

***Ecosystem Functionality/Effects***

Under the Dams In Scenario, fish and invertebrate populations will continue to be affected by loss of habitat, less suitable water temperature regimes, and blockage of substrate movement negatively affecting spawning habitat, poor water quality conditions, and more suitable habitat conditions for the spread of disease and parasites. These reduced fish and invertebrate populations are indicative of an unhealthy ecosystem. It is not only fish and aquatic invertebrates that are affected by the altered Klamath River; riparian vegetation

[112] Federal Energy Regulatory Commission (2007); Westover (2010).

and terrestrial resources that depend on aquatic resources for food are affected by the heavily managed and modified Klamath River.

Populations of Chinook salmon, coho salmon, steelhead, anadromous and resident lampreys, and shortnose and Lost River suckers are expected to remain low, with low viability of Klamath River populations. Efforts to improve habitat are underway, along with implementation of the TMDLs and the USFWS and NMFS 2010 BOs, if accepted. These efforts will help reduce the stress on the fish, but will not be sufficient to bring the species to recovery. Climate change is also expected to negatively affect the survival and propagation of fish species.

Under the Dams In Scenario, anadromous fish would continue to be restricted to the lower reaches of the lower Klamath River basin. This restriction prevents them from accessing approximately 350 miles of spawning and rearing habitat unless fish passage is required under an accepted NMFS BO. This blockage particularly reduces the ability of coho salmon and spring-run Chinook salmon populations to recover. The reduced numbers of anadromous fish mean that piscivorous (fish-eating) birds and animals would continue to have fewer food resources available to them. Additionally, it has been shown that Chinook salmon carcasses are an important source of nutrients in the system, providing food for smaller and/or younger fishes. The reduction in carcasses would result in reduced nutrient input.

Under the Dams In Scenario, flows will continue to be managed differently than would occur in a natural hydrograph. These managed flows will continue to change the geomorphology of the lower river, impact riparian vegetation recruitment, reduce river habitat heterogeneity, reduce instream fish habitat structures, decrease food web support, increase nutrient input, and continue to impact water quality as described above. Impacts to the Klamath River and to the habitat and terrestrial species dependent on the Klamath River will continue to occur.

The presence of upstream reservoirs and poor water quality results in increased amounts of toxic algae in the summer months. Implementation of the TMDLs and the accepted BOs will improve overall conditions for the fisheries; however, because of the lack of access to the upper watershed, where optimal spawning habitat previously occurred, the anadromous fish populations will not be able to fully recover.

#### *Effects on Cultural Values*

Hydrology and water quality throughout the Klamath River are important to support the aquatic ecosystems on which these fishes depend. In addition, the Klamath River is central to the cultural activities such as bathing and religious ceremonies, of the Klamath Tribes.

Water in Upper Klamath Lake and its tributaries is an important traditional resource for the Klamath Tribes, supporting hunting, fishing, and gathering. In addition, instream flows and water quality in the Klamath River are important for propagation and migration of sufficient numbers of fish for harvest. A number of ritual traditions of the Klamath Tribes depend on access to clean water from natural sources, and it is used in ritual purification of people, places, and objects, as well as in rituals associated with drought abatement and other environmentally restorative activities. Although tribal members sometimes acquire water for these purposes from the Klamath River canyon area, the Klamath River is widely viewed as being of compromised quality for these ritual uses, in part because of the effects of the dams on water temperature, algae development, and other variables of water quality.

The Klamath Tribes sustained a stable lifestyle because of the abundance of the fish species in their waters. The fishes were used as a staple food and provided extended multifamily fishing operations. The presence of the dams eliminated the presence of all anadromous species in the upper watershed. Additionally, populations of Lost River suckers and shortnose suckers declined severely as a result of the change in water operations and were subsequently listed as endangered under the ESA. These fish losses resulted in a collapse of the former wealth of these tribes

Currently, no Chinook salmon (fall-run or spring-run), coho salmon, steelhead, or Pacific lamprey are able to access habitat along the Klamath Tribes' land. Under the Dams In Scenario, Chinook salmon, steelhead, and Pacific lamprey will continue to be excluded or absent from waters available to the Klamath Tribes for fishing; it is unlikely that these fish could be restored to the upper watershed.

Also culturally valuable are the sucker species in the upper watershed, particularly Lost River, shortnose, Klamath smallscale, and Klamath largescale suckers. Under the Dams In Scenario, there is no anticipated improvement in sucker populations because there is less opportunity for improvements to habitat and overall ecosystem functionality and health. Additionally, although TMDLs will be in place, insufficient improvements in water quality are anticipated that would result in improved conditions for population increases.

The loss of social and cultural practices was partially triggered by the reduced abundance of Chinook salmon, steelhead, and suckers in particular, which contributed to diminished economic opportunity and negative health effects from dietary changes. Because the fish species identified as the tribes' trust resources were the main food sources for the Klamath Tribes, the reduction in availability of these fishes has contributed to decreased physical and mental health, manifested in increased inflammation, cardiovascular disease, diabetes, and depression. Additionally, the loss of these fishes has led to lost opportunities for intergenerational transmission of traditional knowledge and an

increase in the number of young people leaving the ancestral homeland in search of a higher standard of living.

# Chapter 4. Dams Out Scenario

This chapter is a discussion of the Dams Out Scenario. First is a description of the Dams Out Scenario, including a summary of the KBRA program, followed by an analysis of the Dams Out Scenario's potential effects on the trust resources, tribal rights to take these resources, other resources traditionally used by tribes, and the related cultural values of each of the six tribes.

## Description of the Dams Out Scenario

The Dams Out Scenario includes the removal of the four PacifiCorp dams (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dams) as described in the KHSA. This scenario would include the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, ancillary buildings, and dam foundations. Prior to construction, "Interim Measures" as described in the KHSA would be implemented and would control operations of the hydroelectric facilities. During deconstruction the four reservoirs would be closed to recreation. This scenario would include the transfer of Keno Dam to the Department Of Interior and the implementation of the KBRA. The KBRA will be treated as a connected action as defined under NEPA. The KHSA includes decommissioning of PacifiCorp's East Side/West Side facilities; however, the removal would occur with or without an Affirmative Determination and is not analyzed as part of the Dams Out Scenario.

The result of the Dams Out Scenario would be that the Klamath River would have no dams downstream from Keno Dam. Operation of Reclamation's Klamath Project and the related river flows, measured at the USGS gauge downstream from Iron Gate Dam, would be according to the KBRA Appendix E-5.

### Reservoir Restoration

Under the Dams Out Scenario, there will be substantial erosion of the reservoir sediment while the reservoirs are being drawn down. The eroded sediment will then be transported downstream.

Following (and, to the degree possible, during) drawdown of the reservoirs, revegetation efforts will be initiated to support establishment of native grasses and riparian species on exposed reservoir sediment. This will minimize the time the exposed sediments are vulnerable to invasive species, discourage erosion, take advantage of residual moisture for desirable species, and provide valuable habitat in a timely manner.

## Keno Transfer

As part of the KHSA implementation, PacifiCorp will transfer ownership and operational responsibility of the Keno facility to the Interior. The agreement in principle for the transfer will occur, pending final negotiations, between June 1, 2011, and October 1, 2011. If acceptable terms cannot be reached through negotiations by these dates, the parties will make their best efforts to reach an agreement by March 31, 2012 (KHSA section 7.5.2).

Prior to the transfer, PacifiCorp will complete any necessary improvements to the facility to meet Interior's Directives and Standards for dam safety. Prior to the transfer, the facility will be operated under the terms of the existing contract signed in 1968 between PacifiCorp and Reclamation. Following the transfer, Reclamation will continue to operate the facility consistent with the terms of the January 4, 1968 contract and with historic practices (KHSA sections 7.5.3 and 7.5.4); there will be no changes to operations or the surrounding areas. Upgrades at the Keno facility by the Interior will be subject to additional NEPA and ESA compliance.

## The KBRA

The KBRA is intended to restore and sustain fish production in the Klamath River basin, establish reliable water and power supplies, and contribute to the public welfare and sustainability of all Klamath River basin communities.

The KBRA is connected to the KHSA because the removal of the four PacifiCorp dams on the Klamath River is a condition precedent to fully executing actions in the KBRA. An affirmative determination would meet this condition so that the KBRA actions may start during the period between determination and actual dam removal. The KBRA also includes a clause stating that the parties to the agreement will support implementation of the KHSA (KBRA Section 8). Similarly, the KHSA includes a clause that the parties will support implementation of the KBRA (KHSA Section 2.2).

Many of the activities envisioned in the KBRA start with the development of specific plans or the collection of data needed to make further decisions. Plans to be prepared under the KBRA would identify the specific actions and funding needed to undertake each program as well as the parties responsible for implementation; therefore, the KBRA typically does not include details about each program that could be analyzed at this time.

Programs under the KBRA are grouped under fisheries programs, water and power programs, and county and tribal programs, summarized in Table 4-1. The fisheries programs include an extensive habitat restoration program throughout the basin, fisheries reintroduction programs, fisheries monitoring programs, and actions intended to increase flows and reliability of instream water in the main stem of the Klamath River and its tributaries (with the

exception of the Trinity River basin). Additional descriptions of the fisheries programs are found below.

The water and power programs consist of an agreement regarding limitations on water diversions to Reclamation's Klamath Project users such as the National Wildlife Refuge (NWR), a voluntary water use retirement program (WURP) to allow for more instream water for fisheries, and agreements and assurances that the parties will work collaboratively to resolve outstanding water rights contests through the Oregon Klamath Basin Adjudication process.

County and tribal programs include economic development programs for local governments and tribes, regulatory assurances that adverse impacts on communities would be minimized, and tribal fisheries and natural resource conservation management programs. Generally, fisheries programs proposed in the KBRA apply to the entire basin (with the exception of the Trinity River basin), whereas programs related to water use apply mostly to the upper Klamath River basin upstream of J. C. Boyle Dam. County and tribal programs apply to the relevant jurisdictions throughout the entire basin.

**Table 4-1. KBRA Program Summary**

| Program[1] | Ongoing | Increased Magnitude or Accelerated Schedule with the KBRA | New Program Initiated by the KBRA | Interim Period Program | Long-Term Program |
|---|---|---|---|---|---|
| ***Fisheries Programs:*** | | | | | |
| Fisheries Restoration Phase I Plan | | x | | x | |
| Fisheries Restoration Phase II Plan | | | x | | x |
| Fisheries Reintroduction Plan—Phase I, Oregon | | | x | | x |
| Fisheries Reintroduction Plan—Phase II, Oregon | | | x | | x |
| Fisheries Reintroduction Plan—California | | | x | | x |
| Fisheries Monitoring Plan | | x | | x | x |
| ***Additional Water Storage Projects:*** | | | | | |
| Williamson River Delta project | | x | | x | |
| Agency Lake and Barnes Ranches project | | x | | x | |
| Wood River Wetland Restoration Project | | x | | x | |
| Future storage opportunities | x[2] | | x[3] | x | x |

| Program[1] | Ongoing | Increased Magnitude or Accelerated Schedule with the KBRA | New Program Initiated by the KBRA | Interim Period Program | Long-Term Program |
|---|---|---|---|---|---|
| ***Water and Power Programs:*** | | | | | |
| Water Diversion Allocations for Reclamation's Klamath Project and National Wildlife Refuges | | | x | x[4] | x |
| ***Water Management on Reclamation's Klamath Project:*** | | | | | |
| Collaboration on Irrigation Diversions and Environmental Water | | x | | x | |
| Plan for Delivery of Refuge Allocation | | | x | x | |
| Determination of Passed-Through Water | | x | | x | |
| Groundwater Technical Investigations | | x | | x | |
| On-Project Plan | | | x | x | x |
| Winter Shortage Plan | | x | | x | x |
| Water Use Retirement Program (WURP) | | | x | x | |
| Off-Project Water Settlement | | | x | x | x |
| Off-Project Reliance Program | | | x | x | x |
| Power for Water Management Program | | | x | x | x |
| Drought Plan | | | x | x | x |
| Emergency Response Plan | x | | | x | x |
| Climate Change Assessment and Adaptive Management | | x | | x | x |
| Interim Flow and Lake Level Program | | | x | x | |
| ***County and Tribal Programs:*** | | | | | |
| Fish Entrainment Reduction | | | x | x | |
| General Conservation Plan or Habitat Conservation Plan | | | x | | x |
| Klamath County Economic Development Plan | | | x | x | |
| California Water Bond Legislation | | | x | x | |
| Tribal Programs Fisheries and Conservation Management | | | x | x | |
| Tribal Programs Economic Revitalization | | | x | x | |
| Mazama Forest Project | | x | | x | |

Notes
1. Plans include both the planning phase and the implementation phase. Therefore, although a plan may be completed in the short term, implementation may take place over the long term or be subject to the availability of funding following an affirmative Secretarial Determination.
2. Current activities would not include development of additional storage.
3. Development of additional storage would take place with implementation of the KBRA and associated funding.
4. Water diversion limitations to Reclamation's Klamath Project users would conform to the limits described in the Diversion Limitations section during the interim period as closely as possible. However, before full implementation of the On-Project Plan as described below, it might not be possible to fully comply with the diversion limitations in all years.

### *Fisheries Program*

The Fisheries Program of the KBRA has three main goals:

- Restore and maintain ecological functionality and connectivity to historic habitat.
- Re-establish and maintain naturally sustainable and viable populations of fish to the full capacity of the restored habitats.

- Provide for full participation in harvest opportunities.

These goals would be met through the implementation of fisheries restoration, reintroduction, and monitoring plans, as well as provision of additional sources of instream water to support the fish.

**Fisheries Restoration Plans**

The Phase I Fisheries Restoration Plan is intended to establish restoration priorities and criteria for restoration project selection for the immediate future through 2018 (KBRA Section 10.1). The plan is to be prepared by basin Fish Managers who are defined in the KBRA as federal, state, or tribal agencies that have responsibility under applicable laws to manage one or more fish species or their habitat in the Klamath Basin. USFWS and NMFS are to be the co-leads for administrative tasks related to the preparation of both the Phase I and Phase II Restoration Plans. Under the schedule anticipated in the KBRA, the Phase I Plan would be completed in March 2012.

Fish habitat restoration activities include the following types of work:

- Floodplain rehabilitation work includes activities to improve or restore connections between channels and floodplains to create and maintain off-channel habitat accessible to overwintering juvenile salmonids. Floodplain rehabilitation could include activities such as riparian planting and understory thinning to facilitate the development of mature riparian stands that would provide shading and large and small wood to stream channels and floodplains, wetland restoration, and levee setback or dike removal to reconnect floodplain hydrology.

- Large woody debris placement could include both mobile wood and complex structures and could be used to create off-channel habitat or provide cover in pools.

- Correction of fish passage issues could include culvert upgrades or replacement to meet current fish passage standards and correction of other fish blockages to restore access to new or historic habitats.

- Cattle exclusion typically includes the construction of fencing to prevent cattle from trampling stream banks, which allows riparian vegetation to regrow.

- Mechanical thinning and prescribed burning are used to mimic some of the functions and characteristics historically provided by a natural fire regime.

- Purchases of conservation easements and land from willing sellers allow for more direct land management for habitat enhancement purposes.

- Decommissioning of roads could reduce road densities in areas with a high potential for failure and could stabilize slopes.

- Gravel augmentation involves the direct placement of spawning-size gravel into the stream channel.

**Fisheries Reintroduction Plans**

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

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

**Fisheries Monitoring Plan**

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

**Additional Water for Fish**

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

Most of the programs that provide additional water for fishes are organized under the Water Programs section of the KBRA. Some of these programs include:

- Limit on diversions to Reclamation's Klamath Project
- Interim program of water lease and purchase to reduce diversions upstream of Upper Klamath Lake
- Increased water storage and conservation through specific projects
- Assessment of effects of climate change on basin water budget
- Acquisition of an additional 10,000 acre-feet of storage in the upper basin to allow increased diversions in some years, to mitigate effects of drought, and/or to further fish restoration goals

***Additional Water Storage Projects***

Three restoration projects, which are intended to increase the amount of water storage in the upper Klamath River basin, are included in the KBRA. These projects include:

- Williamson River Delta Project—This project involved breaching levees on the Williamson River (completed in 2008). This project is expected to provide 20,800 acre-feet of additional lake storage capacity when Upper Klamath Lake elevations are between 4,143 and 4,136 feet. The effects on fisheries and water quality would be monitored under the Fisheries Monitoring Plan, which would also confirm the amount of expected storage benefits (KBRA Section 18.2).
- Wood River Wetland Restoration Project—This project would involve a study to consider options for managing the Wood River Wetland Area that would include operating it as a pumped storage within existing dikes or fully reconnecting the area to Agency Lake by breaching the dikes (KBRA Section 18.2.3). The intent is to provide 16,000 acre-feet of additional storage between elevations of 4,143 and 4,136 feet.
- Agency Lake Ranch and Barnes Ranch Project—This project would involve a study by USFWS and other KBRA parties to consider options for managing the Agency Lake/Barnes Ranches area to enhance water management flexibility in providing benefits for water storage, fish, wildlife, and wetlands habitats (KBRA Section 18.2.2). The restoration of diked and drained portions could add up to 63,770 acre-feet of additional storage to Upper Klamath Lake between elevations of 4,143 and 4,136 feet.
- Additional Water Storage—The KBRA includes provisions for further investigations and acquisition of an additional 10,000 acre-feet of storage (KBRA Section 18.3 and 15.1.1). This additional 10,000 acre-feet of storage is one of the identified milestones that would allow for

increased diversion to Reclamation's Klamath Project users during the irrigation season in some years (KBRA Section 15.1.1).

***Water and Power Program***

The Water and Power Program in the KBRA addresses water supply reliability and power affordability for On-Project and Off-Project agricultural users and for moving water through Reclamation's Klamath Project area. Plans and programs to be developed and implemented under the Water and Power Program of the KBRA consist of the following:

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

These plans are intended to improve management of water and power in the On-Project area and to help all water users in the basin to be better prepared for reasonably foreseeable events and unexpected conditions.

