Draft Environmental Assessment

Implementation of Klamath Project Operating Procedures 2020-2023

Klamath Project, Oregon/California
Interior Region 10 California Great Basin
CGB-EA-2020-018

Estimated Lead Agency Total Costs Associated with Developing and Producing this EA $193,310

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Mission Statements

The Department of the Interior conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Acronyms and Abbreviations

ACFFOD	Amended and Corrected Findings of Fact and Order of Determination
AF	Acre-feet
BA	Biological Assessment
BiOp	Biological Opinion
CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
cfs	Cubic feet per second
DO	Dissolved oxygen
DPS	Distinct Population Segment
DRA	Drought Relief Act
EA	Environmental Assessment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
EWA	Environmental Water Account
FASTA	Flow Account Scheduling Technical Advisory
FERC	Federal Energy Regulatory Commission
Ft	Feet
FONSI	Finding of No Significant Impact
GSA	Groundwater Sustainability Agency
IGD	Iron Gate Dam
IMPLAN	Impact analysis for Planning
KBPM	Klamath Basin Planning Model
KRRC	Klamath River Renewal Corporation
KSD	Klamath Straits Drain
LKNWR	Lower Klamath National Wildlife Refuge
LRDC	Lost River Diversion Channel
LRS	Lost River sucker/s
Magnuson-Stevens Act or MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NWRs	National Wildlife Refuge; Lower Klamath, Tule Lake, Clear Lake, and Upper Klamath National Wildlife Refuges
ODEQ	Oregon Department of Environmental Quality
O&M	Operation and Maintenance
OSF	Oregon Spotted Frog
OWRD	Oregon Water Resources Department
PM	Particulate matter

POE	Probability of exceedance
POI	Prevalence of infection
POR	Period of Record
Project	Bureau of Reclamation's Klamath Project
Program	Klamath River Coho Restoration Program
Reclamation	Bureau of Reclamation
Secretary	Secretary of the Interior
SGMA	Sustainable Groundwater Management Act
SNS	Shortnose sucker/s
SONCC	Southern Oregon/Northern California Coast
SRKW	Southern Resident killer whale
TAF	Thousand acre-feet
fTID	Tulelake Irrigation District
TLNWR	Tule Lake National Wildlife Refuge
TLS1A	Tule Lake Sump 1A
TMDLs	Total Maximum Daily Load
UKL	Upper Klamath Lake
UKNWR	Upper Klamath National Wildlife Refuge
U.S.	United States
U.S.C.	United States Code
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WSRA	Wild & Scenic Rivers Act
WUA	Weighted Usable Area
WY	Water year
2019 BiOps	Coordinated 2019 Biological Opinions from U.S. Fish and Wildlife Service and National Marine Fisheries Service
2019 NMFS BiOp	*Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Klamath Project Operations from April 1, 2019 through March 31, 2024*
2019 USFWS BiOp	*Biological Opinion on the Effects of Proposed Klamath Project Operations from April 1, 2019, through March 31, 2024, on the Lost River Sucker and the Shortnose Sucker*
2018 BA	*The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2019 through March 31, 2029 on Federally-Listed Threatened and Endangered Species*
Modified 2018 Operations Plan	*Final Biological Assessment on the Effects of the Proposed Action to Operate the Klamath Project from April 1, 2019, through March 31, 2024* that was transmitted to the Services on December 21, 2018, with associated addenda dated February 15, 2019, and March 25, 2019

Section 1 Introduction

On March 29, 2019, the Bureau of Reclamation (Reclamation) received the separate, but coordinated *Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response* [2019 National Marine Fisheries Service (NMFS) Biological Opinion (BiOp)] and *Biological Opinion on the Effects of Proposed Klamath Project Operations from April 1, 2019, through March 31, 2024, on the Lost River Sucker and Shortnose Sucker* [2019 United States (U.S.) Fish and Wildlife Service (USFWS) BiOp] from the NMFS and the USFWS (collectively the Services), respectively. Receipt of the Services' separate, but coordinated 2019 BiOps completed reinitiated consultation pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) on Reclamation's *Final Biological Assessment on the Effects of the Proposed Action to Operate the Klamath Project from April 1, 2019, through March 31, 2024* that was transmitted to the Services on December 21, 2018, with associated addenda dated February 15, 2019, and March 25, 2019 [Modified 2018 Biological Assessment (BA; 2018 BA)]. A subsequent amendment was transmitted to and concurred with by the Services on October 11, 2019. Collectively, the operations detailed in Reclamation's 2018 BA and the October 11, 2019, amendment are referred to herein as the "modified 2018 Operations Plan." In evaluation of the modified 2018 Operations Plan, the Services' 2019 BiOps[1] concluded that operation of Reclamation's Klamath Project (Project) was not likely to jeopardize the continued existence of Southern Oregon/Northern California Coast (SONCC) coho salmon, Southern Resident Killer Whale (SRKW), and Lost River sucker (LRS) and shortnose suckers (SNS) nor destroy or adversely modify their designated critical habitat.

Consistent with the National Environmental Policy Act (NEPA), Reclamation conducted an analysis on the modified 2018 Operations Plan resulting in an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) finalized on April 1, 2019[2] (*see https://www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=37522 for the 2018 EA and FONSI)*. Since that time, Reclamation has been operating the Project consistent with the Services' 2019 BiOps and within the bounds of analysis of the 2019 EA/FONSI.