**On-Project Water Management**

*Diversion Limitations*

Limitations on diversions to Reclamation's Klamath Project would reduce the availability of irrigation water to 100,000 acre-feet less than the demand in the driest years to protect mainstem flows (KBRA Section 15 and Appendix E-1). Implementation of the diversion limitations would include assurances of increased reliability of diversions.

The amount of water that would be diverted to On-Project users including the NWRs varies by season and whether a year is forecast to be wet or dry. The forecast to be used to set diversion limits each year is the Natural Resources Conservation Service annual exceedance probability forecast for net inflow to Upper Klamath Lake. The annual exceedance probability forecast is a prediction that there is a 50 percent chance that the actual stream flow will exceed the forecast value (and a 50 percent chance that flows will be less than the forecast value). Although the Klamath Project diverts water from a variety of sources, the Upper Klamath Lake forecast would be used to set the diversion limits each spring and generally characterize whether a particular year is expected to be wet or dry.

## Effects Analysis of the Dams Out Scenario

The area of analysis includes the lower and upper Klamath River basins, as defined below:

Lower Klamath River basin

- Klamath Estuary,
- Klamath Estuary to Salmon River. and
- Salmon River to Iron Gate Dam.

Upper Klamath River basin

- Hydroelectric Reach (Iron Gate Reservoir to J. C. Boyle Reservoir);
- Klamath River upstream of J. C. Boyle Reservoir to Link River Dam;
- Upper Klamath Lake; and
- Wood, Williamson, and Sprague rivers.

This evaluation examines the effects of the Dams Out Scenario on hydrology and water quality, consisting of water temperature, pH, dissolved oxygen, and toxins and contaminants. This document also evaluates the effects of the Dams Out Scenario on anadromous and resident fishes, consisting of Chinook salmon, coho salmon, steelhead, green sturgeon, lampreys, eulachon, shortnose sucker, Lost River sucker, redband trout, and invertebrate species such as mussels, where they are pertinent to each tribe.

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## Yurok Tribe

### *Water Resources*

**Hydrology**

Under the Dams Out Scenario, Klamath River hydrology would no longer be dominated by hydropower peaking events between J. C. Boyle Powerhouse and Copco Reservoir. Although the hydrograph would still be influenced by the Klamath Reclamation Project, flows would more closely mimic the natural hydrograph, both within the Hydroelectric Reach and downstream.[113] Higher seasonal flows, such as those prescribed under the KBRA, would improve the quality of riparian habitat. KBRA flows, dam removal, and ecosystem restoration activities would move the hydrograph toward a duration, timing, and magnitude of flows that provide more ecosystem benefits.[114]

**Water Temperature**

The Dams Out Scenario would have a beneficial effect on water temperatures in the Hydroelectric Reach and in the Klamath River from Iron Gate Dam to the Salmon River during summer and fall.

An expected long-term increase in spring water temperatures and a decrease in summer and fall water temperatures in the Hydroelectric Reach would be beneficial. Water temperature in the Hydroelectric Reach immediately downstream from J. C. Boyle Dam would be expected to exhibit more daily fluctuations in June through September compared to those of the Dams In Scenario because of the absence of the thermal mass in J. C. Boyle Reservoir and the lack of hydropower peaking operations, both of which tend to moderate daily temperature fluctuations.

As described previously, under the Dams In Scenario, water in the Hydroelectric Reach and the lower Klamath River basin is cooler during spring and warmer during late summer and early fall as a result of the presence of the dams.[115] The absence of the reservoirs would allow the Klamath River downstream from Iron Gate Dam to be more in phase with the natural temperature regime. Hydraulic residence time between J. C. Boyle Reservoir and Iron Gate Dam would decrease from several weeks to less than a day.[116] Current evaporation from the surface of existing reservoirs (about 11,000 acre feet)[117] would be reduced and that volume would be added to the river flow. The thermal lag, a result from water storage in reservoirs and the associated increased thermal mass, would be eliminated in the lower Klamath River. The

[113] Hamilton et al. (2010).
[114] Hetrick et al. (2009).
[115] Federal Energy Regulatory Commission (2007).
[116] Hamilton et al. (2010).
[117] Reclamation (2011).

Dams Out Scenario may also serve as partial mitigation for climate change by increasing the likelihood that beneficial uses would be supported during summer and fall because removal of the project reservoirs under the Dams Out Scenario would result in slightly lower summer and fall water temperatures in the Hydroelectric Reach.

The Dams Out Scenario would not be expected to have direct or indirect water temperature effects on the Klamath River downstream from the Salmon River, in the Klamath Estuary, or in the marine nearshore environment.

**Suspended Sediment**

The Dams Out Scenario would result in both short-term and long-term effects on suspended sediment. Over the short term, high loads of suspended sediment are expected immediately downstream from Iron Gate Dam under the Dams Out Scenario.[118] High levels of suspended sediment concentrations are also expected downstream from J. C. Boyle Reservoir in the short term, although the relatively small volume of the sediment deposits behind J. C. Boyle Dam would cause concentrations that would be considerably less than those anticipated to occur downstream from Iron Gate Reservoir. Overall, sediment release associated with the Dams Out Scenario would cause short-term increases in suspended material (>30 mg/L for 6 to 10 months following drawdown) that would result in non-attainment of applicable water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary, and would substantially adversely affect beneficial use of the cold freshwater habitat. In the nearshore marine environment, suspended sediment concentrations would remain elevated (>1,000 mg/L) for 3 or 4 months following drawdown under the Dams Out Scenario. The Dams Out Scenario would have a minor impact on suspended sediment concentrations in the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment because of sediments entering the water from deconstruction site runoff or in-water deconstruction work and implementation of best management practices.

Over the long term, the Dams Out Scenario would slightly increase mineral (inorganic) suspended sediment concentrations and would increase summer and fall algae-derived (organic) suspended sediment concentrations in the Hydroelectric Reach, the reach downstream from Iron Gate Dam, the Klamath Estuary, and the marine nearshore environment because of lack of sediment trapping by dams on Klamath River. However, these increases would not be expected to exceed levels that would cause non-attainment of beneficial uses.

The effects of dam-released sediment and sediment resupply would likely extend from Iron Gate Dam to Cottonwood Creek.[119] Estimates of reach-

[118] U.S. Bureau of Reclamation (2011); Stillwater Sciences (2008).
[119] Reclamation (2011).

averaged stream power (the ability of the river to move sediment) show a decrease from Iron Gate Dam to Cottonwood Creek, with stream power increasing again downstream from Cottonwood Creek. The increase suggests that short- or long-term sediment deposition, either from dam release or sediment resupply, is unlikely downstream from Cottonwood Creek. Using this point as the downstream extent of bedload-related effects, 8 miles of channel could be affected by sediment release and resupply. The affected channel represents 4 percent of the total channel length of the mainstem Klamath River downstream from Iron Gate Dam (190 miles). Under the Dams Out Scenario, sediment mobilization flows would decrease relative to existing conditions.

**Nutrients**

Under the Dams Out Scenario, short-term increases in nutrient 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. However, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the lower Klamath River and the Klamath Estuary. Short-term increases in nutrient concentrations would be a minor impact.

Over the long term in the Hydroelectric Reach and the lower Klamath River basin, the Dams Out Scenario is expected to increase annual nutrient concentrations during summer months because of the absence of nutrient interception and retention behind dams after removal. Summer concentrations of nitrogen are expected to increase much more than phosphorus.[120] The increases would not be expected to result in flow conditions exceeding relevant water quality objectives beyond levels experienced under the Dams In Scenario. In addition, the lacustrine environment that supports the growth of toxin-producing nuisance algae blooms would be eliminated under the Dams Out Scenario, reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species.

In the Klamath River immediately downstream from Iron Gate Dam, while a total nutrient increase would likely occur under the Dams Out Scenario, the increase would shift the system away from strong nitrogen limitation, and away from the nutrient conditions that promote nuisance algae blooms and adversely affect beneficial uses. Farther downstream, the increase in nutrients, both from an absolute concentration perspective and from a relative perspective, would be diminished.

**Dissolved Oxygen**

In the short term following dam removal, the Dams Out Scenario would result in a decrease in dissolved oxygen concentrations in the Klamath River

[120] Asarian et al. (2010).

downstream from J. C. Boyle Dam to the California-Oregon state line. Increases in short-term oxygen demand (and subsequent reductions in dissolved oxygen) in the Hydroelectric Reach downstream from J. C. Boyle Dam and in the lower Klamath River downstream from Iron Gate Dam are conservatively estimated to be similar. The short-term decrease in dissolved oxygen concentrations would be a substantial impact on the lower Klamath River from Iron Gate Dam to approximately Clear Creek, but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment.

Over the long term, the Dams Out Scenario would result in increases in dissolved oxygen in June through September along with potentially increasing daily variability in the Klamath River from Link River Dam to the California-Oregon state line and from Iron Gate Dam to the Seiad Valley. Effects would diminish with distance downstream from Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen below the confluence with the Trinity River.

**pH**

The Dams Out Scenario would result in small beneficial increases in daily pH variability during March, April, and May in the Hydroelectric Reach. However, it would result in an adverse increase in overall pH and the magnitude of daily variability during summer months in Klamath River from Iron Gate Dam to the confluence with the Scott River. The Dams Out Scenario would have no effect on the Klamath River immediately downstream from Seiad Valley, in the Klamath Estuary, and in the marine nearshore environment.

**Algal Toxins and Chlorophylls**

Under the Dams Out Scenario, algal toxins and chlorophylls in the lower Klamath River would be substantially reduced. Although algal toxins and chlorophyll-a produced in Upper Klamath Lake could potentially be transported into the lower Klamath River basin at levels that would exceed water quality objectives, additional in-situ production of the toxins and chlorophyll-a would not occur in the free-flowing river under the Dams Out Scenario. More important, data collected between 2005 and 2008 have never shown elevated Microcystis cell counts or microcystin toxin levels immediately above Copco Reservoir, indicating that Iron Gate and Copco reservoirs have been responsible for all flow conditions affecting public health in the lower river.[121]

**Inorganic and Organic Contaminants**

The Dams Out Scenario would cause the release of inorganic and organic contaminants from sediment deposits stored behind the dams to the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment. However, concentrations of

[121] Kann and Corum (2009).

inorganic and organic contaminants would not be high enough to adversely affect beneficial uses, be toxic to aquatic life, or result in bioaccumulation.

### *Aquatic Resources*

The Dams Out Scenario is intended to improve and increase fish populations in the Klamath River; and under the Dams Out Scenario, restoration of fishes and habitat is identified. The KBRA outlines habitat restoration and fish reintroduction plans to re-establish anadromous fish in the upper Klamath River basin. The following evaluation examines the aquatic resources in the Klamath River basin and examines how any potential changes (or lack thereof) resulting from the Dams Out Scenario would affect the aquatic resources.

#### Anadromous Fish

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Yurok Tribe. These fisheries are affected by riverine conditions that include water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) under the Dams Out Scenario are described in the previous section, and this section describes how the water resource conditions affect the anadromous fisheries of the Klamath River under the Dams Out Scenario.

*Habitat Area*

Under the Dams Out Scenario, removal of the four facilities would allow spring-run and fall-run Chinook and coho salmon, steelhead, and possibly Pacific lamprey and green sturgeon to gain access to the Klamath River upstream of J. C. Boyle Reservoir. The access would expand the fish habitat to include historic habitat along the mainstem Klamath River, upstream of the Sprague, Williamson, and Wood rivers,[122] a potential increase in habitat of 350 miles.

Additionally, the KBRA has specific tasks for improving the fisheries in the Klamath River, consisting of restoring floodplain habitat, improving instream fish habitat, improving fish passage, and cattle exclusion. The KBRA also includes a fish program that will identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam, a monitoring program to track the progress of the reintroduction, and actions that would increase instream flows and that are intended to benefit anadromous fish populations regardless of the effects of dam removal.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for

[122] Hamilton et al. (2005).

all fish species.[123] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to disease and parasites. [124]

The long-term effects of the Dams Out Scenario, from both the KHSA and the KBRA, would include more natural daily variations in water temperature, resulting in migration and spawning periods for Klamath River Chinook salmon that are more comparable to historic conditions. Water would become warmer earlier in the spring and cooler earlier in late summer and fall compared to existing conditions, and hence under conditions that would occur under the Dams In Scenario.[125] Under the Dams Out Scenario, water temperatures would increase 2°C to 4°C (3.6°F to 7.2°F) during spring and summer for rearing anadromous fish. Improved water temperatures (reduced by 7°C to 9°C (12.6°F to 16.2°F)) from October through November would create more ideal temperatures for adult migration and spawning, and spawning below Iron Gate Dam would no longer be delayed; therefore, pre-spawn mortality would be reduced.[126]

The Dams Out Scenario also provides improved thermal conditions (as described above). This new thermal regime will result in:

- earlier spawning,
- longer incubation,
- earlier emergence and growth, and
- earlier downstream migration.

This lifecycle change benefits the Klamath River anadromous fish because it takes them closer to their historic conditions. The river would experience a higher daily maximum, but it would also experience a lower daily minimum. This would allow rearing juveniles to move out of their temperature refugia to forage at night. Cooler water temperatures also makes habitat conditions much less suitable for the spread of diseases and parasites.

*Suspended and Bedload Sediments*

The Dams Out Scenario would release dam-stored sediment downstream to the lower Klamath River. Under the most likely condition, suspended sediment concentrations would be low enough that they would not be expected to affect adult anadromous fish relative to current conditions. In the worst case, suspended sediment concentrations would be high enough to cause major physiological stress and impaired homing.

The Dams Out Scenario would bury redds (i.e., nests) constructed in fall 2019 in dam-released sediment, decreasing embryo survival and alevin emergence

[123] Ibid.
[124] Wood et al. (2006).
[125] Stillwater Sciences (2009); Hamilton et al. (2010).
[126] Hamilton et al. (2010).

potentially as far downstream as Cottonwood Creek, or in 4 percent of the river below Iron Gate Dam. The deposition could aggrade pools or overwhelm other habitat features that salmonids use for adult holding or juvenile rearing. The effect would be short term, as pools would likely return to their pre-sediment release depth relatively quickly.[127] In the long term, the river would revert to and maintain a pool-riffle morphology.

The Dams Out Scenario would allow the movement of bedload material that more closely mimics the historic conditions because the dams would no longer block its movement. This would benefit fishes spawning downstream from the dams' current locations.

*Other Water Quality Components*

Implementation of the Dams Out Scenario would not affect water quality in the Wood, Williamson, and Sprague rivers, Upper Klamath Lake, and Link River to the upstream end of J. C. Boyle Reservoir. It would, however, cause long-term overall increases in dissolved oxygen and increased daily variability in dissolved oxygen in the Hydroelectric Reach. The removal of the four facilities under the Dams Out Scenario would cause slight, long-term increases in dissolved oxygen in the summer and fall, increasing the likelihood of consistently supporting beneficial uses during this period.

Downstream from Iron Gate Dam, sediment release associated with the Dams Out Scenario could cause short-term increases in oxygen demand and reductions in dissolved oxygen that could adversely affect fisheries resources.

Overall, implementation of the Dams Out Scenario will directly affect anadromous fish by accelerating the TMDL process, and thus improving water quality conditions at a more rapid rate.

*Disease and Parasites*

The Dams Out Scenario would be expected to result in changed habitat conditions that would reduce impacts on salmonids from fish diseases. The main factors contributing to parasitic fish diseases in the Klamath River basin include physical habitat components (pools, eddies, and sediment), microhabitat characteristics (stable flows and low velocities), proximity to spawning areas, and temperatures above 15°C (59°F).

The Dams Out Scenario would likely reduce the availability of favorable physical habitat components for the polychaete host. The removal of Iron Gate Dam would also remove a major barrier to fish migration, resulting in a reduced concentration of spawning adults. Greater dispersal of spawning adult salmon would reduce the proximity of salmon to dense populations of polychaetes.

[127] Stillwater Sciences (2008).

Increased variability in flow management and the restoration of a more natural sediment regime would likely reduce the suitability of habitat conditions for *M. speciosa*, the invertebrate host for *P. minibicornis* and *C. shasta*. In some areas, increased mobilization of the substrate would help reduce the availability of habitat for polychaetes.[128] Infection rates are related in part to raised water temperatures. If flows increase during the spring, juvenile migration time could be decreased, potentially resulting in reduced disease exposure, especially for fishes originating in lower Klamath River tributaries.

The Dams Out Scenario would, however, allow anadromous salmonid migration upstream in the mainstem Klamath River and tributaries, which would result in introduction of parasite genotypes that have been restricted to the lower river. Although the effects of these introductions are uncertain, at least some degree of host specificity appears to exist,[129] indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes of *C. shasta* introduced into the upper watershed. It is not expected that introduction of *C. shasta* genotypes upstream would result in adverse effects because fishes in the upstream basin have shown resistance to the downstream genotypes.

**Estuarine Fish**

The Dams Out Scenario would not substantially change or affect estuarine fish habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

**Aquatic Invertebrates**

Under the Dams Out Scenario, aquatic invertebrates are expected to undergo short-term impacts caused primarily by water quality (specifically sedimentation issues) as described above for anadromous fish, but are also expected to experience long-term benefits through the more natural hydrograph created by the removal of the four dams.

***Ecosystem Functionality/Effects***

Under the Dams Out Scenario, fish and invertebrate populations will benefit through increased habitat, more suitable water temperature regimes, and substrate movement, which will affect spawning habitat, improve water quality conditions, and create less suitable habitat conditions for the spread of disease and parasites. These improved fish and invertebrate populations are indicative of a healthier ecosystem. It is not only fishes and aquatic invertebrates that are affected by the Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are affected by the heavily managed and modified Klamath River. These resources would benefit from the Dams Out Scenario.

[128] Stocking et al. (2007).
[129] Atkinson et al. (2010).

The populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to increase, with a higher likelihood of viability of the Klamath River populations. The Dams Out Scenario, with the KBRA, will reduce the stress on the fishes and may be sufficient to bring the species to recovery. These benefits are important in light of expected climate change.

Under the Dams Out Scenario, anadromous fish would no longer be restricted to the lower reaches of the lower Klamath River basin, but would be able to access approximately 350 miles of spawning and rearing habitat. This access particularly increases the ability of coho salmon and spring-run Chinook salmon populations to recover. The increased numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have more food resources. Additionally, the increase in salmon carcasses would provide nutrients and food for other aquatic resources and for terrestrial resources.

Under the Dams Out Scenario, flows will more closely mimic a natural hydrograph. The flows will change the geomorphology of the lower river, benefit riparian vegetation recruitment, increase river habitat heterogeneity, increase instream fish habitat structures, increase food web support, and improve water quality as described above. Benefits to the Klamath River and to the habitat and terrestrial species that depend on the Klamath River will occur.

The removal of upstream reservoirs and improved water quality will result in decreased amounts of toxic algae in the summer months. Implementation of the TMDLs and future BOs will improve overall conditions for the fisheries; however, anadromous salmonids historically have not inhabited this region during the summer months. Additionally, populations of coho salmon and spring-run Chinook salmon will likely increase, with a potential for downgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

The Yurok Tribe has a reserved right to water in the Klamath River to support harvest of fishes that the Yurok require to maintain a moderate standard of living. The tribe also has subsistence and ceremonial fisheries.

Removing the project reservoirs will result in water quality conditions that would provide the opportunity for improved cultural values of the Yurok Tribe, such as conducting traditional bathing ceremonies, fishing, and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem for the Yurok Tribe. The algae produce potent liver toxins at such a high level that warnings against contact with the water are posted along the river each summer because it clogs traditional fishing nets, degrades water for contact recreational and ceremonial uses, and can produce toxins hazardous to fishes and humans. However, over time, successful implementation of the Dams Out Scenario would support beneficial uses by the Yurok Tribe.

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the Yurok people. The Dams Out Scenario would increase anadromous fish populations, which would likely benefit the Yurok Tribe and provide the opportunity to improve their standard of living through more stable commercial and subsistence fisheries, including salmon for tribal ceremonies. This increase in fish populations would provide the opportunity for improved health by increasing the salmon in their diets, decreasing discontent and depression, and increasing opportunities for intergenerational transmission of traditional knowledge. This sense of tribal unity potentially would result in fewer young people leaving the reservation. Additionally, healthier riparian vegetation would improve the opportunities to gather plants that might be used for such things as baskets, medicine, utensils, regalia, and structures.

## Resighini Rancheria

### *Water Resources*

**Hydrology**

Under the Dams Out Scenario, Klamath River hydrology would no longer be dominated by hydropower peaking events between J. C. Boyle Powerhouse and Copco Reservoir. Although the hydrograph would still be influenced by the Klamath Reclamation Project, flows would more closely mimic the natural hydrograph, both within the Hydroelectric Reach and downstream.[130] Higher seasonal flows, such as those prescribed under the KBRA, would improve the quality of riparian habitat. KBRA flows, dam removal, and ecosystem restoration activities would move the hydrograph toward a duration, timing, and magnitude of flows that provide more ecosystem benefits. [131]

Short-term sediment deposition resulting from dam removal is expected only well upstream from the rancheria.[132] Over the long term, transport of gravels that were previously intercepted by project reservoirs would be restored downstream from Iron Gate Dam under the Dams Out Scenario.[133] It is unclear to what extent gravel replenishment on the Resighini Rancheria would be affected. However, it would be reasonable to expect minor beneficial affects to gravel replenishment. Flood magnitudes and frequencies downstream from Iron Gate Dam are not expected to appreciably change.

**Groundwater**

In the absence of detailed hydrogeological information regarding Resighini Rancheria groundwater, an assessment of the effect of the Dams Out Scenario is not possible at this time. However, in general, flows and water quality in the lower reach of the Klamath River, which runs past the Resighini Rancheria, are expected to undergo minimal or beneficial changes under the Dams Out Scenario relative to the Dams In Scenario.

**Water Temperature**

The Dams Out Scenario would have a beneficial effect on water temperatures in the Hydroelectric Reach and in the Klamath River from Iron Gate Dam to the Salmon River during summer and fall.

An expected long-term increase in spring water temperatures and decrease in summer and fall water temperatures in the Hydroelectric Reach would be beneficial. Water temperature in the Hydroelectric Reach immediately downstream from J. C. Boyle Dam would be expected to exhibit more daily

[130] Hamilton et al. (2010).
[131] Hetrick et al. (2009).
[132] Stillwater Sciences (2004) in Federal Energy Regulatory Commission (2007).
[133] Hamilton et al. (2010)

fluctuations in June through September compared to those of the Dams In Scenario because of the absence of the thermal mass in J. C. Boyle Reservoir and the lack of hydropower peaking operations, both of which tend to moderate daily temperature fluctuations.

As described previously, under the Dams In Scenario, water in the Hydroelectric Reach and the lower Klamath River basin is cooler during spring and warmer during late summer and early fall as a result of the presence of the dams.[134] The absence of the reservoirs would allow the Klamath River downstream from Iron Gate Dam to be more in phase with the natural temperature regime. Hydraulic residence time between J. C. Boyle Reservoir and Iron Gate Dam would decrease from several weeks to less than a day.[135] Current evaporation from the surface of existing reservoirs (about 11,000 acre feet[136]) would be reduced and that volume would be added to the river flow. The thermal lag, a result of water storage in reservoirs and the associated increased thermal mass, would be eliminated in the lower Klamath River. The Dams Out Scenario may also serve as partial mitigation for climate change by increasing the likelihood that beneficial uses would be supported during summer and fall, because removal of the project reservoirs under the Dams Out Scenario would result in slightly cooler summer and fall water temperatures in the Hydroelectric Reach.

The Dams Out Scenario would not be expected to have direct or indirect water temperature effects on the Klamath River downstream from the Salmon River, in the Klamath Estuary, or in the marine nearshore environment.

**Suspended Sediment**

The Dams Out Scenario would result in both short-term and long-term effects on suspended sediment. Over the short term, high loads of suspended sediment are expected immediately downstream from Iron Gate Dam under the Dams Out Scenario.[137] High levels of suspended sediment concentrations are also expected downstream from J. C. Boyle Reservoir in the short term, although the relatively small volume of the sediment deposits behind J. C. Boyle Dam would cause concentrations to be considerably less than those anticipated to occur downstream from Iron Gate Reservoir. Overall, sediment release associated with the Dams Out Scenario would cause short-term increases in suspended material (>30 mg/L for 6 to 10 months following drawdown) that would result in non-attainment of applicable water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary, and would substantially adversely affect the cold freshwater habitat beneficial use. In the nearshore marine environment, suspended sediment concentrations would remain elevated

[134] Federal Energy Regulatory Commission (2007).
[135] Hamilton et al. (2010).
[136] Reclamation (2011).
[137] U.S. Bureau of Reclamation (2011); Stillwater Sciences (2008).

(>1,000 mg/L) for 3 or 4 months following drawdown under the Dams Out Scenario. The Dams Out Scenario would have a minor impact on suspended sediment concentrations in the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment because of sediments entering the water from deconstruction site runoff or in-water deconstruction work and implementation of best management practices.

Over the long term, the Dams Out Scenario would slightly increase mineral (inorganic) suspended sediment concentrations and would increase summer and fall algae-derived (organic) suspended sediment concentrations in the Hydroelectric Reach, the reach downstream from Iron Gate Dam, in the Klamath Estuary, and in the marine nearshore environment because of lack of sediment trapping by dams on Klamath River. However, these increases would not be expected to exceed levels that would cause non-attainment of beneficial uses.

The effect of dam-released sediment and sediment resupply would likely extend from Iron Gate Dam to Cottonwood Creek.[138] Estimates of reach-averaged stream power (the ability of the river to move sediment) show a decrease from Iron Gate Dam to Cottonwood Creek, with stream power then increasing again downstream from Cottonwood Creek. The increase suggests that short- or long-term sediment deposition, either from dam release or sediment resupply, is unlikely downstream from Cottonwood Creek. Using this point as the downstream extent of bedload-related effects, 8 miles of channel could be affected by sediment release and resupply. The affected channel represents 4 percent of the total channel length of the mainstem Klamath River downstream from Iron Gate Dam (190 miles). Under the Dams Out Scenario, sediment mobilization flows would decrease relative to existing conditions.

**Nutrients**

Under the Dams Out Scenario, short-term increases in nutrient 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. However, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the lower Klamath River and Klamath Estuary. Short-term increases in nutrient concentrations would be a minor impact.

Over the long term in the Hydroelectric Reach and the lower Klamath River basin, the Dams Out Scenario is expected to increase annual nutrient concentrations during summer months because of the absence of nutrient interception and retention behind dams after removal. The increases would not be expected to result in flow conditions exceeding relevant water quality

[138] Reclamation (2011).

objectives beyond levels experienced under the Dams In Scenario. In addition, the lacustrine environment that supports the growth of toxin-producing nuisance algae blooms would be eliminated under the Dams Out Scenario, reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species.

In the Klamath River immediately downstream from Iron Gate Dam, while a total nutrient increase would likely occur under the Dams Out Scenario, the increase would shift the system away from strong nitrogen limitation, and away from the nutrient conditions that promote nuisance algae blooms and adversely affect beneficial uses. Farther downstream, the increase in nutrients, both from an absolute concentration perspective and from a relative perspective, would be diminished.

**Dissolved Oxygen**

In the short term following dam removal, the Dams Out Scenario would result in a decrease in dissolved oxygen concentrations in the Klamath River downstream from J. C. Boyle Dam to the California-Oregon state line. Increases in short-term oxygen demand (and subsequent reductions in dissolved oxygen) in the Hydroelectric Reach downstream from J. C. Boyle Dam and in the lower Klamath River downstream from Iron Gate Dam are conservatively estimated to be similar. The short-term decrease in dissolved oxygen concentrations would be a substantial impact on the lower Klamath River from Iron Gate Dam to approximately Clear Creek, but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment.

Over the long term, the Dams Out Scenario would result in increases in dissolved oxygen in June through September along with potentially increasing daily variability in the Klamath River from Link River Dam to the California-Oregon state line and from Iron Gate Dam to the Seiad Valley. Effects would diminish with distance downstream from Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen below the confluence with the Trinity River.

**pH**

The Dams Out Scenario would result in small beneficial increases in daily pH variability during March, April, and May in the Hydroelectric Reach. However, it would result in an adverse increase in overall pH and the magnitude of daily variability during summer months in Klamath River from Iron Gate Dam to the confluence with the Scott River. The Dams Out Scenario would have no effect in the Klamath River immediately downstream from Seiad Valley, in the Klamath Estuary, and in the marine nearshore environment.

**Algal Toxins and Chlorophylls**

Under the Dams Out Scenario, algal toxins and chlorophylls in the lower Klamath River would be substantially reduced. Although algal toxins and

chlorophyll-a produced in Upper Klamath Lake could potentially be transported into the lower Klamath River basin at levels that would exceed water quality objectives, additional in-situ production of the toxins and chlorophyll-a would not occur in the free-flowing river under the Dams Out Scenario.

**Inorganic and Organic Contaminants**

The Dams Out Scenario would cause the release of inorganic and organic contaminants from sediment deposits stored behind the dams to the Hydroelectric Reach in the Klamath River from Iron Gate Dam to the Klamath Estuary and to the marine nearshore environment. However, concentrations of inorganic and organic contaminants would not be high enough to adversely affect beneficial uses, be toxic to aquatic life, or result in bioaccumulation.

***Aquatic Resources***

The Dams Out Scenario is intended to improve and increase fish populations in the Klamath River; and under the Dams Out Scenario, restoration of fishes and habitat are identified. The KBRA outlines habitat restoration and fish reintroduction plans to re-establish anadromous fish in the upper Klamath River basin. The following evaluation examines the aquatic resources in the Klamath River basin and how any potential changes (or lack thereof) resulting from the Dams Out Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Resighini Rancheria. These fisheries are affected by riverine conditions such as water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) under the Dams Out Scenario are described in the previous section, and this section describes how the water resource conditions affect the anadromous fisheries of the Klamath River under the Dams Out Scenario.

*Habitat Area*

Under the Dams Out Scenario, removal of the four facilities would allow spring-run and fall-run Chinook and coho salmon, steelhead, and possibly Pacific lamprey and green sturgeon to gain access to the Klamath River upstream of J. C. Boyle Reservoir. The access would expand the fish habitat to include historic habitat along the mainstem Klamath River, upstream to the Sprague, Williamson, and Wood rivers, a potential increase in habitat of 350 miles. [139]

Additionally, the KBRA has specific tasks for improving the fisheries in the Klamath River, including restoring floodplain habitat, improving instream fish habitat, improving fish passage, and cattle exclusion. The KBRA also includes

[139] Hamilton et al. (2005).

a fish program that will identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam; a monitoring program to track the progress of the reintroduction; and actions that would increase instream flows are intended to benefit anadromous fish populations regardless of the effects of dam removal.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[140] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to disease and parasites.[141]

The long-term effects of the Dams Out Scenario, both from the KHSA and the KBRA, would include more natural daily variations in water temperature, resulting in migration and spawning periods for Klamath River Chinook salmon that are more comparable to historic conditions. Water would become warmer earlier in the spring and cooler earlier in late summer and fall compared to existing conditions, compared to existing Dams In Scenario conditions.[142] Under the Dams Out Scenario, water temperatures would increase 2°C to 4°C (3.6°F to 7.2°F) during spring and summer for rearing anadromous fish. Improved water temperatures (reduced by 7°C to 9°C (12.6°F to 16.2°F)) from October through November would create more ideal temperatures for adult migration and spawning, and spawning below Iron Gate Dam would no longer be delayed; therefore, pre-spawn mortality would be reduced.[143]

The Dams Out Scenario also provides improved thermal conditions (as described above). This new thermal regime will result in:

- earlier spawning,
- longer incubation,
- earlier emergence and growth, and
- earlier downstream migration.

This lifecycle change benefits the Klamath River anadromous fish because it takes them closer to their historic conditions. The river would experience a higher daily maximum, but it would also experience a lower daily minimum. This would allow rearing juveniles to move out of their temperature refugia to forage at night. Lower water temperatures also make habitat conditions much less suitable for the spread of diseases and parasites.

[140] Hamilton et al. (2010).
[141] Wood et al. (2006).
[142] Stillwater Sciences (2009); Hamilton et al. (2010).
[143] Hamilton et al. (2010).

*Suspended and Bedload Sediments*

The Dams Out Scenario would release dam-stored sediment downstream to the lower Klamath River. Under the most likely condition, suspended sediment concentrations would be low enough that they are not expected to affect adult anadromous fish relative to current conditions. In the worst case, suspended sediment concentrations would be high enough to cause major physiological stress and impaired homing.

The Dams Out Scenario would bury redds (i.e., nests) constructed in fall 2019 in dam-released sediment, decreasing embryo survival and alevin emergence potentially as far downstream as Cottonwood Creek, or 4 percent of the river below Iron Gate Dam. The deposition could aggrade pools or overwhelm other habitat features that salmonids use for adult holding or juvenile rearing. The effect would be short term, as pools would likely return to their pre-sediment release depth relatively quickly.[144] In the long term, the river would revert to and maintain a pool-riffle morphology.

The Dams Out Scenario would allow a movement of bedload material that more closely mimics the historic conditions because the dams would no longer block its movement. This would benefit fishes spawning downstream from the current locations of the dams.

*Other Water Quality Components*

Implementation of the Dams Out Scenario would not affect water quality in the Wood, Williamson, and Sprague rivers; Upper Klamath Lake; and Link River to the upstream end of J. C. Boyle Reservoir. It would, however, cause long-term overall increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach. The removal of the four facilities under the Dams Out Scenario would cause slight, long-term increases in summer and fall dissolved oxygen, increasing the likelihood of consistently supporting beneficial uses during this period.

Downstream from Iron Gate Dam, sediment release associated with the Dams Out Scenario could cause short-term increases in oxygen demand and reductions in dissolved oxygen that could adversely affect fisheries resources.

Overall, implementation of the Dams Out Scenario will directly affect anadromous fish by accelerating the TMDL process, and thus improving water quality conditions at a more rapid rate.

*Disease and Parasites*

The Dams Out Scenario would be expected to result in changed habitat conditions that would reduce impacts on salmonids from fish diseases. The main factors contributing to parasitic fish diseases in the Klamath are physical

[144] Stillwater Sciences (2008).

habitat components (pools, eddies, and sediment), microhabitat characteristics (stable flows and low velocities), proximity to spawning areas, and temperatures above 15°C (59°F).

The Dams Out Scenario would likely reduce the availability of favorable physical habitat components for the polychaete host. The removal of Iron Gate Dam would also remove a major barrier to fish migration, resulting in a reduced concentration of spawning adults. Greater dispersal of spawning adult salmon would reduce the proximity of salmon to dense populations of polychaetes.

Increased variability in flow management and the restoration of a more natural sediment regime would likely reduce the suitability of habitat conditions for *M. speciosa*, the invertebrate host for *P. minibicornis* and *C. shasta*. In some areas, increased mobilization of the substrate would help reduce the availability of habitat for polychaetes.[145] Infection rates are related in part to raised water temperatures. If flows increase during spring, juvenile migration time could be decreased, potentially resulting in reduced disease exposure, especially for fishes originating in lower Klamath River tributaries.

The Dams Out Scenario would, however, allow anadromous salmonid migration upstream in the mainstem Klamath River and tributaries, which would result in introduction of parasite genotypes that have been restricted to the lower river. Although the effects of these introductions are uncertain, at least some degree of host specificity appears to exist,[146] indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes of *C. shasta* introduced into the upper watershed. It is not expected that introduction of *C. shasta* genotypes upstream would result in adverse effects because fishes in the upstream basin have shown resistance to the downstream genotypes.