In late August 2019, Reclamation was made aware that computer modeling input files used to evaluate the amount of available habitat for SONCC coho fry, both in Reclamation's modified 2018 BA and NMFS' 2019 BiOp, contained erroneous information related to the SONCC coho fry Weighted Usable Area (WUA) habitat curves. These files, which were provided by a third party, were confirmed in October 2019 as revealing effects of the modified 2018 Operations Plan on listed species or critical habitat (specifically to SONCC coho salmon) in a manner or to an extent not previously considered. After release of the 2019 NMFS BiOp, there

[1] Though completed on March 29, 2019, the Services reviewed Reclamation's October 11, 2019 letter proposal for consistency with the effects analyzed in their 2019 BiOps. NMFS responded on October 22, 2019, concluding that Reclamation's October 11, 2019, May/June trigger modification to the 2018 Operations Plan did not create an effect that was not considered in their 2019 BiOp.
[2] Reclamation reviewed the amendments made to the modified 2018 Operations Plan as described in the March 25, 2019 and October 11, 2019 amendments prior to implementation. It was concluded that the modifications and any associated impacts were within the bounds of the April 1, 2019, Final EA and FONSI.

was an elevated level of concern expressed relative to the amount of habitat available for juvenile coho salmon, whereas in the previous consultation, the focus had been primarily focused on disease mitigation. Reclamation also continues to have concerns about the current science available to analyze both habitat and disease impacts to threatened coho salmon. As a result, Reclamation requested reinitiation of formal consultation under Section 7 of the ESA with both Services on November 13, 2019.

As part of the November 13, 2019, reinitiated consultation, Reclamation, on February 7, 2020, transmitted a new *Final Biological Assessment on The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2020 through March 31, 2024 on Federally Listed, Threatened, and Endangered Species* (2020 Biological Assessment [2020 BA]) to both Services on Project operations during the period of April 1, 2020, through March 31, 2024. Following discussions in late February, Reclamation and the Services agreed that it is in the public interest that additional time be provided to complete the consultations on Project operations. While Reclamation and the Services complete the November 13, 2019 reinitiation of consultation, Reclamation proposes to operate the Project in accordance with an Interim Plan (Proposed Action Alternative) for the time period April 2020 – March 2023.

During the three-year interim period, the agencies will collect, review, and analyze additional scientific information, as well as work with the Tribes, key stakeholders, and other agencies to better inform the longer-term ESA consultation and the transition to the Operations Plan resulting from that consultation.

The Proposed Action Alternative includes a water supply based operational strategy and water management approach for Upper Klamath Lake (UKL) and the Klamath and Lost rivers that endeavors to mimic natural hydrologic conditions observed in the Upper Klamath Basin. This approach attempts to meet the agency's obligations under the ESA, while also attempting to maintain reliable water deliveries for the Project through the agricultural season and then begin to fill UKL during the fall/winter to increase and maximize the ecologic benefit of the volumes available for the Environmental Water Account (EWA[3]; including habitat and disease mitigation flows), UKL, and Project irrigation supply during the following spring/summer operational period.

Reclamation has prepared this EA to determine whether implementing the Interim Plan and acquisition of Project water supplies as described in Section 2 may significantly affect the quality of the human environment.

1.1 Need for Proposal

There is a need to continue operation of the Project consistent with contractual and/or water right delivery obligations while complying with Federal laws, including the ESA, during the interim period prior to transition to the Operations Plan that results from the longer-term ESA consultation. The Proposed Action Alternative defines how Project operations would be conducted, consistent with Reclamation's responsibilities and obligations, with an April 1

[3] EWA is defined as water allocated for Klamath River flows and is discussed further in Chapter 2

determination of available Project Supply (*defined below in Section 2.4*). Implementation of the Proposed Action Alternative also defines how Reclamation would manage UKL elevations and Klamath River flows below Iron Gate Dam (IGD).

In development of the Proposed Action Alternative, Reclamation's legal requirements and obligations were considered, including:

- The ESA
- Klamath Basin Indian tribes' trust status and water right interests
- Project contract water users and/or water rights beneficiaries
- The Klamath Basin National Wildlife Refuges

1.2 Geographic Scope

The geographic scope of the Interim Plan extends throughout the Klamath River Basin *(see map in Appendix A*). The Klamath River Basin is commonly divided into two basins − the Upper Klamath Basin being the portion of Klamath River upstream of IGD and the Lower Klamath Basin being the portion downstream of IGD. Elevations in the Upper Klamath Basin range from approximately 2,500 feet (ft) to a high of 9,000 ft above sea level. The mean annual precipitation at the Klamath Falls airport from 1981 to 2019 was 13.86 inches. Precipitation occurs mainly in the winter months in the form of snow, which provides the majority of the water available for the Project; winter and spring runoff is stored in Project reservoirs for release during the spring/summer and fall/winter operating periods.

Klamath Project

The Project is located in Klamath County in Oregon, and Siskiyou and Modoc counties in California (*see map in Appendix A*). As constructed, the Project provides a primary irrigation water source for approximately 230,000 acres of farmed lands, including lands within 18 irrigation, drainage, and improvement districts. Project water is stored and released from three reservoirs – UKL, Clear Lake, and Gerber reservoirs – with additional water available for Project use from the natural flow of the Klamath and Lost rivers. Available water supplies from these sources are delivered to Project lands through a network of diversion structures, canals, laterals, and pumps.