**Estuarine Fish**

The Dams Out Scenario would not substantially change or affect estuarine fish habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

**Aquatic Invertebrates**

Under the Dams Out Scenario, aquatic invertebrates are expected to undergo short-term impacts caused primarily by water quality (specifically sedimentation issues) as described above for anadromous fish, but are also expected to experience long-term benefits through the more natural hydrograph created by the removal of the four dams.

[145] Stocking et al. (2007).
[146] Atkinson et al. (2010).

### *Ecosystem Functionality/Effects*

Under the Dams Out Scenario, fish and invertebrate populations will benefit through increased habitat, more suitable water temperature regimes, substrate movement affecting spawning habitat, improved water quality conditions, and less suitable habitat conditions for the spread of diseases and parasites. These improved fish and invertebrate populations are indicative of a healthier ecosystem. It is not only fishes and aquatic invertebrates that are affected by the Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are affected by the heavily managed and modified Klamath River. These resources would benefit from the Dams Out Scenario.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected increase, with a higher likelihood of viability of the Klamath River populations. The Dams Out Scenario, with the KBRA, will reduce stress on the fishes and may be sufficient to bring the species to recovery. These benefits are important in light of the expected climate change.

Under the Dams Out Scenario, anadromous fish would no longer be restricted to the lower reaches of the lower Klamath River basin, but would be able to access approximately 350 miles of spawning and rearing habitat. This access particularly increases the ability of coho salmon and spring-run Chinook salmon populations to recover. The increased numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have increased available food resources. Additionally, the increase in salmon carcasses would result in more nutrients and food for other aquatic resources and for terrestrial resources.

Under the Dams Out Scenario, flows will more closely mimic a natural hydrograph. The flows will change the geomorphology of the lower river, benefit riparian vegetation recruitment, increase river habitat heterogeneity, increase instream fish habitat structures, increase food web support, and improve water quality as described above. Benefits to the Klamath River and to the habitat and terrestrial species that depend on the Klamath River will occur.

The removal of upstream reservoirs and improved water quality result in decreased amounts of toxic algae in the summer months. Implementation of the TMDLs and the future BOs will improve overall conditions for the fisheries; however, anadromous salmonids historically have not inhabited this region during the summer months. Additionally, populations of coho salmon and spring-run Chinook salmon will likely increase with a potential for downgrading their listing under the ESA and CESA.

### *Effects on Cultural Values*

Removing the project reservoirs will result in water quality conditions that would provide the opportunity for improved Resighini Rancheria cultural values, such as conducting traditional bathing ceremonies, fishing, and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem for

the Resighini Rancheria. The algae produce potent liver toxins at such a high level that warnings against contact with the water are posted along the river each summer. However, over time, successful implementation of the Dams Out Scenario would support beneficial uses by the Resighini Rancheria.

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey were the main food sources for the Resighini Rancheria. The Dams Out Scenario, however, would increase anadromous fish populations and thus would likely benefit the Resighini Rancheria by improving the fisheries and by providing salmon for tribal ceremonies. This increase in fish populations would improve health by increasing the salmon in their diets, decreasing discontent and depression, and improving the opportunities for intergenerational transmission of traditional knowledge. This sense of tribal unity has the potential to reduce the number of young people leaving the reservation. Additionally, healthier riparian vegetation would improve the ability to gather plants that might be used for such things as baskets, medicine, utensils, regalia, and structures.

## Hoopa Valley Indian Tribe

### *Water Resources*

**Hydrology**

Under the Dams Out Scenario, Klamath River hydrology would no longer be dominated by hydropower peaking events between J. C. Boyle Powerhouse and Copco Reservoir. Although the hydrograph would still be influenced by the Klamath Reclamation Project, flows would more closely mimic the natural hydrograph, both within the Hydroelectric Reach and downstream.[147] Higher seasonal flows, such as those prescribed under the KBRA, would improve the quality of riparian habitat. KBRA flows, dam removal, and ecosystem restoration activities would move the hydrograph toward a duration, timing, and magnitude of flows that provide more ecosystem benefits.[148]

**Water Temperature**

The Dams Out Scenario would have a beneficial effect on water temperatures in the Hydroelectric Reach and in the Klamath River from Iron Gate Dam to the Salmon River during summer and fall.

An expected long-term increase in spring water temperatures and decrease in summer and fall water temperatures in the Hydroelectric Reach would be beneficial. Water temperature in the Hydroelectric Reach immediately downstream from J. C. Boyle Dam would be expected to exhibit more daily fluctuations in June through September compared to those of the Dams In Scenario because of the absence of the thermal mass in J. C. Boyle Reservoir and the lack of hydropower peaking operations, both of which tend to moderate daily temperature fluctuations.

As described previously, under the Dams In Scenario, water in the Hydroelectric Reach and the lower Klamath River basin is cooler during spring months and warmer during late summer and early fall as a result of the presence of the dams.[149] The absence of the reservoirs would allow the Klamath River downstream from Iron Gate Dam to be more in phase with the natural temperature regime. Hydraulic residence time between J. C. Boyle Reservoir and Iron Gate Dam would decrease from several weeks to less than a day.[150] Current evaporation from the surface of existing reservoirs (about 11,000 acre feet[151]) would be reduced and that volume would be added to the river flow. The thermal lag, a result of water storage in reservoirs and the associated increased thermal mass, would be eliminated in the lower Klamath River. The

[147] Hamilton et al. (2010).
[148] Hetrick et al. (2009).
[149] Federal Energy Regulatory Commission (2007).
[150] Hamilton et al. (2010).
[151] Reclamation (2011).

Dams Out Scenario may also serve as partial mitigation for climate change by increasing the likelihood that beneficial uses would be supported during summer and fall months because removal of the project reservoirs under the Dams Out Scenario would result in slightly lower summer and fall water temperatures in the Hydroelectric Reach.

The Dams Out Scenario would not be expected to have direct or indirect water temperature effects on the Klamath River downstream from the Salmon River, in the Klamath Estuary, or in the marine nearshore environment.

**Suspended Sediment**

The Dams Out Scenario would result in both short-term and long-term effects on suspended sediment. Over the short term, high short-term loads of suspended sediment are expected immediately downstream from Iron Gate Dam under the Dams Out Scenario.[152] High levels of suspended sediment concentrations are expected downstream from J. C. Boyle Reservoir in the short term, although the relatively small volume of the sediment deposits behind J. C. Boyle Dam would cause concentrations to be considerably less than those anticipated to occur downstream from Iron Gate Reservoir. Overall, sediment release associated with the Dams Out Scenario would cause short-term increases in suspended material (>30 mg/L for 6 to 10 months following drawdown) that would result in non-attainment of applicable water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary, and would substantially adversely affect the cold freshwater habitat beneficial use. In the nearshore marine environment, suspended sediment concentrations would remain elevated (>1,000 mg/L) for 3 or 4 months following drawdown under the Dams Out Scenario. The Dams Out Scenario would have a minor impact on suspended sediment concentrations in the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment because of sediments entering the water from deconstruction site runoff or in-water deconstruction work and implementation of best management practices.

Over the long term, the Dams Out Scenario would slightly increase mineral (inorganic) suspended sediment concentrations and would increase summer and fall algae-derived (organic) suspended sediment concentrations in the Hydroelectric Reach, the reach downstream from Iron Gate Dam, the Klamath Estuary, and the marine nearshore environment because of lack of sediment trapping by dams on Klamath River. However, these increases would not be expected to exceed levels that would cause non-attainment of beneficial uses.

The effect of dam-released sediment and sediment resupply would likely extend from Iron Gate Dam to Cottonwood Creek.[153] Estimates of reach-averaged

[152] Reclamation 2011; Stillwater Sciences (2008).
[153] Reclamation (2011).

stream power (the ability of the river to move sediment) show a decrease from Iron Gate Dam to Cottonwood Creek, with stream power then increasing again downstream from Cottonwood Creek. The increase suggests that short- or long-term sediment deposition, either from dam release or sediment resupply, is unlikely downstream from Cottonwood Creek. Using this point as the downstream extent of bedload-related effects, 8 miles of channel could be affected by sediment release and resupply. The affected channel represents 4 percent of the total channel length of the mainstem Klamath River downstream from Iron Gate Dam (190 miles). Under the Dams Out Scenario, sediment mobilization flows would decrease relative to existing conditions.

**Nutrients**

Under the Dams Out Scenario, short-term increases in nutrient 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. However, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the lower Klamath River and Klamath Estuary. Short-term increases in nutrient concentrations would be a minor impact.

Over the long term in the Hydroelectric Reach and the lower Klamath River basin, the Dams Out Scenario is expected to increase annual nutrient concentrations during summer months because of the absence of nutrient interception and retention behind dams after removal. The increases would not be expected to result in flow conditions exceeding relevant water quality objectives beyond levels experienced under the Dams In Scenario. In addition, the lacustrine environment that supports the growth of toxin-producing nuisance algae blooms would be eliminated under the Dams Out Scenario, reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species.

In the Klamath River immediately downstream from Iron Gate Dam, while a total nutrient increase would likely occur under the Dams Out Scenario, the increase would shift the system away from strong nitrogen limitation, and away from the nutrient conditions that promote nuisance algae blooms and adversely affect beneficial uses. Farther downstream, the increase in nutrients, both from an absolute concentration perspective and from a relative perspective, would be diminished.

**Dissolved Oxygen**

In the short term following dam removal, the Dams Out Scenario would result in a decrease in dissolved oxygen concentrations in the Klamath River downstream from J. C. Boyle Dam to the California-Oregon state line. Increases in short-term oxygen demand (and subsequent reductions in dissolved oxygen) in the Hydroelectric Reach downstream from J. C. Boyle Dam and in

the lower Klamath River downstream from Iron Gate Dam are conservatively estimated to be similar. The short-term decrease in dissolved oxygen concentrations would be a substantial impact on the lower Klamath River from Iron Gate Dam to approximately Clear Creek, but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment.

Over the long term, the Dams Out Scenario would result in increases in dissolved oxygen during June-September along with potentially increasing daily variability in the Klamath River from Link River Dam to the California-Oregon state line and from Iron Gate Dam to the Seiad Valley. Effects would diminish with distance downstream from Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen at the confluence with the Trinity River.

**pH**

The Dams Out Scenario would result in small beneficial increases in daily pH variability during March, April, and May in the Hydroelectric Reach. However, it would result in an adverse increase in overall pH and the magnitude of daily variability during summer months in Klamath River from Iron Gate Dam to the confluence with the Scott River. The Dams Out Scenario would have no effect in the Klamath River immediately downstream from Seiad Valley, in the Klamath Estuary, and in the marine nearshore environment.

**Algal Toxins and Chlorophylls**

Under the Dams Out Scenario, algal toxins and chlorophylls in the lower Klamath River would be substantially reduced. Although algal toxins and chlorophyll-a produced in Upper Klamath Lake could potentially be transported into the lower Klamath River basin at levels that would exceed water quality objectives, additional in-situ production of the toxins and chlorophyll-a would not occur in the free-flowing river under the Dams Out Scenario.

**Inorganic and Organic Contaminants**

The Dams Out Scenario would cause the release of inorganic and organic contaminants from sediment deposits stored behind the dams to the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and to the marine nearshore environment. However, concentrations of inorganic and organic contaminants would not be high enough to adversely affect beneficial uses, be toxic to aquatic life, or result in bioaccumulation.

***Aquatic Resources***

The Dams Out Scenario is intended to improve and increase fish populations in the Klamath River; and under the Dams Out Scenario, restoration of fishes and habitat are identified. The KBRA outlines habitat restoration and fish reintroduction plans to re-establish anadromous fish in the upper Klamath River basin. The following evaluation examines the aquatic resources in the Klamath

River basin and how any potential changes (or lack thereof) resulting from the Dams Out Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Hoopa Valley Indian Tribe. These fisheries are affected by riverine conditions such as water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) under the Dams Out Scenario are described in the previous section, and this section describes how the water resource conditions affect the anadromous fisheries of the Klamath River under the Dams Out Scenario.

*Habitat Area*

Under the Dams Out Scenario, removal of the four facilities would allow spring-run and fall-run Chinook and coho salmon, steelhead, and possibly Pacific lamprey and green sturgeon to gain access to the Klamath River upstream of J. C. Boyle Reservoir. The access would expand the fish habitat to include historic habitat along the mainstem Klamath River, upstream to the Sprague, Williamson, and Wood rivers, a potential increase in habitat of approximately 350 miles. [154]

Additionally, the KBRA has specific tasks for improving the fisheries in the Klamath River, including restoring floodplain habitat, improving instream fish habitat, improving fish passage, and cattle exclusion. The KBRA also includes a fish program that will identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam, a monitoring program to track the progress of the reintroduction, and actions that would increase instream flows that are intended to benefit both anadromous fish populations regardless of the effects of dam removal.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[155] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to disease and parasites. [156]

The long-term effects of the Dams Out Scenario, both from the KHSA and the KBRA, would include more natural daily variations in water temperature, resulting in migration and spawning periods for Klamath River Chinook salmon that are more comparable to historical conditions. Water would become warmer

[154] Hamilton et al. (2005).
[155] Ibid.
[156] Wood et al. (2006).

earlier in the spring and cooler earlier in late summer and fall compared to existing conditions, compared to existing Dams In Scenario conditions.[157] Under the Dams Out Scenario, water temperatures would increase 2°C to 4°C (3.6°F to 7.2°F) during spring and summer for rearing anadromous fish. Improved water temperatures (reduced by 7°C to 9°C (12.6°F to 16.2°F)) from October through November would create more ideal temperatures for adult migration and spawning, and spawning below Iron Gate Dam would no longer be delayed; therefore, pre-spawn mortality would be reduced.[158]

The Dams Out Scenario also provides improved thermal conditions (as described above). This new thermal regime will result in:

- earlier spawning,
- longer incubation,
- earlier emergence and growth, and
- earlier downstream migration.

This lifecycle change benefits the Klamath River anadromous fish because it takes them closer to their historic conditions. The river would experience a higher daily maximum, but it would also experience a lower daily minimum. This would allow rearing juveniles to move out of their temperature refugia to forage at night. Lower water temperatures also make habitat conditions much less suitable for the spread of diseases and parasites.

*Suspended and Bedload Sediments*

The Dams Out Scenario would release dam-stored sediment downstream to the lower Klamath River. Under the most likely condition, suspended sediment concentrations would be low enough that they are not expected to affect adult anadromous fish relative to current conditions. In the worst case, suspended sediment concentrations would be high enough to cause major physiological stress and impaired homing.

The Dams Out Scenario would bury redds (i.e., nests) constructed in fall 2019 in dam-released sediment, decreasing embryo survival and alevin emergence potentially as far downstream as Cottonwood Creek, or 4 percent of the river below Iron Gate Dam. The deposition could aggrade pools or overwhelm other habitat features that salmonids use for adult holding or juvenile rearing. The effect would be short term, as pools would likely return to their pre-sediment release depth relatively quickly.[159] In the long term, the river would revert to and maintain a pool-riffle morphology.

[157] Stillwater Sciences (2009); Hamilton et al. (2010).
[158] Hamilton et al. (2010).
[159] Stillwater Sciences (2008).

The Dams Out Scenario would allow a movement of bedload material that more closely mimics the historic conditions because the dams would no longer block its movement. This would benefit fishes spawning downstream from the current locations of the dams.

*Other Water Quality Components*

Implementation of the Dams Out Scenario would not affect water quality in the Wood, Williamson, and Sprague rivers; Upper Klamath Lake; and Link River to the upstream end of J. C. Boyle Reservoir. It would, however, cause long-term overall increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen in the Hydroelectric Reach. The removal of the four facilities under the Dams Out Scenario would cause slight, long-term increases in summer and fall dissolved oxygen, increasing the likelihood of consistently supporting beneficial uses during this period.

Downstream from Iron Gate Dam, sediment release associated with the Dams Out Scenario could cause short-term increases in oxygen demand and reductions in dissolved oxygen that could adversely affect fisheries resources.

Overall, implementation of the Dams Out Scenario will directly affect anadromous fish by accelerating the TMDL process, and thus improving water quality conditions at a more rapid rate.

*Disease and Parasites*

The Dams Out Scenario would be expected to result in changed habitat conditions that would reduce impacts on salmonids from fish diseases. The main factors contributing to parasitic fish diseases in the Klamath include physical habitat components (pools, eddies, and sediment); microhabitat characteristics (stable flows and low velocities); proximity to spawning areas; and temperatures above 15°C (59°F).

The Dams Out Scenario would likely reduce the availability of favorable physical habitat components for the polychaete host. The removal of Iron Gate Dam would also remove a major barrier to fish migration, resulting in a reduced concentration of spawning adults. Greater dispersal of spawning adult salmon would reduce the proximity of salmon to dense populations of polychaetes.

Increased variability in flow management and the restoration of a more natural sediment regime would likely reduce the suitability of habitat conditions for *M. speciosa*, the invertebrate host for *P. minibicornis* and *C. shasta.* In some areas, increased mobilization of the substrate would help reduce the availability of habitat for polychaetes.[160] Infection rates are related in part to raised water temperatures. If flows increase during spring, juvenile migration time could be

[160] Stocking et al. (2007).

decreased, potentially resulting in reduced disease exposure, especially for fishes originating in lower Klamath River tributaries.

The Dams Out Scenario would, however, allow anadromous salmonid migration upstream in the mainstem Klamath River and tributaries, which would result in introduction of parasite genotypes that have been restricted to the lower river. Although the effects of these introductions are uncertain, at least some degree of host specificity appears to exist,[161] indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes of *C. shasta* introduced into the upper watershed. It is not expected that introduction of *C. shasta* genotypes upstream would result in adverse effects because fishes in the upstream basin have shown resistance to the downstream genotypes.

**Estuarine Fish**

The Dams Out Scenario would not substantially change or affect estuarine fish habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the Klamath Estuary.

**Aquatic Invertebrates**

Under the Dams Out Scenario, aquatic invertebrates are expected to undergo short-term impacts caused primarily by water quality (specifically sedimentation issues) as described above for anadromous fish, but are also expected to experience long-term benefits through the more natural hydrograph created by the removal of the four dams.

***Ecosystem Functionality/Effects***

Under the Dams Out Scenario, fish and invertebrate populations will benefit through increased habitat, more suitable water temperature regimes, substrate movement affecting spawning habitat, improved water quality conditions, and less suitable habitat conditions for the spread of diseases and parasites. These improved fish and invertebrate populations are indicative of a healthier ecosystem. It is not only fish and aquatic invertebrates that are affected by the Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are affected by the heavily managed and modified Klamath River. These resources would benefit from the Dams Out Scenario.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to increase, with a higher likelihood of viability of the Klamath River populations. The Dams Out Scenario, with the KBRA, will reduce stress on the fishes and may be sufficient to bring the species to recovery. These benefits are important in light of the expected climate change.

[161] Atkinson et al. (2010).

Under the Dams Out Scenario, anadromous fish would no longer be restricted to the lower reaches of the lower Klamath River basin, but would be able to access approximately 350 miles of spawning and rearing habitat. This access particularly increases the ability of coho salmon and spring-run Chinook salmon populations to recover. The increased numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have increased available food resources. Additionally, the increase in salmon carcasses would result in more nutrients and food for other aquatic resources and for terrestrial resources.

Under the Dams Out Scenario, flows will more closely mimic a natural hydrograph. The flows will change the geomorphology of the lower river, benefit riparian vegetation recruitment, increase river habitat heterogeneity, increase instream fish habitat structures, increase food web support, and improve water quality as described above. Benefits to the Klamath River and to the habitat and terrestrial species that depend on the Klamath River will occur.

The removal of upstream reservoirs and improved water quality result in decreased amounts of toxic algae in the summer months. Implementation of the TMDLs and the future BOs will improve overall conditions for the fisheries; however, anadromous salmonids historically did not often occur in this region during the summer months. Additionally, populations of coho salmon and spring-run Chinook salmon will likely increase with a potential for downgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

The Hoopa Valley Indian Tribe has a reserved right to water in the Klamath River to support harvest of fishes that the Hupa require to maintain a moderate standard of living. The tribe also has subsistence and ceremonial fisheries.

Removing the project reservoirs will result in water quality conditions that would provide the opportunity for improved Hoopa Valley Indian Tribe cultural values, such as conducting traditional bathing ceremonies, fishing, and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem for the Hoopa Valley Indian Tribe for the approximately 1/3 mile of the Hoopa reservation that is along the Klamath River because they degrade water for contact recreational and ceremonial uses and can produce toxins hazardous to fishes and humans. However, over time, successful implementation of the Dams Out Scenario would support beneficial uses by the Hoopa Valley Indian Tribe.

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the Hupa people. Under the Dams Out Scenario, however, increases in anadromous fish populations would likely benefit the Hoopa Valley Indian Tribe and provide the opportunity to improve their standard of living through more stable commercial and subsistence fisheries and would provide salmon for tribal ceremonies. This increase in fish

populations would provide the opportunity for improved health by increasing the salmon in their diets, decreasing discontent and depression, and improving the capability of intergenerational transmission of traditional knowledge. This sense of tribal unity has the potential to result in a reduction in the number of young people leaving the reservation. Additionally, healthier riparian vegetation would improve the ability to gather plants that might be used for such things as baskets, medicine, utensils, regalia, and structures.

## Karuk Tribe

### *Water Resources*

**Hydrology**

Under the Dams Out Scenario, Klamath River hydrology would no longer be dominated by hydropower peaking events between J. C. Boyle Powerhouse and Copco Reservoir. Although the hydrograph would still be influenced by the Klamath Reclamation Project, flows would more closely mimic the natural hydrograph, both within the Hydroelectric Reach and downstream.[162] Higher seasonal flows, such as those prescribed under the KBRA, would improve the quality of riparian habitat. KBRA flows, dam removal, and ecosystem restoration activities would move the hydrograph toward a duration, timing, and magnitude of flows that provide more ecosystem benefits.[163]

**Water Temperature**

The Dams Out Scenario would have a beneficial effect on water temperatures in the Hydroelectric Reach and in the Klamath River from Iron Gate Dam to the Salmon River during summer and fall.

An expected long-term increase in spring water temperatures and decrease in summer/fall water temperatures in the Hydroelectric Reach would be beneficial. Water temperature in the Hydroelectric Reach immediately downstream from J. C. Boyle Dam would be expected to exhibit more daily fluctuations in June through September compared to those of the Dams In Scenario because of the absence of the thermal mass in J. C. Boyle Reservoir and the lack of hydropower peaking operations, both of which tend to moderate daily temperature fluctuations.

As described previously, under the Dams In Scenario, water in the Hydroelectric Reach and the lower Klamath River basin is cooler during spring and warmer during late summer and early fall as a result of the presence of the dams.[164] The absence of the reservoirs would allow the Klamath River downstream from Iron Gate Dam to be more in phase with the natural temperature regime. Hydraulic residence time between J. C. Boyle Reservoir and Iron Gate Dam would decrease from several weeks to less than a day.[165] Current evaporation from the surface of existing reservoirs (about 11,000 acre feet[166]) would be reduced and that volume would be added to the river flow. The thermal lag, a result of water storage in reservoirs and the associated increased thermal mass, would be eliminated in the lower Klamath River. The

[162] Hamilton et al. (2010).
[163] Hetrick et al. (2009).
[164] Federal Energy Regulatory Commission (2007).
[165] Hamilton et al. (2010).
[166] Reclamation (2011).

Dams Out Scenario may also serve as partial mitigation for climate change by increasing the likelihood that beneficial uses would be supported during summer and fall because removal of the project reservoirs under the Dams Out Scenario would result in slightly lower summer and fall water temperatures in the Hydroelectric Reach.

The Dams Out Scenario would not be expected to have direct or indirect water temperature effects on the Klamath River downstream from the Salmon River, in the Klamath Estuary, or in the marine nearshore environment.

**Suspended Sediment**

The Dams Out Scenario would result in both short-term and long-term effects on suspended sediment. Over the short term, high loads of suspended sediment are expected immediately downstream from Iron Gate Dam under the Dams Out Scenario.[167] High levels of suspended sediment concentrations are also expected downstream from J. C. Boyle Reservoir in the short term, although the relatively small volume of the sediment deposits behind J. C. Boyle Dam would cause concentrations to be considerably less than those anticipated to occur downstream from Iron Gate Reservoir. Overall, sediment release associated with the Dams Out Scenario would cause short-term increases in suspended material (>30 mg/L for 6 to 10 months following drawdown) that would result in non-attainment of applicable water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary and would substantially adversely affect the cold freshwater habitat beneficial use. In the nearshore marine environment, suspended sediment concentrations would remain elevated (>1,000 mg/L) for 3 or 4 months following drawdown under the Dams Out Scenario. The Dams Out Scenario would have a minor impact on suspended sediment concentrations in the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment because of sediments entering the water from deconstruction site runoff or in-water deconstruction work and implementation of best management practices.

Over the long term, the Dams Out Scenario would slightly increase mineral (inorganic) suspended sediment concentrations and would increase summer and fall algae-derived (organic) suspended sediment concentrations in the Hydroelectric Reach, the reach downstream from Iron Gate Dam, in the Klamath Estuary, and in the marine nearshore environment because of lack of sediment trapping by dams on Klamath River. However, these increases would not be expected to exceed levels that would cause non-attainment of beneficial uses.

The effect of dam-released sediment and sediment resupply would likely extend from Iron Gate Dam to Cottonwood Creek.[168] Estimates of reach-averaged

[167] Greimann et al. 2010); Stillwater Sciences (2008).
[168] Reclamation (2011).

stream power (the ability of the river to move sediment) show a decrease from Iron Gate Dam to Cottonwood Creek, with stream power increasing again downstream from Cottonwood Creek. The increase suggests that short- or long-term sediment deposition, either from dam release or sediment resupply, is unlikely downstream from Cottonwood Creek. Using this point as the downstream extent of bedload-related effects, 8 miles of channel could be affected by sediment release and resupply. The affected channel represents 4 percent of the total channel length of the mainstem Klamath River downstream from Iron Gate Dam (190 miles). Under the Dams Out Scenario, sediment mobilization flows would decrease relative to existing conditions.

**Nutrients**

Under the Dams Out Scenario, short-term increases in nutrient 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. However, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the lower Klamath River and Klamath Estuary. Short-term increases in nutrient concentrations would be a minor impact.

Over the long term in the Hydroelectric Reach and the lower Klamath River basin, the Dams Out Scenario is expected to increase annual nutrient concentrations during summer months because of the absence of nutrient interception and retention behind dams after removal. The increases would not be expected to result in flow conditions exceeding relevant water quality objectives beyond levels experienced under the Dams In Scenario. In addition, the lacustrine environment that supports the growth of toxin-producing nuisance algae blooms would be eliminated under the Dams Out Scenario, reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species.

In the Klamath River immediately downstream from Iron Gate Dam, while a total nutrient increase would likely occur under the Dams Out Scenario, the increase would shift the system away from strong nitrogen limitation, and away from the nutrient conditions that promote nuisance algae blooms and adversely affect beneficial uses. Farther downstream, the increase in nutrients, both from an absolute concentration perspective and from a relative perspective, would be diminished.

**Dissolved Oxygen**

In the short term following dam removal, the Dams Out Scenario would result in a decrease in dissolved oxygen concentrations in the Klamath River downstream from J. C. Boyle Dam to the California-Oregon state line. Increases in short-term oxygen demand (and subsequent reductions in dissolved oxygen) in the Hydroelectric Reach downstream from J. C. Boyle Dam and in

the lower Klamath River downstream from Iron Gate Dam are conservatively estimated to be similar. The short-term decrease in dissolved oxygen concentrations would be a substantial impact on the lower Klamath River from Iron Gate Dam to approximately Clear Creek, but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment.

Over the long term, the Dams Out Scenario would result in increases in dissolved oxygen during June-September along with potentially increasing daily variability in the Klamath River from Link River Dam to the California-Oregon state line and from Iron Gate Dam to the Seiad Valley. Effects would diminish with distance downstream from Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen at the confluence with the Trinity River.

**pH**

The Dams Out Scenario would result in small beneficial increases in daily pH variability during March, April, and May in the Hydroelectric Reach. However, it would result in an adverse increase in overall pH and the magnitude of daily variability during summer in Klamath River from Iron Gate Dam to the confluence with the Scott River. The Dams Out Scenario would have no effect in the Klamath River immediately downstream from Seiad Valley, in the Klamath Estuary, and in the marine nearshore environment.

**Algal Toxins and Chlorophylls**

Under the Dams Out Scenario, algal toxins and chlorophylls in the lower Klamath River would be substantially reduced. Although algal toxins and chlorophyll-a produced in Upper Klamath Lake could potentially be transported into the lower Klamath River basin at levels that would exceed water quality objectives, additional in-situ production of the toxins and chlorophyll-a would not occur in the free-flowing river under the Dams Out Scenario.

**Inorganic and Organic Contaminants**

The Dams Out Scenario would cause the release of inorganic and organic contaminants from sediment deposits stored behind the dams to the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and to the marine nearshore environment. However, concentrations of inorganic and organic contaminants would not be high enough to adversely affect beneficial uses, be toxic to aquatic life, or result in bioaccumulation.

***Aquatic Resources***

The Dams Out Scenario is intended to improve and increase fish populations in the Klamath River; and under the Dams Out Scenario, restoration of fishes and habitat is identified. The KBRA outlines habitat restoration and fish reintroduction plans to re-establish anadromous fish in the upper Klamath River basin. The following evaluation examines the aquatic resources in the Klamath

River basin and how any potential changes (or lack thereof) resulting from the Dams Out Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Karuk Tribe. These fisheries are affected by riverine conditions that include water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) under the Dams Out Scenario are described in the previous section, and this section describes how the water resource conditions affect the anadromous fisheries of the Klamath River under the Dams Out Scenario.

*Habitat Area*

Under the Dams Out Scenario, removal of the four facilities would allow spring-run and fall-run Chinook and coho salmon, steelhead, and possibly Pacific lamprey and green sturgeon to gain access to the Klamath River upstream of J. C. Boyle Reservoir. The redband trout population would increase its range (downstream) as well. The access would expand the fish habitat to include historic habitat along the mainstem Klamath River, upstream to the Sprague, Williamson, and Wood rivers, a potential increase in habitat of approximately 350 miles. [169]

Additionally, the KBRA has specific tasks for improving the fisheries in the Klamath River, including restoring floodplain habitat, improving instream fish habitat, improving fish passage, and cattle exclusion. The KBRA also includes a fish program that will identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam, a monitoring program to track the progress of the reintroduction, and actions that would increase instream flows and that are intended to benefit both anadromous fish populations regardless of the effects of dam removal.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[170] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to disease and parasites and also provides habitat conditions suitable for exotic species competing for viable habitat. [171]

[169] Hamilton et al. (2005).
[170] Ibid.
[171] Wood et al. (2006).

The long-term effects of the Dams Out Scenario, from both the KHSA and the KBRA, would include more natural daily variations in water temperature, resulting in migration and spawning periods for Klamath River Chinook salmon that are more comparable to historical conditions. Water would become warmer earlier in the spring and cooler earlier in late summer and fall compared to existing conditions, and hence conditions that would occur under the Dams In Scenario.[172] Under the Dams Out Scenario, water temperatures would increase 2°C to 4°C (3.6°F to 7.2°F) during spring and summer for rearing anadromous fish. Improved water temperatures (reduced by 7°C to 9°C (12.6°F to 16.2°F)) from October through November would create more ideal temperatures for adult migration and spawning, and spawning below Iron Gate Dam would no longer be delayed, therefore reducing pre-spawn mortality.[173]

The Dams Out Scenario also provides improved thermal conditions (as described above). This new thermal regime will result in:

- earlier spawning,
- longer incubation,
- earlier emergence and growth, and
- earlier downstream migration.

This lifecycle change benefits the Klamath River anadromous fish because it takes them closer to their historic conditions. The river would experience a higher daily maximum, but it would also experience a lower daily minimum. This would allow rearing juveniles to move out of their temperature refugia to forage at night. Lower water temperatures also make habitat conditions much less suitable for the spread of diseases and parasites.

*Suspended and Bedload Sediments*

The Dams Out Scenario would release dam-stored sediment downstream to the lower Klamath River. Under the most likely condition, suspended sediment concentrations would be low enough that they are not expected to affect adult anadromous fish relative to current conditions. In the worst case, suspended sediment concentrations would be high enough to cause major physiological stress and impaired homing.

The Dams Out Scenario would bury redds (i.e., nests) constructed in fall 2019 in dam-released sediment, decreasing embryo survival and alevin emergence potentially as far downstream as Cottonwood Creek, or 4 percent of the river below Iron Gate Dam. The deposition could aggrade pools or overwhelm other habitat features that salmonids use for adult holding or juvenile rearing. The effect would be short term, as pools would likely return to their pre-sediment

[172] Stillwater Sciences (2009); Hamilton et al. (2010).
[173] Hamilton et al. (2010).

release depth relatively quickly.[174] In the long term, the river would revert to and maintain a pool-riffle morphology. The revitalized pool-riffle morphology would presumably increase the river's velocity, which would provide an opportunity for the Karuk people to re-establish historic fishing locations (platforms, trigger nets). More fishes would be available, and the spawning migration corridor would presumably shift to known fishing sites because of the increased velocity of the river, increased riffle size, and the re-establishment of back eddies.

The Dams Out Scenario would allow a movement of bedload material that more closely mimics the historic conditions because the dams would no longer block its movement. This would benefit fishes spawning downstream from the present locations of the dams. A free-flowing river would provide the natural bedload transport/deposition rate that the culturally sensitive species (e.g., freshwater clams and mussels, Pacific lamprey, crawdads) need to re-establish vital habitat.

*Other Water Quality Components*

Implementation of the Dams Out Scenario would not affect water quality in the Wood, Williamson, and Sprague rivers; Upper Klamath Lake; and Link River to the upstream end of J. C. Boyle Reservoir. It would, however, cause long-term overall increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach. The removal of the four facilities under the Dams Out Scenario would cause slight, long-term increases in summer and fall dissolved oxygen, increasing the likelihood of consistently supporting beneficial uses during this period.

Downstream from Iron Gate Dam, sediment release associated with the Dams Out Scenario could cause short-term increases in oxygen demand and reductions in dissolved oxygen that could adversely affect fisheries resources.

Overall, implementation of the Dams Out Scenario will directly affect anadromous fish by accelerating the TMDL process, and thus improving water quality conditions at a more rapid rate.

*Disease and Parasites*

The Dams Out Scenario would be expected to result in changed habitat conditions that would reduce impacts on salmonids from fish diseases. The main factors contributing to parasitic fish diseases in the Klamath are physical habitat components (pools, eddies, and sediment); microhabitat characteristics (stable flows and low velocities); proximity to spawning areas; and temperatures above 15°C (59°F).

[174] Stillwater Sciences (2008).

The Dams Out Scenario would likely reduce the availability of favorable physical habitat components for the polychaete host. The removal of Iron Gate Dam would also remove a major barrier to fish migration, resulting in a reduced concentration of spawning adults. Greater dispersal of spawning adult salmon would reduce the proximity of salmon to dense populations of polychaetes.

Increased variability in flow management and the restoration of a more natural sediment regime would likely reduce the suitability of habitat conditions for *M. speciosa*, the invertebrate host for *P. minibicornis* and *C. shasta*. In some areas, increased mobilization of the substrate would help reduce the availability of habitat for polychaetes.[175] Infection rates are related in part to raised water temperatures. If flows increase during spring, juvenile migration time could be decreased, potentially resulting in reduced disease exposure, especially for fishes originating in lower Klamath River tributaries.

The Dams Out Scenario would, however, allow anadromous salmonid migration upstream in the mainstem Klamath River and tributaries, which would result in introduction of parasite genotypes that have been restricted to the lower river. Although the effects of these introductions are uncertain, at least some degree of host specificity appears to exist,[176] indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes of *C. shasta* introduced into the upper watershed. It is not expected that introduction of *C. shasta* genotypes upstream would result in adverse effects because fishes in the upstream basin have shown resistance to the downstream genotypes.