Klamath River

The upper reach of the Klamath River begins at the outlet of Link River, at the upper end of Lake Ewauna, and flows 253 miles through southern Oregon and northern California to the Pacific Ocean. Flows in the upper portion of the Klamath River are managed by PacifiCorp (in coordination with Reclamation) through a series of private reservoirs and dams owned and operated by PacifiCorp. See Section 3.1.1.3 below for more information on the Klamath River.

National Wildlife Refuges

Four national wildlife refuges (NWR), comprising approximately 148,500 acres (*see map in Appendix A)*, are included in the geographic scope of this EA: Lower Klamath, Tule Lake, Clear

Lake, and Upper Klamath National Wildlife Refuges (collectively the NWRs). These refuges were established by various Executive Orders beginning in 1908. USFWS manages the NWRs in accordance with Federal law, including the Migratory Bird Treaty Act, as amended (16 United States Code (U.S.C.) §§703-712), the National Wildlife Refuge System Administration Act of 1966 (Pub. L. 89-669; 16 U.S.C. §§ 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Pub. L. 105-57), the Kuchel Act (16 U.S.C. §§ 695k-695r), and other laws pertaining to the National Wildlife Refuge System. The NWRs support many fish and wildlife species and provide habitat and food resources for migratory birds of the Pacific Flyway. Portions of Tule Lake National Wildlife Refuge (TLNWR) and Lower Klamath National Wildlife Refuge (LKNWR) are also used for agricultural purposes and receive water from the Project for irrigation purposes. However, water availability for the LKNWR may be limited due to the lack of an established allocation for the refuge from Project Supply.

1.3 Legal and Statutory Authorities

No Action Alternative and Proposed Action Alternative (Water Operations-Interim Plan)
Operation of the Project as proposed under each alternative was authorized by the Secretary of the Interior (Secretary) on May 15, 1905, in accordance with the Reclamation Act of 1902 (32 Stat. 388), and the Act of February 9, 1905 (33 Stat. 714), and approved by the President on January 5, 1911, in accordance with the Act of June 25, 1910 (36 Stat. 835). The Secretary, through Reclamation, must manage and operate the Project consistent with Federal and applicable state law and in accordance with the Secretary's tribal trust obligations. Acts that are supplemental or amendatory to the Reclamation Act of 1902, together with the 1902 Act, are collectively referred to as "federal reclamation law" (43 U.S.C. §2401(2)). Reclamation operates and maintains the Project consistent with federal reclamation law.

Proposed Action Alternative (Water Acquisition)
The proposed water acquisition is being undertaken pursuant to title I of the Drought Relief Act (DRA). Part (c) of section 101 of the DRA (43 U.S.C. §2211(c)) authorizes Reclamation to "purchase water from willing sellers, including, but not limited to, water made available by Federal Reclamation project contractors through conservation or other means with respect to which the seller has reduced the consumption of water." Part (d) of section 102 of the DRA (43 U.S.C. §2212(d)) authorizes Reclamation to "make water from Federal Reclamation projects and non-Project water available on a non-reimbursable basis for the purposes of protecting or restoring fish and wildlife resources, including mitigation losses, that occur as a result of drought conditions or the operation of a Federal Reclamation project during drought conditions

1.4 Related Actions that Influence the Scope of this Environmental Assessment

Several actions or court decisions are related to or would assist the reader in understanding the alternatives and resource issues analyzed here.

1.4.1 Northern District of California Court Cases and Orders

On July 31, 2019, Earth Justice on behalf of the Yurok Tribe, Pacific Coast Federation of Fishermen's Associations, and Institute for Fisheries Resources (collectively, the Plaintiffs) initiated a lawsuit (Case No. 3:19-cv-04405-WHO) in the U.S. District Court for the Northern District of California, challenging, in part, the "no jeopardy" and "no adverse modification" conclusions in NMFS' BiOp, as well as Reclamation's associated 2019 NEPA compliance. In September 2019, the Plaintiffs amended their complaint, alleging Reclamation failed to reinitiate formal ESA consultation in response to the discovery of erroneous data used for SONCC coho salmon habitat analysis (i.e., WUA curves), and challenging Reclamation's reliance on the BiOp for ESA compliance.

Subsequently, on October 18, 2019, Plaintiffs filed a motion for preliminary injunction on their ESA claims, seeking an injunction to: revert to and operate the Project under its operations plan from 2012, consistent with the BiOp on that operations plan from 2013; require Reclamation to supplement Klamath River flows to address coho salmon disease and habitat concerns). By January 22, 2020, Plaintiffs modified their motion for preliminary injunction by requesting to alter the 2018 Operations Plan analyzed in the 2019 BiOps by adding 50,000 acre-feet (AF) of water to the EWA; or water allocated for Klamath River flows).