**Estuarine Fish**

The Dams Out Scenario would not substantially change or affect estuarine fish habitat. Sediment, flow, and water temperature effects would likely not extend downstream to the estuary.

**Aquatic Invertebrates**

Under the Dams Out Scenario, aquatic invertebrates are expected to undergo short-term impacts caused primarily by water quality (specifically sedimentation issues) as described above for anadromous fish, but are also expected to experience long-term benefits through the more natural hydrograph created by the removal of the four dams.

***Ecosystem Functionality/Effects***

Under the Dams Out Scenario, fish and invertebrate populations will benefit through increased habitat, more suitable water temperature regimes, substrate movement affecting spawning habitat, improved water quality conditions, and less suitable habitat conditions for the spread of diseases and parasites. These

[175] Stocking et al. (2007).
[176] Atkinson et al. (2010).

improved fish and invertebrate populations are indicative of a healthier ecosystem. The traditional food base, regalia, and other symbolic ceremonial species should, over time, become adequate for subsistence and ceremonial needs. It is not only fish and aquatic invertebrates that are affected by the Klamath River; riparian vegetation and terrestrial resources that depend on aquatic resources for food are affected by the heavily managed and modified Klamath River. These resources would benefit from the Dams Out Scenario.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to increase, with a higher likelihood of viability of the Klamath River populations. The Dams Out Scenario, with the KBRA, will reduce stress on the fishes and may be sufficient to bring the species to recovery. These benefits are important in light of the expected level of climate change.

Under the Dams Out Scenario, anadromous fish would no longer be restricted to the lower reaches of the lower Klamath River basin, but would be able to access approximately 350 miles of spawning and rearing habitat. This access particularly increases the ability of coho salmon and spring-run Chinook salmon populations to recover. The increased numbers of anadromous fish mean that piscivorous (fish-eating) birds and animals would continue to have increased food resources. Additionally, the increase in salmon carcasses would result in more nutrients and food for other aquatic resources and for terrestrial resources.

Under the Dams Out Scenario, flows will more closely mimic a natural hydrograph. The flows will change the geomorphology of the lower river, benefit riparian vegetation recruitment, increase river habitat heterogeneity, which provides higher quality basket-making and artisan materials, increase instream fish habitat structures, increase food web support, and improve water quality as described above. Benefits to the Klamath River and to the habitat and terrestrial species that depend on the Klamath River will occur.

The removal of upstream reservoirs and improved water quality result in decreased amounts of toxic algae in the summer. Implementation of the TMDLs and the future BOs will improve overall conditions for the fisheries; however, anadromous salmonids historically have not inhabited this region during the summer. Additionally, populations of coho salmon and spring-run Chinook salmon will likely increase, with a potential for downgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

The Karuk Tribe has a state fishing right for dip-net fishing at Ishi Pishi Falls in the Klamath River. This fishery is expected to increase as a result of the Dams Out Scenario because improved habitat (including access to historic habitat), water quality, water temperature, and bedload movement would result in growing numbers of Chinook salmon, coho salmon, steelhead, spring- and fall-run Chinook, salmon and other traditional food base and regalia species.

> By improving water quality both aesthetically and hygienically, removal of the project reservoirs would benefit Karuk Tribe cultural values. Under the Dams Out Scenario, the river will return to an environment that more closely resembles the river as it is represented in Karuk ceremonies and creation stories. The tribe would have increased opportunities to conduct traditional bathing ceremonies, fish, and enjoy the aesthetic qualities of the river. Under this scenario, health risks encountered by Karuk people when performing key Pikiawish, Brush Dance, puberty, funerals, personal hygiene, courtship, and other spiritual cleansing ceremonies would be alleviated. The Dams Out Scenario would dilute the particulate matter in the water during low-water years that presently creates unpleasant odors, which raises concerns by tribal members about the healthfulness of the fish for consumption and the safety of the river for swimming. Algae, in particular, are a major problem for the Karuk Tribe. The algae produce potent liver toxins at such a high level that warnings against contact with the water are posted along the river each summer. Over time, successful implementation of the Dams Out Scenario would support beneficial uses by the Karuk Tribe.

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey have been the main food sources for the Karuk people. The Dams Out Scenario, however, would increase anadromous fish populations and, thus, would likely benefit the Karuk Tribe. The increase in fish populations would improve health by increasing the salmon in their diets, decreasing discontent and depression, and improving the capability of intergenerational transmission of traditional knowledge. This sense of tribal unity has the potential to result in fewer young people leaving the reservation. Additionally, healthier riparian vegetation would improve the ability to gather plants that might be used for such things as baskets, medicine, utensils, regalia, and structures.

## Quartz Valley Indian Community

There are no trust resources, tribal rights, or other resources traditionally used by the Quartz Valley Indian Community associated with water or fishes that are affected by the Dams Out Scenario.

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## Klamath Tribes

### *Water Resources*

**Hydrology**

Under the Dams Out Scenario, in the upper Klamath River basin above the Klamath Hydroelectric Project reservoirs, a Technical Advisory Team would be established to advise the Secretary on the management of flows. Although the Team's future management decisions cannot be determined, it is expected that flows would be managed to more closely replicate natural hydrologic regimes, to increase survival of anadromous fish and suckers, and to improve other important ecological, chemical, physical, and biological processes.[177] The Dams Out Scenario is expected to result in higher water surface elevations in Upper Klamath Lake than the Dams In Scenario throughout the year. Differences in flow and lake elevations would primarily be caused by differences in water deliveries to agriculture and wildlife refuges in addition to the flow releases at Link Dam; the removal of the PacifiCorp dams would not substantially affect average monthly flows from Upper Klamath Lake because they do not alter their normal pool elevation significantly throughout the year.

Under the Dams Out Scenario, Klamath River hydrology would no longer be dominated by hydropower peaking events between J. C. Boyle Powerhouse and Copco Reservoir. Although the hydrograph would still be influenced by the Klamath Reclamation Project, flows would more closely mimic the natural hydrograph, both within the Hydroelectric Reach and downstream.[178] Higher seasonal flows, such as those prescribed under the KBRA, would improve the quality of riparian habitat. KBRA flows, dam removal, and ecosystem restoration activities would move the hydrograph toward a duration, timing, and magnitude of flows that provide more ecosystem benefits.[179]

**Water Temperature**

The Dams Out Scenario would have a beneficial effect on water temperatures in the Hydroelectric Reach and in the Klamath River from Iron Gate Dam to the Salmon River during summer and fall.

An expected, long-term increases in spring water temperatures and decreases in summer and fall water temperatures in the Hydroelectric Reach would be beneficial. Water temperature in the Hydroelectric Reach immediately downstream from J. C. Boyle Dam would be expected to exhibit more daily fluctuations in June through September compared to those of the Dams In Scenario because of the absence of the thermal mass in J. C. Boyle Reservoir

[177] Hamilton et al (2010)
[178] Ibid.
[179] Hetrick et al. (2009).

and the lack of hydropower peaking operations, both of which tend to moderate daily temperature fluctuations.

As previously described, under the Dams In Scenario, water in the Hydroelectric Reach and the lower Klamath River basin is cooler during spring months and warmer during late summer and early fall as a result of the presence of the dams.[180] Under the Dams Out Scenario, the absence of the reservoirs would allow the Klamath River downstream from Iron Gate Dam to be more in phase with the natural temperature regime. Hydraulic residence time between J. C. Boyle Reservoir and Iron Gate Dam would decrease from several weeks to less than a day.[181] Current evaporation from the surface of existing reservoirs (about 11,000 acre feet[182]) would be reduced and that volume would be added to the river flow. The thermal lag, a result of water storage in reservoirs and the associated increased thermal mass, would be eliminated in the lower Klamath River. The Dams Out Scenario may also serve as partial mitigation for climate change by increasing the likelihood that beneficial uses would be supported during summer and fall months because removal of the project reservoirs under the Dams Out Scenario would result in slightly lower summer and fall water temperatures in the Hydroelectric Reach.

The Dams Out Scenario would not be expected to have direct or indirect water temperature effects on the Klamath River downstream from the Salmon River, in the Klamath Estuary, or in the marine nearshore environment.

**Suspended Sediment**

In the upper Klamath River basin, resource management actions included in the KBRA and accelerated implementation of TMDLs are expected to decrease concentrations of suspended sediments in Upper Klamath Lake and its tributaries.

In the Hydroelectric Reach and the lower Klamath River basin, the Dams Out Scenario would result in both short-term and long-term effects on suspended sediment. Over the short term, high loads of suspended sediment are expected immediately downstream from Iron Gate Dam under the Dams Out Scenario.[183] High levels of suspended sediment concentrations are also expected downstream from J. C. Boyle Reservoir in the short term, although the relatively small volume of the sediment deposits behind J. C. Boyle Dam would cause concentrations to be considerably less than those anticipated to occur downstream from Iron Gate Reservoir. Overall, sediment release associated with the Dams Out Scenario would cause short-term increases in suspended material (>30 mg/L for 6 to 10 months following drawdown) that would result

[180] Federal Energy Regulatory Commission (2007).
[181] Hamilton et al. (2010).
[182] Reclamation (2011).
[183] Reclamation (2011); Stillwater Sciences (2008).

in non-attainment of applicable water quality objectives for suspended material in the lower Klamath River and the Klamath Estuary and would substantially adversely affect the cold freshwater habitat beneficial use. In the nearshore marine environment, suspended sediment concentrations would remain elevated (>1,000 mg/L) for 3 or 4 months following drawdown under the Dams Out Scenario. The Dams Out Scenario would have a minor impact on suspended sediment concentrations in the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment because of sediments entering the water from deconstruction site runoff or in-water deconstruction work and implementation of best management practices.

Over the long term, the Dams Out Scenario would slightly increase mineral (inorganic) suspended sediment concentrations and would increase summer and fall algae-derived (organic) suspended sediment concentrations in the Hydroelectric Reach, the reach downstream from Iron Gate Dam, the Klamath Estuary, and the marine nearshore environment because of lack of sediment trapping by dams on Klamath River. However, these increases would not be expected to exceed levels that would cause non-attainment of beneficial uses.

The effect of dam-released sediment and sediment resupply would likely extend from Iron Gate Dam to Cottonwood Creek.[184] Estimates of reach-averaged stream power (the ability of the river to move sediment) show a decrease from Iron Gate Dam to Cottonwood Creek, with stream power increasing again downstream from Cottonwood Creek. The increase suggests that short- or long-term sediment deposition, either from dam release or sediment resupply, is unlikely downstream from Cottonwood Creek. Using this point as the downstream extent of bedload-related effects, 8 miles of channel could be affected by sediment release and resupply. The affected channel represents 4 percent of the total channel length of the mainstem Klamath River downstream from Iron Gate Dam (190 miles). Under the Dams Out Scenario, sediment mobilization flows would decrease relative to existing conditions.

**Nutrients**

In the upper Klamath River basin, resource management actions included in the KBRA and accelerated implementation of TMDLs are expected to decrease concentrations of nutrients in Upper Klamath Lake and its tributaries.

Under the Dams Out Scenario, short-term increases in nutrient 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. However, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the lower Klamath River and the Klamath

[184] Reclamation (2011).

Estuary. Short-term increases in nutrient concentrations would be a minor impact.

Over the long term in the Hydroelectric Reach and the lower Klamath River basin, the Dams Out Scenario is expected to increase annual nutrient concentrations during summer because of the absence of nutrient interception and retention behind dams after removal. The increases would not be expected to result in flow conditions exceeding relevant water quality objectives beyond levels experienced under the Dams In Scenario. In addition, the lacustrine environment that supports the growth of toxin-producing nuisance algae blooms would be eliminated under the Dams Out Scenario, reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species.

**Dissolved Oxygen**

In the upper Klamath River basin, resource management actions included in the KBRA and accelerated implementation of TMDLs are expected to accelerate ongoing improvements in dissolved oxygen in Upper Klamath Lake and its tributaries.

In the short term following dam removal, the Dams Out Scenario would result in a decrease in dissolved oxygen concentrations in the Klamath River downstream from J. C. Boyle Dam to the California-Oregon state line. Increases in short-term oxygen demand (and subsequent reductions in dissolved oxygen) in the Hydroelectric Reach downstream from J. C. Boyle Dam and in the lower Klamath River downstream from Iron Gate Dam are conservatively estimated to be similar. The short-term decrease in dissolved oxygen concentrations would be a substantial impact on the lower Klamath River from Iron Gate Dam to approximately Clear Creek, but would not affect dissolved oxygen in the Klamath Estuary or the marine nearshore environment.

Over the long term, the Dams Out Scenario would result in increases in dissolved oxygen in June through September along with potentially increasing daily variability in the Klamath River from Link River Dam to the California-Oregon state line and from Iron Gate Dam to the Seiad Valley. Effects would diminish with distance downstream from Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen at the confluence with the Trinity River.

**pH**

In the upper Klamath River basin, resource management actions included in the KBRA and accelerated implementation of TMDLs are expected to accelerate ongoing improvements in pH Upper Klamath Lake and its tributaries.

The Dams Out Scenario would beneficially result in small increases in daily pH variability during March, April, and May in the Hydroelectric Reach. However, it would result in an adverse increase in overall pH and the magnitude of daily

variability during summer in the Klamath River from Iron Gate Dam to the confluence with the Scott River. The Dams Out Scenario would have no effect in the Klamath River immediately downstream from Seiad Valley, in the Klamath Estuary, and in the marine nearshore environment.

**Algal Toxins and Chlorophylls**

In the upper Klamath River basin, resource management actions included in the KBRA and accelerated implementation of TMDLs are expected to reduce production of algal toxins and chlorophylls in Upper Klamath Lake and its tributaries.

Under the Dams Out Scenario, algal toxins and chlorophylls in the lower Klamath River would be substantially reduced. Although algal toxins and chlorophyll-a produced in Upper Klamath Lake could potentially be transported into the lower Klamath River basin at levels that would exceed water quality objectives, additional in-situ production of the toxins and chlorophyll-a would not occur in the free-flowing river under the Dams Out Scenario.

**Inorganic and Organic Contaminants**

The Dams Out Scenario would cause the release of inorganic and organic contaminants from sediment deposits stored behind the dams to the Hydroelectric Reach, the Klamath River from Iron Gate Dam to the Klamath Estuary, and the marine nearshore environment. However, concentrations of inorganic and organic contaminants would not be high enough to adversely affect beneficial uses, be toxic to aquatic life, or result in bioaccumulation.

### *Aquatic Resources*

The Dams Out Scenario is intended to improve and increase fish populations in the Klamath River; and under the Dams Out Scenario, restoration of fishes and habitat are identified. The KBRA outlines habitat restoration and fish reintroduction plans to re-establish anadromous fish in the upper Klamath River basin. The following evaluation examines the aquatic resources in the Klamath River basin and how any potential changes (or lack thereof) resulting from the Dams Out Scenario would affect the aquatic resources.

**Anadromous Fish**

Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are important anadromous fisheries to the Klamath Tribes. These fisheries are affected by riverine conditions that include water temperature, sediment movement, water quality, disease and parasites, and habitat area. Effects on water resources (temperature, sediment, pH, nutrients, etc.) under the Dams Out Scenario are described in the previous section, and this section describes how the water resource conditions affect the fisheries of the Klamath River under the Dams Out Scenario.

*Habitat Area*

Under the Dams Out Scenario, removal of the four facilities would allow spring-run and fall-run Chinook and coho salmon, steelhead, and possibly Pacific lamprey and green sturgeon to gain access to the Klamath River upstream of J. C. Boyle Reservoir. The access would expand the fish habitat to include historic habitat along the mainstem Klamath River, upstream to the Sprague, Williamson, and Wood rivers, a potential increase in habitat of approximately 350 miles. [185]

Additionally, the KBRA has specific tasks for improving the fisheries in the Klamath River, including restoring floodplain habitat, improving instream fish habitat, improving fish passage, and cattle exclusion. The KBRA also includes a fish program that will identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam, a monitoring program to track the progress of the reintroduction, and actions that would increase instream flows and that are intended to benefit both anadromous fish populations regardless of the effects of dam removal.

*Water Temperature*

Water temperature affects the timing of each life stage, and changes can alter migration patterns, delay and shorten the spawning season, impair reproductive success, reduce growth, and result in an ongoing lack of temporal diversity for all fish species.[186] High water temperatures can facilitate the spread of disease by making cold-water species more vulnerable to infections by stressing their immune systems. [187]

The long-term effects of the Dams Out Scenario, from both the KHSA and the KBRA, would include more natural daily variations in water temperature, resulting in migration and spawning periods for Klamath River Chinook salmon that are more comparable to historical conditions. Water would become warmer earlier in the spring and cooler earlier in late summer and fall compared to existing conditions, and hence conditions that would occur under the Dams In Scenario.[188] Under the Dams Out Scenario, water temperatures would increase 2°C to 4°C (3.6°F to 7.2°F) during spring and summer for rearing anadromous fish. Improved water temperatures (reduced by 7°C to 9°C (12.6°F to 16.2°F)) from October through November would create more ideal temperatures for adult migration and spawning, and spawning below Iron Gate Dam would no longer be delayed, therefore reducing pre-spawn mortality.[189]

The Dams Out Scenario also provides improved thermal conditions (as described above). This new thermal regime will result in:

[185] Hamilton et al. (2005).
[186] Ibid.
[187] Wood et al. (2006).
[188] Stillwater Sciences (2009); Hamilton et al. (2010).
[189] Hamilton et al. (2010).

- earlier spawning,
- longer incubation,
- earlier emergence and growth, and
- earlier downstream migration.

This lifecycle change benefits the Klamath River anadromous fish because it takes them closer to their historic conditions. The river would experience a higher daily maximum, but it would also experience a lower daily minimum. This would allow rearing juveniles to move out of their temperature refugia to forage at night. Lower water temperatures also make habitat conditions much less suitable for the spread of diseases and parasites.