Pursuant to a stipulation to stay litigation reached by the litigating parties and approved by the court, until such time that Reclamation completes consultations with the Services (*as described above in Section 1*), if Reclamation operates the Project in accordance with the Proposed Action Alternative (Project Operations-Interim Plan) the current litigation will be stayed through September 30, 2022.[4]

1.4.2 Lower Klamath Project

In 2010, representatives of numerous organizations within the Klamath River Basin negotiated with PacifiCorp, arriving at the 2010 Klamath Hydroelectric Settlement Agreement. The Klamath Hydroelectric Settlement Agreement addressed the interim operations of the Klamath Hydroelectric Project (Project No. 2082 or Lower Klamath Project), consisting of four PacifiCorp owned dams (i.e., JC Boyle, Copco 1 and 2, and IGD) downstream of the Project and established a framework for facilities removal. Activities undertaken as a precursor to dam removal have included establishment of the Klamath River Renewal Corporation (KRRC) as the designated Dam Removal Entity and separating the Klamath Hydroelectric Project's Federal Energy Regulatory Commission (FERC) license to isolate the four dams in preparation for their transfer to the KRRC.

In 2016, PacifiCorp and the KRRC submitted an application to FERC to amend the existing license for the Lower Klamath Project, establish a new license, and transfer this new license to the KRRC. This application was partly approved on March 15, 2018, establishing the Lower Klamath Project as license number 14803; action on the request to transfer the license from PacifiCorp to the KRRC was deferred. Simultaneous with the 2016 joint application, KRRC applied to FERC to surrender the license for the Lower Klamath Project and decommission the four dams.

[4] Consistent with and as outlined in the Stipulated Stay of Litigation dated March 27, 2020.

This action is intended to carry out the terms of the Klamath Hydroelectric Settlement Agreement, as amended in 2016. FERC has yet to take final action on this application. Under the current schedule proposed by the KRRC, the dams would be removed in 2022 or 2023, followed by environmental restoration thereafter (KRRC 2018).

As the Lower Klamath Project is under the jurisdiction of FERC, KRRC will perform any necessary environmental compliance related to dam removal. Given the uncertainty associated with PacifiCorp and KRRC's pending applications before FERC, this potential future action is not considered reasonably foreseeable for this NEPA analysis at this time.

1.4.3 Comprehensive Conservation Plan/Environmental Impact Statement for the Klamath National Wildlife Refuge Complex

The Record of Decision for the Final Comprehensive Conservation Plan (CCP)/Environmental Impact Statement for Lower Klamath, Clear Lake, Tule Lake, Upper Klamath, and Bear Valley national wildlife refuges was prepared and signed on January 13, 2017, by the USFWS. The CCP is a programmatic plan that describes how the USFWS proposes to manage the NWRs for the next 15 years consistent with Federal law. The CCP is intended to provide a clear and comprehensive statement of the desired future conditions for the refuges and to ensure public involvement in refuge management decisions. Subsequent litigation was filed by environmental and water user groups seeking revisions of the CCP/Environmental Impact Statement. Specifically, four separate, but related lawsuits were filed in spring of 2017, pertaining to the Service's implementation of the CCP. On November 18, 2019, the Magistrate Judge of the District of Oregon (Medford Division) issued a recommendation in favor of the USFWS on all claims in the four (combined) lawsuits. The Magistrate's recommendation is under review by the District Court judge. Court proceedings are underway and will extend into spring/summer 2020.

Section 2 Proposed Action and Alternatives

This EA analyzes two alternative water management approaches for Project operations covering the time period from 2020-2023: The No Action and the Proposed Action alternatives. The elements common to both alternatives are described in Section 2.2, with the differences described in Sections 2.3 (No Action Alternative) and 2.4 (Proposed Action Alternative). Alternatives that were considered but eliminated from further consideration are described below in Section 2.1.

2.1 Alternatives Considered but Eliminated from Further Consideration

Reclamation conducted an iterative hydrologic modeling process involving the Tri-Agency Hydro Team (comprised of hydrologic modelers from Reclamation and the Services) to develop and evaluate alternative water management approaches for operation of the Project.

The alternative considered and eliminated from further analysis is stated below, including the reasons why each alternative was not consistent with the *need for the proposal*, described in Section 1.1 above.

The below alternative water management scenario was considered and evaluated through the hydrologic model (*described below in Section 2.2.1*) for consistency with Reclamation's obligations for operating the Project and in Reclamation's 2020 BA consistent with legal responsibilities under the ESA.

Provide an additional 20,000 AF of water to augment the EWA (water allocated for Klamath River flows) to address coho salmon disease and habitat concerns, while also modifying the frequency of surface flushing flow implementation from annually to approximately two out of every three years (though consecutive years without a flushing flow are possible). The 20,000 AF of water was to be provided from a commensurate reduction in Project Supply.

The Proposed Action Alternative considered in this EA provides additional water for the EWA in the same number of years as the alternative considered but eliminated (roughly half). The Proposed Action Alternative includes an EWA augmentation volume that provides an additional 40,000 AF (20,000 AF greater than the alternative considered but eliminated). This EWA augmentation is comprised of water from both Project Supply[5] (23,000 AF) and UKL (17,000 AF) (whereas the considered but eliminated alternative was comprised of water from only Project Supply (20,000 AF) in order to augment EWA)[6]. Therefore, effects as a result of the alternative considered but eliminated would generally be expected to result in similar impacts to Project Supply (potential reductions of 20,000 AF compared to 23,000 AF). Under the Proposed Action Alternative, greater impacts to UKL elevations (as a result of utilizing 17,000 AF for

[5] Water available from UKL for irrigation purposes
[6] A full description of the Proposed Action Alternative is described in section 2.4

EWA augmentation) as compared to the alternative considered but eliminated would occur, though the effects on lake elevations appear to be relatively minor and protective of ESA-listed suckers, as the Proposed Action Alternative includes spring and annual UKL minimums deemed important to sucker spawning and survival[7].

However, the nearly-annual frequency of surface flushing flows under the Proposed Action Alternative is thought to provide additional disease mitigation benefits through disruption of the *Ceratanova shasta* (*C. shasta)* intermediate host, a potentially important action while the four lower mainstem dams are in place that continue to disrupt sediment transport dynamics (and thus *C. shasta'*s intermediate host) in the Klamath River.

As part of the above-mentioned Stipulated Stay of Litigation (*See Chapter 1.4.1*), the Agencies seek to facilitate a longer, more collaborative consultation process on Project operations without judicial interference, which Reclamation and the Services agree is in the public interest. The stipulated stay is contingent upon implementation of an interim operations plan, comprised of the Proposed Action Alternative, identified as a water management approach that could be implemented, pending completion of the consultation, that is consistent with Reclamation's legal obligations.

As such, given the: 1) relatively similar effects to Project Supply, 2) relatively minor UKL elevation difference (that fall within the range of impacts to these resources when considering the Proposed Action Alternative), 3) potential additional beneficial impacts of annual surface flushing flows for coho and Chinook salmon, and 4) inconsistency with the conditions necessary to maintain the stipulated stay of the court proceedings and therefore the overall public interest, this alternative was eliminated from further consideration.

2.2 Elements Common to Both Alternatives

The elements described in this section are common to both alternatives, such that their inclusion in the Proposed Action Alternative does not alter the environmental baseline which is the No Action Alternative. As a result, the common elements and their potential impacts to various resources are not further discussed in detail in Sections 3 and 4.

In general, both alternatives consist of several elements: (1) store waters of the Klamath and Lost rivers; (2) operate the Project, or direct the operation of Project facilities, for the delivery of water for irrigation purposes and NWR needs, subject to water availability, or as necessary for flood control purposes; (3) while maintaining conditions in UKL and the Klamath River that meet the legal requirements under section 7 of the ESA; and (4) perform operation and maintenance (O&M) activities necessary to maintain Project facilities.

Reclamation manages the Project to provide water for irrigation and related purposes to the Project's service area. To provide this water, Reclamation stores water year-round in UKL, Clear Lake Reservoir, and Gerber Reservoir. The Project's service area (*see map in Appendix A*) under each alternative does not change and encompasses lands in Klamath County, Oregon and Siskiyou and Modoc counties, California. Approximately 200,000 acres are primarily served

[7] See section 2.1.2 for a full description of the proposed UKL minimums and section 4.4.1 for effects to UKL)

from UKL and the Klamath River. Approximately 10,000 acres are served from the Lost River, with about 20,000 acres served from Clear Lake and Gerber reservoirs, although stored water from these reservoirs can be used if necessary, to meet irrigation demands in portions of the area typically served from UKL and the Klamath River.

2.2.1 Hydrologic Modeling

Water management under each alternative relies heavily on seasonal water supply forecasts provided by the Natural Resources Conservation Service (NRCS) for UKL and Gerber Reservoir. The water supply forecasts are developed based on antecedent streamflow conditions, precipitation, snowpack, current hydrologic conditions, a climatological index, and historical streamflow patterns. More information and background regarding water supply forecasts can be found at the NRCS website: https://www.wcc.nrcs.usda.gov/about/forecasting.html.

In development of the alternatives, Reclamation utilized the Water Resource Integrated Modeling System to simulate Klamath River and UKL hydrographs that are likely to occur as a result of implementing the No Action and Proposed Action alternatives. The Water Resource Integrated Modeling System is a generalized water resources modeling system, broadly accepted by the hydrologic community, for evaluating operational alternatives of large, complex river basins. Reclamation has worked closely with the Services to develop a Water Resource Integrated Modeling System model specific to the Klamath Basin, referred to hereafter as the Klamath Basin Planning Model (KBPM).

The KBPM encompasses the areas of the Project served by UKL and the Klamath River and extends from UKL to IGD. KBPM does not model the portion of the Project served by Clear Lake and Gerber reservoirs, although the net effects of conditions on this portion of the Project on the Klamath River are included in the model via the gains (i.e., accretions to the Klamath River) and losses (i.e., Project diversions) within the Lost River Diversion Channel (LRDC). The KBPM also does not model explicit operational details for many facilities on the Klamath River such as IGD or other reservoirs owned and operated by PacifiCorp. Operation of Project facilities that store and divert water from UKL and the Klamath River was simulated over a range of hydrologic conditions using daily input data to obtain daily, weekly, monthly, and annual results for Klamath River flows (below IGD), Project diversions, (including deliveries to the LKNWR), and UKL elevations. A Period of Record (POR) of WYs 1981 – 2019 was used to evaluate the alternatives.