*Suspended and Bedload Sediments*

The Dams Out Scenario would release dam-stored sediment downstream to the lower Klamath River. Under the most likely condition, suspended sediment concentrations would be low enough that they are not expected to affect adult anadromous fish relative to current conditions. In the worst case, suspended sediment concentrations would be high enough to cause major physiological stress and impaired homing.

The Dams Out Scenario would bury redds (i.e., nests) constructed in fall 2019 in dam-released sediment, decreasing embryo survival and alevin emergence potentially as far downstream as Cottonwood Creek, or 4 percent of the river below Iron Gate Dam. The deposition could aggrade pools or overwhelm other habitat features that salmonids use for adult holding or juvenile rearing. The effect would be short term, as pools would likely return to their pre-sediment release depth relatively quickly.[190] In the long term, the river would revert to and maintain a pool-riffle morphology.

The Dams Out Scenario would allow a movement of bedload material that more closely mimics the historic conditions because the dams would no longer block its movement. This would benefit fishes spawning downstream from the present locations of the dams.

*Other Water Quality Components*

Implementation of the Dams Out Scenario would not affect water quality in the Wood, Williamson, and Sprague rivers; Upper Klamath Lake; and Link River to the upstream end of J. C. Boyle Reservoir. It would, however, cause long-term overall increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach. The removal of the four facilities under the Dams Out Scenario would cause slight, long-term increases in summer and fall dissolved oxygen, increasing the likelihood of consistently supporting beneficial uses during this period.

[190] Stillwater Sciences (2008).

Downstream from Iron Gate Dam, sediment release associated with the Dams Out Scenario could cause short-term increases in oxygen demand and reductions in dissolved oxygen that could adversely affect fisheries resources.

Overall, implementation of the Dams Out Scenario will directly affect anadromous fish by accelerating the TMDL process, and thus improving water quality conditions at a more rapid rate.

*Disease and Parasites*

The Dams Out Scenario would be expected to result in changed habitat conditions that would reduce impacts on salmonids from fish diseases. The main factors contributing to parasitic fish diseases in the Klamath include physical habitat components (pools, eddies, and sediment); microhabitat characteristics (stable flows and low velocities); proximity to spawning areas; and temperatures above 15°C (59°F).

The Dams Out Scenario would likely reduce the availability of favorable physical habitat components for the polychaete host. The removal of Iron Gate Dam would also remove a major barrier to fish migration, resulting in a reduced concentration of spawning adults. Greater dispersal of spawning adult salmon would reduce the proximity of salmon to dense populations of polychaetes.

Increased variability in flow management and the restoration of a more natural sediment regime would likely reduce the suitability of habitat conditions for *M. speciosa*, the invertebrate host for *P. minibicornis* and *C. shasta*. In some areas, increased mobilization of the substrate would help reduce the availability of habitat for polychaetes.[191] Infection rates are related in part to raised water temperatures. If flows increase during spring, juvenile migration time could be decreased, potentially resulting in reduced disease exposure, especially for fishes originating in lower Klamath River tributaries.

The Dams Out Scenario would, however, allow anadromous salmonid migration upstream in the mainstem Klamath River and tributaries, which would result in introduction of parasite genotypes that have been restricted to the lower river. Although the effects of these introductions are uncertain, at least some degree of host specificity appears to exist,[192] indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes of *C. shasta* introduced into the upper watershed. It is not expected that introduction of *C. shasta* genotypes upstream would result in adverse effects because fishes in the upstream basin have shown resistance to the downstream genotypes.

[191] Stocking et al. (2007).
[192] Atkinson et al. (2010).

**Resident Fish**

Under the Dams Out Scenario, water elevations in Upper Klamath Lake would be higher, which would benefit Lost River and shortnose suckers; but the difference in habitat value would not be substantive. No adverse impacts on these species are predicted for this area.

Lost River and shortnose suckers are found in reservoirs in the Hydroelectric Reach. The Dams Out Scenario would eliminate reservoir habitat, as dams within the Hydroelectric Reach would be removed and sediment allowed to move downstream. Under the Dams Out Scenario, adult Lost River and shortnose suckers in reservoirs downstream of Keno Dam would be captured and relocated to Upper Klamath Lake.[193] Those not relocated to the upper basin would likely be lost; however, the individuals downstream of Keno Dam have little or no successful reproduction and no connection to upstream populations, and do not contribute substantially to the achievement of conservation goals or recovery.[194] The Dams Out Scenario would be expected to have long-term impacts on Lost River and shortnose sucker habitat in the Hydroelectric Reach; however, the overall impact on their populations would not be substantive. These species are listed as fully protected under CESA.

Under the Dams Out Scenario, redband trout would be able to migrate more successfully from the Hydroelectric Reach to the upper Klamath River basin[195] than under existing conditions. Establishment of a more natural flow regime downstream of Keno Dam would eliminate the stranding of redband trout caused by flow reductions at Klamath Hydroelectric Project facilities and would create stable stream habitat between J. C. Boyle Reservoir and the California state line. Movement of adult salmon into the upper basin would result in introduction of genotypes of *C. shasta* that have been restricted to the lower river. Although the effects of these introductions are uncertain, at least some degree of host specificity appears to exist,[196] indicating that newly exposed species, such as redband trout, might not be susceptible to the new genotypes. Additionally, the changes in habitat that could result from dam removal (fewer areas of slow-flowing, stable habitat) would be likely to reduce the density of polychaete populations, resulting in reduced disease exposure for fish.

Redband trout currently inhabit the Hydroelectric Reach, migrating between tributaries and reservoirs to complete their life cycle.[197] Redband trout throughout this reach of the mainstem, except the areas upstream of J. C. Boyle Reservoir, would be affected by high suspended sediment concentrations under the Dams Out Scenario. Redband trout found in riverine reaches between

[193] Buchanan et al. (2011).
[194] Hamilton et al. (2010).
[195] Ibid.
[196] Atkinson et al. (2010).
[197] Hamilton et al. (2010).

reservoirs in the Hydroelectric Reach would be affected by sediment released during dam removal by bedload deposition.[198] Suspended sediment concentrations in the Hydroelectric Reach would be similar to those predicted for Iron Gate Dam. Effects on redband trout would be similar to those predicted for anadromous fish. Some portion of the redband trout population in this area would be in tributaries during dam removal. Those in the affected area could move to tributaries for refuge.

The Dams Out Scenario would eliminate reservoir habitat, returning sections of river currently inundated by reservoirs and riverine sections between reservoirs to a pool-riffle morphology. Modeling data indicate that after dam removal, spawning gravel in all sections of the Hydroelectric Reach would be within the range usable for salmonids, but the amount of sand in the bed within former reservoir sections might inhibit spawning success. Riverine sections between reservoirs would be expected to provide gravel with very little sand, suggesting high-quality spawning habitat. The initial movement of coarse and fine sediment after drawdown would likely create adverse conditions for redband trout in the mainstem Klamath River, but these conditions would be short term. Buchanan et al. estimate that 43 miles of additional riverine habitat would be available to resident redband trout as a result of the Dams Out Scenario.[199] Migratory opportunities would increase for these fish, allowing them to access areas with suitable habitat when conditions become adverse in one area of their range. The Dams Out Scenario would also increase the number of thermal refugia available to redband trout because they would have access to more tributaries, the cool areas near the mouths of the tributaries, and the many springs within this reach.

**Aquatic Invertebrates**

Under the Dams Out Scenario, aquatic invertebrates are expected to undergo short-term impacts caused primarily by water quality (specifically sedimentation issues) as described above, but are also expected to experience long-term benefits through the more natural hydrograph created by the removal of the four dams.

***Ecosystem Functionality/Effects***

Under the Dams Out Scenario, fish and invertebrate populations will benefit through increased habitat, more suitable water temperature regimes, substrate movement affecting spawning habitat, improved water quality conditions, and less suitable habitat conditions for the spread of diseases and parasites. These improved fish and invertebrate populations are indicative of a healthier ecosystem. It is not only fishes and aquatic invertebrates that are affected by the Klamath River; riparian vegetation and terrestrial resources that depend on

[198] Buchanan et al. (2011).
[199] Ibid.

aquatic resources for food are affected by the heavily managed and modified Klamath River. These resources would benefit from the Dams Out Scenario.

Populations of Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey are expected to increase, with a higher likelihood of viability of the Klamath River populations. The Dams Out Scenario, with the KBRA, will reduce stress on the fishes and may be sufficient to bring the species to recovery. These benefits are important in light of the expected climate change.

Under the Dams Out Scenario, anadromous fish would no longer be restricted to the lower reaches of the lower Klamath River basin, but would be able to access approximately 350 miles of spawning and rearing habitat. This access particularly increases the ability of coho salmon and spring-run Chinook salmon populations to recover. The increased numbers of anadromous fish means that piscivorous (fish-eating) birds and animals would continue to have increased food resources. Additionally, the increase in salmon carcasses would result in more nutrients and food resources for other aquatic resources and for terrestrial resources.

Under the Dams Out Scenario, flows will more closely mimic a natural hydrograph. The flows will change the geomorphology of the lower river, benefit riparian vegetation recruitment, increase river habitat heterogeneity, increase instream fish habitat structures, increase food web support, and improve water quality as described above. Benefits to the Klamath River and to the habitat and terrestrial species that depend on the Klamath River will occur.

The removal of upstream reservoirs and improved water quality result in decreased amounts of toxic algae in the summer months. Implementation of the TMDLs and the future BOs will improve overall conditions for the fisheries; however, anadromous salmonids historically have not inhabited this region during the summer. Additionally, populations of coho salmon and spring-run Chinook salmon will likely increase with a potential for downgraded listing under the ESA and CESA.

#### *Effects on Cultural Values*

Hydrology and water quality throughout the Klamath River are important for supporting the aquatic ecosystems on which these fishes depend. In addition, the Klamath River is central to many cultural activities of the Klamath Tribes such as bathing and religious ceremonies.

Effects of project reservoirs on water quality issues, such as the growth of toxin-producing nuisance algae, elevated water temperatures and modified temperature regimes, high pH, and increased toxicity, currently adversely impact the cultural values of the Klamath Tribes. These cultural values include conducting traditional bathing ceremonies, fishing, and enjoying the aesthetic qualities of the river. Algae, in particular, are a major problem for the Klamath Tribes because it degrades water for contact recreational and ceremonial uses

and can produce toxins hazardous to fishes and humans. However, over time, successful implementation of the various TMDLs could result in Klamath River water quality trending toward compliance with water quality objectives and improved support of beneficial uses by the Klamath Tribes. Implementation of TMDLs would be expected to occur more slowly under the Dams In Scenario than under the Dams Out Scenario; and there is substantial uncertainty over when and whether TMDL targets would be achieved, especially given the potentially detrimental effect of climate change.[200]

Under the Dams Out Scenario, the Klamath Tribes would be able to return to social and cultural practices based on the abundance of Chinook salmon, steelhead, lamprey, redband trout, and suckers. The tribes have an increased potential to experience increased economic opportunity as well as improved health from dietary changes. Because the fish species identified as their trust resources were the main food sources for the Klamath Tribes, the return of these fishes will provide the opportunity to improve overall health, decrease cardiovascular disease, decrease diabetes, and decrease levels of depression. Additionally, the return of anadromous fish and the recovered populations of resident fishes will lead to increased opportunities for intergenerational transmission of traditional knowledge and fewer young people leaving the ancestral homeland in search of a higher standard of living.

[200] Hamilton et al. (2010)

# Chapter 5. Findings and Conclusions

Based on the reviews and analyses provided in this report, the Cultural/Tribal Sub-team finds that the current operations of the four dams under consideration for removal have a profound negative effect on the trust resources, tribal rights to take those resources, other resources traditionally used by tribes, and related cultural values of the Klamath River basin tribes. As described in this report, such effects have occurred historically; persist today; and, if the dams remain in operation, are expected to continue for at least 50 years into the future.

Current operations significantly contribute to compromised water quality in many ways, including changes in water temperature, loss of habitat for fishes and other aquatic species, and increased exposure to disease and parasites, all of which have resulted in an altered and unhealthy ecosystem. These factors have contributed to the decline of the Klamath River and lake fishes and other interrelated aquatic populations important to the continuance of a Native American way of life that is centered on the resources of the Klamath aquatic environment. Moreover, the decline of the fisheries is both directly and indirectly linked to the decline of the "Salmon People" of the Klamath River basin, manifested particularly in physical illness, mental illness, the loss of traditional knowledge, and social conflict among the peoples of the region.

There is a direct cause-and-effect link between current dam operations and water quality. This linkage is established in the Basin Plan for the Klamath River prepared by NCRWQCB.[201] The FERC EIS acknowledges this linkage. The testimony of the Klamath River basin tribes repeatedly speaks to the adverse effects that altered water flows manipulated by the dams for purposes largely related to hydroelectric generation have had on the responses of migrating and spawning fishes, which cue their behaviors from river flows and pulse flows. Riparian vegetation, evolved to thrive in the ebb and flow of a dynamic and pulsating river, no longer responds in predictable ways and has been changed and reduced from historic levels.

The effects of each of the proposed scenarios for future management of the Klamath River basin on the resources, rights, and related cultural values of indigenous peoples are similar for each of the tribes in the study area: under the Dams In Scenario, all tribes will continue to suffer; under the Dams Out Scenario, all tribes will benefit.

Under the **Dams In Scenario**, minimal changes will take place relative to the current condition. Water quality will likely improve because of the

[201] North Coast Regional Water Quality Control Board 2011

implementation of the TMDLs and the BOs (as of the date of this document, unaccepted by PacifiCorp), but the effects of climate change could reduce those benefits. Additionally, the fish populations, both anadromous and resident, will remain depleted and may even become extirpated, and ESA and/or CESA listings or upgraded listings could occur. Delaying the reintroduction of fishes into the upper watershed also reduces the likelihood that the extirpated fish could ever return. Prospects for tribal health, welfare, and cultural development—involving intergenerational transmission of tribal information, the practice of traditional ceremonies, and migration of younger members out of the reservation—are expected to remain dismal, and are even likely to worsen under the Dams In Scenario.

Under the **Dams Out Scenario**, it is expected that the benefits of the TMDLs will be accelerated; and water quality will substantially improve. More critically, the Klamath River and lakes in the basin region are expected to return to a more natural hydrograph and water temperature regime, both of which are important for the restoration of water, aquatic, and terrestrial resources. The KBRA restoration activities will help return the Klamath River basin to a well-functioning ecosystem by improving the geomorphology of the river, instream and lake fish habitat, bedload movement, and by promoting riparian revegetation establishment and growth. Both anadromous and resident fish populations will be expected to increase substantially, potentially to the point of delisting under the ESA and/or CESA for those that are currently listed. The Dams Out Scenario will provide opportunities for the health, welfare, and cultural development of the tribes to improve considerably. Food resources will more closely approximate historic conditions, resulting in decreased heart disease, fewer strokes, lower rates of diabetes, reduced risk of obesity, and reduced levels of depression. Additionally, fishes will be available for tribal cultural activities such as fishing and the practice of ceremonies, which will present opportunities for tribal elders to pass down tribal information to the younger generation and thus create a greater sense of tribal strength and unity.

Strong social, cultural, and economic ties have traditionally bound the tribes of the Klamath basin together—ties based in large part on a shared reliance on the region's resources. This reliance has extended well beyond subsistence and commerce to the cultural and social fabric of the tribes, as evidenced by their traditional, ceremonial, and spiritual ways of life that center on the Klamath River's threatened instream flow as well as groundwater in the region and associated aquatic and terrestrial resources. The interaction and identification of the native peoples with the natural environment so define their cultures, lifestyles, and spiritual beliefs that its degradation has had a profoundly devastating impact in many ways.

A tribal way of life that has depended on the Klamath aquatic environment has become less effective in predicting and responding to what nature delivers. In a culturally imbued world with diminishing resources, those resources that remain

will become stressed by further changes. In a particularly hard blow to the region's tribal cultures, Klamath fisheries, famous around the world, are trending toward extinction. It is hard to say how many spring-run Chinook salmon were in the river before mining operations decimated spawning tributaries that had flowed according to a natural regime for centuries; but today, the numbers of spring-run Chinook salmon are a small fraction of what once were uncountable.[202]

Historic and current factors other than the dams—such as mining, timber extraction, agricultural production, and cattle grazing—have disrupted the environmental integrity of the Klamath River basin. But mining activities in the region have significantly decreased over the last several decades. Timber extraction in the basin has slowly become controlled by stronger regulations at the federal and state levels to the point that timber extraction is now better characterized as forest management; however, timber harvesting continues to affect resources and the rights to those resources as well as related cultural values. Grazing and agricultural practices continue in the upper basin and may still have adverse effects as well. Nevertheless, the continued operations of the dams clearly bear the heaviest responsibility for the current decline of Klamath basin resources. Removal of the dams offers the best hope for the once-thriving Klamath basin tribes to again fully engage in their traditional cultural practices—practices that rely almost entirely on the once-abundant water, aquatic, and terrestrial resources of the Klamath River and lakes; in short, a healthy, functioning ecosystem.

[202] Ibid., 53.

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# Appendices

Appendix A. Round 1 Tribal Consultation Letters

Appendix B. Round 2 Tribal Consultation Letters

Appendix C. Round 3 Tribal Consultation Letters

Appendix D. Outreach Package for Owners and Heirs of Public Domain Allotments

# Appendix A. Round 1 Tribal Consultation Letters

On behalf of the Department of the Interior, the Cultural/Tribal Sub-team conducted government-to-government consultations with the six basin tribes. The following are letters sent to each tribal government inviting consultation for the first round of consultation (Round 1), conducted September 28 through October 4, 2010.

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


SEP 1 6 2010

Honorable Thomas P. O'Rourke, Sr.
Chairman, Yurok Tribe
P.O. Box 1027
Klamath, CA 95548

Dear Chairperson O'Rourke:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

Under provisions of the KHSA, the Secretary of the Interior must make a determination whether dam removal:

1) will advance restoration of the salmonid fisheries of the Klamath Basin; and
2) is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and tribes.