Data files generated by the KBPM include daily modeled output which has been aggregated into monthly and annual output for this EA. Probability of exceedance (POE)[8] identifies the probability that specific hydrologic conditions would be met or exceeded during a given time. For example, a 90 POE value would represent extremely dry conditions, because actual hydrological conditions can be expected to meet or exceed that value in 90 out of 100 years. Conversely, a 10 POE value would represent a period of unusually high precipitation, given that conditions can only be expected to meet or exceed that value in 10 years out of 100. A 50 POE value represents median hydrologic conditions. Hydrologic conditions within WY (October 1 to September 30) as represented by the exceedance value, vary between and within months.

[8] Exceedance probability is an expression of how often a value is exceeded over the Period of Record.

For this EA, tables in Section 4.3 show the simulated effects to UKL elevations, IGD releases, total spring/summer (March 1 – November 30) and total fall/winter (November 1 – February 28/29) diversions from UKL, the Klamath River, and the Lost River (downstream of the LRDC), and total annual LKNWR deliveries from UKL and the Klamath River. Additional details regarding the KBPM used for the No Action Alternative (inclusive of assumptions, and outputs) can be found in Section 4 and Appendix 4 of the modified 2018 Operations Plan while a technical explanation of the proposed Interim Plan (developed using the KBPM) associated with the Proposed Action Alternative can be found in Appendix F.

The KBPM is a planning tool that assisted in the development of the Proposed Action Alternative and not all the processes built into the model can be implemented during actual operations. As such, there are many assumptions associated with modeling efforts of this nature.

Critical assumptions made within the KBPM include:

- The upper Klamath River basin will experience WY types within the range observed in the 39-year POR.
- UKL inflows will be within the range observed in the POR.
- NRCS inflow forecasts will be within the range and accuracy of historical inflow forecasts.
- UKL bathymetry in the model is representative of actual UKL bathymetry and therefore accurately represents UKL storage capacity.
- Water deliveries to the Project will be consistent with distribution patterns analyzed for the KBPM.
- Accretions from Link River Dam to IGD will be consistent with accretion timing, magnitude, and volume assumed in the KBPM.
- Facility operational constraints and limitations are the same between the alternatives, and associated maintenance activities at those facilities will occur with the same historical frequency as the POR.
- Facility operational constraints and limitations are the same between the alternatives, and associated maintenance activities at those facilities will occur with the same historical frequency as the POR.

Additionally, the KBPM is a tool and model outcomes are not prescriptive. Implementation of either alternative would not exactly replicate the modeled results, and actual IGD flows and UKL elevations will differ during real-time operations. Factors which may cause real-time operations to deviate slightly from the simulated KBPM output include lack of perfect foresight (e.g., Keno Dam to IGD accretion forecasts, short-term agricultural demand, etc) and occasional physical operational issues (e.g., debris preventing gates from closing). Thus, the occurrence of a condition that does not conform to an assumption or the exact simulated modeled output is not necessarily inconsistent with the Proposed Action.

2.2.2 Operational Periods and Period of Record

Both alternatives have a spring/summer period and a fall/winter period. Generally speaking, the spring/summer period covers the primary irrigation season and the time of year that UKL elevations gradually decrease as the majority of Klamath River and irrigation releases occur, and the fall/winter period covers the timeframe when the majority of water is stored and UKL refill occurs.

Both alternatives are modeled using a POR spanning WYs 1981 through 2019.

2.2.3 Water Deliveries and Releases from Upper Klamath Lake and Minimum Flows in the Klamath River

Under both alternatives, UKL is used to store seasonal runoff to meet irrigation needs with water released via Link River Dam for ESA requirements and to prevent flooding. Project water stored in UKL is used for irrigation of lands within the Project's existing service area, including lands surrounding UKL, between the cities of Klamath Falls and Tulelake, the Lower Klamath Lake areas, and along the Klamath River between Lake Ewauna and the town of Keno, including within 14 separate irrigation, drainage, and other districts, and two NWRs. (*See below and the modified 2018 Operations Plan Part 1.3.3., on Reclamation Water Supply Contracts and further information on service area within the Project, and Part 1.3.6, regarding how water is delivered and used within the Lower Klamath and Tule Lake NWRs*).

2.2.4 Upper Klamath Lake Management – Upper Klamath Lake Control Logic/Central Tendency

UKL Supply, under both alternatives, is calculated using the monthly NRCS UKL inflow forecast from March-June. More specifically it is calculated by adding the 50 percent exceedance volume of forecasted inflow, plus observed inflow, to the end of the February UKL storage, and then subtracting the end of September UKL storage target (or UKL Reserve). This total is then distributed to remain in UKL for sucker needs through the spring/summer period or allocated to Project Supply or the EWA.

Under both alternatives, maintenance of UKL elevations is the result of an elevation management component maintained through the "UKL control logic." This operational approach seeks to fill UKL during the fall/winter to increase the volumes available for the EWA (*further described below and in Section 2.3.2*), UKL, and Project Supply (water available from UKL for irrigation purposes) during the spring/summer period. The UKL control logic is relative to UKL storage and recent hydrologic conditions that maintain UKL elevations important for suckers, and a "UKL Credit" that buffers UKL against uncertainties associated with NRCS forecast error and other factors affecting UKL inflow available for subsequent diversion (*UKL Credit is further described below in Section 2.2.7*).

The UKL control logic helps to manage UKL elevations for endangered suckers while ensuring adequate storage in UKL for both Klamath River and Project releases, utilizing a "central tendency." The central tendency is based on user-defined end-of-month UKL elevations which are subsequently interpolated to daily values (this is termed the generic central tendency). This results in a generic annual hydrograph that accounts for seasonal needs of suckers, seasonal water demand for the Klamath River and Project, and end-of-season elevations intended to result in (after winter inflows) storage volumes appropriate to meet the next year's demands on UKL. This generic hydrograph is then adjusted daily, based on a normalized 60-day trailing average of raw net inflow to UKL, producing an adjusted central tendency. If UKL elevations drop below the adjusted central tendency, then releases to the Klamath River (*subject to IGD minimums described in Appendix 4, Section A.4.4.2, Table A.4.4.2.2 of the modified 2018 Operations Plan*) and winter deliveries to Area A2[9] are reduced until UKL elevations equal or exceed the adjusted central tendency line. The adjusted central tendency is not a target to which UKL should be managed, but rather a guideline that maintains UKL elevation in line with both actual hydrologic conditions and the multiple demands placed upon UKL storage throughout the year. (*See Appendix 4, Section A.4.4.1.1 of the modified 2018 Operations Plan for technical details regarding the UKL control logic.*

The UKL control logic and central tendency are utilized under both alternatives for UKL and EWA management discussed below in Section 2.2.5.

2.2.5 Klamath River Management – Environmental Water Account and Flushing Flows

Relative to the EWA, under both alternatives, the minimum amount of water allocated for Klamath River flows is 400,000 AF (*further details on how this is calculated is described below in Section 2.3.1 and in Section 4.3.2.2.2.3. of the modified 2018 Operations Plan).* Additionally, the minimum monthly Klamath River flows are the same under both alternatives[10] (*see section 4.3.2.2.2.3 and Appendix 4, Section A.4.4.7, Table A.4.4.6.1 of the modified 2018 Operations Plan regarding minimum flows).*

In even years (e.g., 2020, 2022) under both alternatives, EWA is further increased by 7,000 AF to cover releases for the Yurok Tribe's Ceremonial Boat Dance. In years in which augmentation of May/June flows (augmentation of up to 20,000 AF[11]) is triggered to address coho salmon disease and habitat concerns, EWA allocation is increased by the enhanced May/June volume on July 1 to ensure proper formulaic distribution of the remaining EWA following increased May/June release.

Further, the formulaic approach to determining Klamath River flows at IGD *as described in Appendix 4, Section A.4.4.2, and Table A.4.4.2.2 of the modified 2018 Operations Plan* remain the same under each alternative.

Additionally, under both alternatives, the EWA is scaled to provide water to address Federally-listed coho disease concerns through implementation of a 6,030 cubic feet per second (cfs) flushing flow for 72 hours. Surface flushing flows would be forced between March 1 and April 15 in years when March 1 or April 1 EWA is calculated to be less than 576,000 AF. In any year in which a flushing flow is not forced, (i.e., when EWA is greater than or equal to 576,000 AF), an opportunistic surface flushing flow may be implemented between March 1 and April 15 if UKL elevation is greater than or equal to 4,142.4 ft and the previous day's IGD release was greater than or equal to 3,999 cfs. Both forced and opportunistic flushing flows would be followed by appropriate ramping of river flows back to those formulated under the rules of the

[9] Area A2 is defined as privately-owned Project lands served by Ady and North canals.

[10] However, some criteria for augmentation of the EWA and specific spring and fall end of month UKL elevations differ between the alternatives. The differences in the EWA augmentation and UKL elevations are further described in Sections 2.3 and 2.4 below.

[11] The 20,000 AF augmentation is split evenly between Project Supply and from UKL (the split is even at all enhancement volumes) and is further described in Section 2.3.1 and the modified 2018 Operations Plan, February 15, 2019 amendment letter from Reclamation to the Services.

KBPM. The timing of the flushing flow release depends on hydrologic conditions but would occur between March 1 and April 15.

Under both alternatives, Reclamation allows for the EWA account to be managed flexibly. For example, deviations from the formulaic approach to EWA management can occur if NMFS and/or other stakeholders (via the Flow Account Scheduling Technical Advisory [FASTA] team) believe that utilizing EWA volumes in a manner other than that specified by the KBPM (inclusive of flushing flow implementation and the formulaic approach to EWA distribution) would provide greater ecological benefit. The FASTA Team serves as a venue for input on flow management options, including input or evaluations regarding the shaping of EWA for disease mitigation or habitat improvement/protection. The FASTA Team will consider deviations from the default rules used to manage the EWA, including the timing of surface flushing flows, and the timing, distribution, and duration of flows when deviating from the formulaic approach to EWA management. This FASTA Team process is further outlined in *Section 4.3.2.2.3. of the modified 2018 Operations Plan.*

To accomplish the flows described above, Reclamation would coordinate with PacifiCorp when planning for the implementation of surface flushing flows and deviations to EWA management.

2.2.6 Project Supply

Water available from UKL for irrigation purposes during the spring/summer period (Project Supply) is diverted directly from UKL via the A Canal or after release from Link River Dam, directly from the Klamath River via Station 48, Miller Hill Pumping Plants, the North Canal, and the Ady Canal. Project Supply is calculated similarly for both alternatives (*see Section 2.4 for modifications under the Proposed Action Alternative, which are in addition to what is already described below)*. The maximum Project Supply under both alternatives is 350,000 AF (*as further qualified below*).