Nine federal technical sub-teams have been formed to provide the information to support the Secretary of the Interior's Determination. The Cultural/Tribal Sub-team is tasked with assessing the effects of current conditions (dams in) and dam removal on tribal trust resources and cultural values. As steward of their lands and resources, the tribes have the most intimate knowledge of changes that have occurred as a result of damming the Klamath River and would be directly affected by dam removal.

As a critical part of this process, the Bureau of Indian Affairs is requesting that a government-to-government consultation meeting with your tribe be held as soon as convenient. Our primary objective of such a meeting will be to discuss the effects of **current PacifiCorp dam operations** on Indian Trust Resources and Cultural Values and receive any documents and other input that you may have concerning our tasked assessment.

The Bureau of Reclamation (BOR), as the lead Federal agency for the National Historic Preservation Act consultations, would also like to initiate Section 106 consultations pursuant to 36 CFR Part 800 to gather and compile information on historic properties. In order to limit the impact on tribal staff that would be caused by multiple consultation meetings, the BOR would

like to participate in the government-to-government consultations. Ms. Laureen Perry, Bureau of Reclamation's Mid-Pacific Regional Archaeologist, will be the Federal point of contact for this project and can be reached at lperry@usbr.gov or (916) 978-5028.

We are proposing that a meeting occur at the end of September or early in October at a venue of convenience to you and your staff. We wish to document the meeting through employing a professional court reporter. Meeting proceedings will be facilitated through the use of consultants contracted by the BIA to develop the assessment reports. The Tribe will be provided a copy of any reports generated from the meeting.

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Please confirm your willingness to participate in these important collaborative consultation meetings by contacting Dale Morris, Cultural/Tribal Sub-team Leader at (916) 978-6050 or dale.morris@bia.gov.

Sincerely,

Amy L. Dutschke

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


SEP 1 6 2010

Honorable Rick Dowd
Chairman, Resighini Rancheria
P.O. Box 529
Klamath, CA 95548

Dear Chairman Dowd:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy H. Clutsche

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


SEP 1 6 2010

Honorable Leonard Masten, Jr.
Chairman, Hoopa Valley Tribe
P.O.Box 1348
Hoopa, CA 95546

Dear Chairman Masten :

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Amy L Klutschko

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


SEP 16 2010

Honorable Arch Super
Chairman, Karuk Tribe
P.O. Box 1016
Happy Camp, CA 06039

Dear Chairman Super:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy Aldrich

Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825

SEP 1 6 2010

Honorable Harold Bennett
Chairman, Quartz Valley Reservation
13601 Quartz Valley Rd.
Fort Jones, CA 96032

Dear Chairman Bennet:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy H. Lutschke

Regional Director

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
**Northwest Regional Office**
911 N.E. 11th Avenue
Portland, Oregon 97232-4169


TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

SEP 17 2010

PACIFIC REGIONAL OFFICE

Honorable Gary Frost
Chairman, Klamath Tribes
P.O. Box 436
Chiloquin, Oregon 97624-0436

Dear Chairman Frost:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

ACTING

Northwest Regional Director

cc: Dale Morris

# Appendix B. Round 2 Tribal Consultation Letters

On behalf of the Department of the Interior, the Cultural/Tribal Sub-team conducted government-to-government consultations with the six basin tribes. The following are letters sent to each tribal government inviting consultation for the second round of consultation (Round 2), conducted January 24 through January 27, 2011.

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


DEC - 8 2010

Honorable Thomas P. O'Rourke, Sr.
Chairman, Yurok Tribe
P.O. Box 1027
Klamath, CA 95548

Dear Chairperson O'Rourke:

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Sincerely,

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


DEC - 8 2010

Honorable Rick Dowd
Chairman, Resighini Rancheria
P.O. Box 529
Klamath, CA 95548

Dear Chairman Dowd:

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Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


DEC - 8 2010

Honorable Leonard Masten, Jr.
Chairman, Hoopa Valley Tribe
P.O.Box 1348
Hoopa, CA 95546

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Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


DEC - 8 2010

Honorable Arch Super
Chairman, Karuk Tribe
P.O. Box 1016
Happy Camp, CA 96039

Dear Chairman Super:

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Nine federal technical sub-teams have been formed to provide the information to support the Secretary of the Interior's Determination. The Cultural/Tribal Sub-team is tasked with assessing the effects of current conditions (dams in) and dam removal on tribal trust resources and cultural values. As a critical part of this process, the Bureau of Indian Affairs is requesting a government-to-government consultation meeting with your tribe to document **the potential effects of dam removal** on your tribe's Trust Resources and Cultural Values and receive any documents and other input that you may have concerning our tasked assessment.

We are proposing that a meeting occur early in the New Year at a venue of convenience to you and your staff. This proposed schedule will allow us to meet our February 2011 deadline for submitting our final assessment reports. Meeting proceedings will be facilitated through the use of consultants contracted by the BIA to develop the assessment reports. The consultant, Thomas Gates of North State Resources, Inc., will be calling the tribe soon to schedule a meeting date and location. A professional recorder will used to document the consultation and transcripts of the meeting will be available by request. Documents generated using information gathered at the meeting will also be available for review by the tribe.

Please confirm your willingness to participate in these important collaborative consultation meetings by contacting Dale Morris, Cultural/Tribal Sub-team Leader at (916) 978-6050 or dale.morris@bia.gov.

Sincerely,

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


DEC - 8 2010

Honorable Harold Bennett
Chairman, Quartz Valley Reservation
13601 Quartz Valley Rd.
Fort Jones, CA 96032

Dear Chairman Bennet:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

Under provisions of the KHSA, the Secretary of the Interior must make a determination whether dam removal:

1) will advance restoration of the salmonid fisheries of the Klamath Basin; and
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Nine federal technical sub-teams have been formed to provide the information to support the Secretary of the Interior's Determination. The Cultural/Tribal Sub-team is tasked with assessing the effects of current conditions (dams in) and dam removal on tribal trust resources and cultural values. As a critical part of this process, the Bureau of Indian Affairs is requesting a government-to-government consultation meeting with your tribe to document **the potential effects of dam removal** on your tribe's Trust Resources and Cultural Values and receive any documents and other input that you may have concerning our tasked assessment.

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Sincerely,

Acting Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
**Northwest Regional Office**
911 N.E. 11th Avenue
Portland, Oregon 97232-4169

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

DEC 08 2010

Honorable Gary Frost
Chairman, Klamath Tribes
P.O. Box 436
501 Chiloquin Blvd.
Chiloquin, Oregon 97624

Dear Chairman Frost:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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1) will advance restoration of the salmonid fisheries of the Klamath Basin; and
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Nine federal technical sub-teams have been formed to provide the information to support the Secretary of the Interior's Determination. The Cultural/Tribal Sub-team is tasked with assessing the effects of current conditions (dams in) and dam removal on tribal trust resources and cultural values. As a critical part of this process, the Bureau of Indian Affairs is requesting a government-to-government consultation meeting with your tribe to document **the potential effects of dam removal** on your tribe's Trust Resources and Cultural Values and receive any documents and other input that you may have concerning our tasked assessment.

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Sincerely,

ACTING

Northwest Regional Director

# Appendix C. Round 3 Tribal Consultation Letters

On behalf of the Department of the Interior, the Cultural/Tribal Sub-team conducted government-to-government consultations with the six basin tribes. The following are letters sent to each tribal government inviting consultation for the first round of consultation (Round 1), conducted April 4 through April 8, 2011.

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825

MAR 28 2011

Honorable Thomas P. O'Rourke, Sr.
Chairman, Yurok Tribe
P.O. Box 1027
Klamath, CA 95548

Dear Chairperson O'Rourke:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy L. Dutschke

Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825

MAR 28 2011

Honorable Rick Dowd
Chairman, Resighini Rancheria
P.O. Box 529
Klamath, CA 95548

Dear Chairman Dowd:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy L. Dutschke

Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825

MAR 28 2011

Honorable Leonard Masten, Jr.
Chairman, Hoopa Valley Tribe
P.O.Box 1348
Hoopa, CA 95546

Dear Chairman Masten:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy L Dutschke

Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825

MAR 28 2011

Honorable Arch Super
Chairman, Karuk Tribe
P.O. Box 1016
Happy Camp, CA 96039

Dear Chairman Super:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy L. Dutschke

Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825


MAR 28 2011

Honorable Harold Bennett
Chairman, Quartz Valley Reservation
13601 Quartz Valley Rd.
Fort Jones, CA 96032

Dear Chairman Bennet:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Sincerely,

Amy L Dutschke

Regional Director

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
**Northwest Regional Office**
911 N.E. 11th Avenue
Portland, Oregon 97232-4169


TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

MAR 25 2011

Honorable Gary Frost
Chairman, Klamath Tribes
P.O. Box 436
501 Chiloquin Blvd.
Chiloquin, OR 97624

Dear Chairman Frost:

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath River Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA) The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to the FERC relicensing proceedings and lays out the process for evaluation of existing information, conducting additional studies, and environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to making such a decision. This Secretary of the Interior is to make a determination by March 2012 whether to proceed with PacifiCorp facilities removal in March 2020.

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Please confirm your willingness to participate in these important collaborative consultation meetings by contacting Dale Morris, Cultural/Tribal Sub-team Leader at (916) 978-6050 or dale.morris@bia.gov.

Sincerely,

Regional Director

# Appendix C. Public Domain Allotments Outreach Packet

In December 2010, letters were sent to all known owners and heirs of the Public Domain Allotments on or near the Klamath River explaining the pending Secretarial Determination and asking for comments concerning current operations and EIS/EIR alternative effects on trust resources. Return-addressed and stamped postcards were also provided with the letter. These postcards requested that the owners or heirs indicate any perceived effects on PDA trust resources, provide more information, or indicate that they have no further interest in the process. A 15-day turnaround response was requested. A copy of the packet sent to PDAs follows.

IN REPLY REFER TO

# United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825

Dear Owner of a Public Domain Allotment,

By this letter the Bureau of Indian Affairs (BIA) requests your help in determining the effects on public domain allotments (PDAs) of the current operations of four dams on the Klamath River, and of the proposal to remove these dams. BIA has retained North State Resources, Inc., (NSR) to assist it in this matter.

On February 18, 2010, participants in the multi-party negotiations to craft a solution to natural resources issues in the Klamath Basin signed the Klamath Hydroelectric Settlement Agreement (KHSA). The KHSA identifies the removal of the PacifiCorp dams on the upper Klamath River as an alternative to Federal Energy Regulatory Commission (FERC) re-licensing proceedings, and sets forth the process for evaluating existing information, conducting additional studies, and completing an environmental review under the National Environmental Policy Act (NEPA) as a prerequisite to decision-making. The Secretary of the Interior is to determine by March 2012 whether and how best to proceed with removing PacifiCorp facilities. If approved, dam removal would begin in March 2020.

Under provisions of the KHSA, the Secretary of the Interior must make a determination whether dam removal:

1) Will advance restoration of the salmonid fisheries of the Klamath Basin; and
2) Is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes.

The four dams being considered for removal are Iron Gate, Copco 1, Copco 2, and JC Boyle. (Please use the attached map to locate where these dams are along the Klamath River.) Nine technical sub-teams have been formed to provide information supporting the Secretary of Interior's determination. The Cultural/Tribal Sub-team is tasked with assessing the effects of current conditions (no change to existing dams) and dam removal on Trust assets, including PDAs.

The dam removal alternatives being considered are:

1) No-Action Alternative (i.e., the dams remain with no modification)
2) Full removal of all four dams
3) Partial removal of all four dams to allow fish passage without fish ladders
4) Installation of fish ladders over all four dams
5) Removal of Iron Gate and Copco 1 dams and installation of fish ladders over Copco 2 and JC Boyle dams

These alternatives are more fully described in Attachment 1.

Trust resources, consisting of resources and related rights, are held in trust by the federal government for federally recognized Tribes or for individuals. Generally, trust resources are land, water (surface water and groundwater), fish, wildlife, timber, and gravel and minerals. We recognize that, as an owner of one or more PDAs located on or near the Klamath River, you may have intimate knowledge of what, if any, effects the current dam operations or dam removal alternatives may have on your PDA(s) and

related trust resources. If you would like your knowledge to be considered in this decision-making process, please take a few minutes to fill out the attached, self-addressed and stamped postcard, and mail it for delivery to North State Resources, Inc., by January 12, 2011. If you are an owner of more than one PDA, you will receive multiple copies of this request for your input. Please complete and return a separate postcard for each allotment for which you wish to share information.

Thank you in advance for your comments.

Sincerely,

Amy Dutschke
Regional Director BIA Pacific Region

**Attachment A**
**Draft Alternatives for Full Consideration in the Secretarial Determination EIS/EIR**

| Alternative | Brief Description |
|---|---|
| 1. No Action | Under NEPA, the No Action Alternative represents the state of the environment without the proposed action or any of the alternatives. In this particular instance, No Action would be no change from current management conditions with the dams in place. Because the federal components of the KBRA[1] are a connected action to the proposed action of dam removal consistent with the KHSA, it is not included in the No Action Alternative but instead as a connected action to those alternatives that are consistent with the KHSA[2]. Under the No Action alternative it will be assumed the hydroelectric project would continue to operate under annual licenses issued by FERC to PacifiCorp. |
| 2. Full Project Facilities Removal | Alternative 2 is the removal of four dams as provided for in the KHSA with the implementation of those portions of the KBRA that would be authorized, funded or carried out by the federal government (including actions that could be implemented under separate authorities) as a connected action and those portions of the KBRA that could be implemented by non-federal actors in the absence of dam removal as a cumulative action. This alterative would include the removal of all the facilities including dams and all structures currently associated with the PacifiCorp hydroelectric project. Partial removal of sediments from the reservoirs to an upland location may be included in this alternative as a project element or as mitigation for the potential impacts on sensitive species of releasing sediments downstream. |
| 3. Partial Project Facilities Removal | Alternative 3 is the removal of four dams as provided for in the KHSA with the implementation of those portions of the KBRA that would be authorized, funded or carried out by the federal government (including actions that could be implemented under separate authorities) as a connected action and those portions of the KBRA that could be implemented by non-federal actors in the absence of dam removal as a cumulative action. This alternative would include the removal of all four dams in order to achieve a free flowing river and volitional fish passage but could leave some offstream facilities in place. A description of those facilities to be potentially abandoned in place is being developed. Cost, public safety, and other considerations will guide the development of the list of facilities that could be left in place. As with Alternative 2, partial removal of sediments from the reservoirs may be included in this alternative as a project element or as mitigation for the impacts of releasing sediments to downstream on sensitive fish species |

[1] KBRA is the acronym for the Klamath Basin Restoration Agreement. The KBRA and the KHSA were negotiated by the Klamath River Basin Stakeholders to resolve longstanding disputes between them regarding a broad range of resource issues. The Agreements, in combination, are intended to result in effective and durable solutions which: 1) restore and sustain natural production and provide opportunities for full participation in ocean and river harvest of fish species throughout the Klamath Basin; 2) establish reliable water and power supplies which sustain agricultural uses, communities, and National Wildlife Refuges; and 3) contribute to the public interest and the sustainability of agricultural uses, local communities and Tribes, along with public trust resources of the Klamath Basin. The two Agreements, while dependent on the enactment of federal legislation to authorize certain obligations, are by their terms intended to be implemented concurrently.

[2] Connected Actions, as defined by CEQ, are those actions that are closely related to the proposed action, and therefore should be analyzed as part of the proposed action to provide the decision-maker and the public a full understanding of the potential environmental impacts of the proposed action. KBRA implementation, however, is not the subject of this NEPA analysis. Consequently, while the KBRA, as explained above, will be analyzed as a connected action in this EIS/EIR, it will still be subject to an independent NEPA analysis once it has been fully developed.

**Attachment A**
**Draft Alternatives for Full Consideration in the Secretarial Determination EIS/EIR**

| Alternative | Brief Description |
|---|---|
| 4. Fish Ladder on Four Dams | Alternative 4 will update the FERC staff alternative with mandatory conditions which retains all four dams and constructs fish ladders. Ongoing programs under existing laws and authorities to ensure the protection of ESA listed threatened and endangered species, water quality, and Tribal Trust resources would be assumed to continue under this alternative. The KBRA is not a connected to action to this alternative and is therefore not analyzed as a part of this alternative. |
| 5. Removal of Iron Gate and Copco I Dams with Fish Ladders on Copco II and J.C. Boyle Dams | Alternative 5 includes the removal of two of the four PacifiCorp Dams (Copco I and Iron Gate). This alternative also includes the elimination of peaking power generation at J.C. Boyle, development of a fish passage and ladder for Copco II Dam with intake screening. The alternative would include a new facility to provide downstream passage of anadromous fish at J.C. Boyle dam and make minor improvements to the J.C. Boyle fish ladder to facilitate the passage of adult fish. Flows released from the Copco II Dam would be consistent with Reclamation's Klamath Operations Plans and the Biological Opinions (BOs). The KBRA is not a connected action to this alternative and therefore not analyzed as a part of this alternative. |

[redacted]

Please check as many boxes as apply, fill in any necessary information, and drop this postcard into the mail no later than January 5, 2011.

- ☐ I have no questions and do not want to be contacted anymore concerning this project.
- ☐ I would like further information concerning this project sent to me.
- ☐ I prefer that information be sent to my mail address
  _____
  _____
- ☐ I prefer that information be sent to my e-mail address
  _____
- ☐ I would like to talk to someone concerning this project.
- ☐ I can be reached by phone at (_____)_____
- ☐ during the hours of _____
- ☐ The current dam operations do not affect trust resources associated with my PDA.
- ☐ The current dam operations have affected trust resources associated with my Public Domain allotment as follows:
  Resource _____
  Affect _____
- ☐ The current dam removal alternatives do not affect trust resources associated with my PDA.
- ☐ The current dam removal alternatives may affect trust resources associated with my Public Domain allotment as follows:
  Resource _____
  Affect _____