Project Supply is initially determined in early March as the quantity of water remaining after the end of September target UKL storage and EWA are determined, or a maximum of 350,000 AF, whichever is less. It is recalculated in early April using the April NRCS inflow forecast to reflect the most current information on hydrologic conditions. Should EWA allocation be less than 576,000 AF on May 1, the calculated Project Supply is further reduced by 10,000 AF in order to support enhanced May/June river flows *(See Part 4 and Appendix 4 of the modified 2018 Operations Plan for additional details regarding Project Supply calculations (Section 4.3.2.2.2.2) and enhanced May/June river flows (Section 4.3.2.2.2.5*)). With the exception of potential reductions to Project Supply that may result from triggering enhanced May/June flows in May, the April 1 Project Supply establishes the minimum Project Supply for the irrigation season. The Project Supply is recalculated again in May and June, and while the Project Supply cannot decrease below the April 1 allocation (unless enhanced May/June flows are triggered in May), it may increase in May and June.

Additionally, as addressed in the addendum to the modified 2018 Operations Plan dated March 25, 2019, under both alternatives Reclamation would, to properly account for Project-associated diversions from the Klamath River other than Station 48, Miller Hill Pumping Plant, North Canal and Ady Canal, reduce the Project Supply calculation initially by 7,436 AF after March 1, April 1, May 1, and June 1. To the extent Reclamation determines and it can adequately verify that actual irrigation deliveries at Project-associated points of diversion from the Klamath River other than Station 48, Miller Hill Pumping Plant, Ady Canal and North Canal are occurring at volumes less than 7,436 AF during the spring-summer period, the verified volume would be added back to the available Project Supply for diversion at A Canal, Station 48, Miller Hill Pumping Plant, North Canal, and Ady Canal. In actual operations, Reclamation would make this determination by notifying Project contractors of the volume available for diversion at these locations, then visually verifying that diversions are consistent with that volume identified as available and notifying the Services accordingly.

Reclamation would monitor these diversions to ensure that there is no increase in the amount diverted compared to the POR (1981-2019), and to the extent there is an increase, adjust Project Supply to account for these additional diversions. Based on the assumption that Project-associated diversions from the Klamath River (other than at Station 48, Miller Hill Pumping Plant, North Canal, and Ady Canal) would occur at a level consistent with diversions at these locations during the POR, Reclamation would reduce monthly Project Supply allocations by 7,436 AF. Further reference in this EA to the maximum available Project Supply under both alternatives will be 350,000 AF which reflects the anticipated deduction of 7,436 AF from the Project Supply cap as described above (e.g., 350,000 AF - 7,436 AF = 342,564 AF).

2.2.7 Flows from the Lost River Diversion Channel and Klamath Straits Drain

Consistent with both alternatives, under normal Project operations, all water in the Lost River, up to approximately 3,000 cfs, is diverted into the LRDC at the Lost River Diversion Dam, just east of Olene (a suburb of Klamath Falls, Oregon). Likewise, irrigation return flows, flood flows, and drainage from LKNWR is pumped into the Klamath River via the Klamath Straits Drain (KSD) year-round. Accounting for and use of this water is consistent between the two alternatives.

During the spring/summer period, water diverted from the Lost River and conveyed through the LRDC is available for Project diversion and irrigation use and does not count against the Project Supply from UKL. This rule applies for water diverted directly from the LRDC (i.e., at Station 48, Miller Hill Pumping Plant) during the period of March 1 through November 30, and for water that is released from the LRDC into the Klamath River and subsequently diverted (i.e., at Ady Canal or North Canal) during the period of March 1 through October 31. The availability of LRDC flows for diversion and irrigation use at Ady and North canals during the month of October also remains the same for both alternatives.

Additionally, for purposes of water accounting, water diverted from the Lost River, conveyed through the LRDC (and not subsequently diverted at Ady and North Canal), and released into the Klamath River is accounted for as an accretion and contributes to IGD releases. This water is not available for irrigation use within the Project from November 16 through the end of February under either alternative.

Under both alternatives Reclamation measures and accounts for the water released into the Klamath River from the LRDC daily, both with respect to its availability and use. For accounting purposes, use of water diverted from the Lost River and conveyed via the LRDC is only attributed to Station 48, Miller Hill Pumping Plant, Ady Canal and North Canal. Water use associated with other minor Project diversions from the LRDC or the Klamath River is accounted for similarly under both alternatives.

Both alternatives make KSD return flows available for irrigation use within the Project from March 1 through September 30 of each year, with the re-diverted water not counting against the spring/summer Project Supply available from UKL. During the fall/winter period, water pumped into the Klamath River from the KSD is accounted for as an accretion to the Klamath River and contributes towards IGD releases.

The total spring/summer water supply available for irrigation within the portion of the Project primarily served from UKL under both alternatives is comprised of Project Supply from UKL, water diverted from the Lost River (including through the LRDC) and return flows from KSD.

From March 1 through September 30, LRDC discharges and KSD return flows that are not diverted for use within the Project contribute towards, but do not increase, IGD releases and instead are accounted for as a "UKL Credit." The purpose of the UKL Credit is to buffer UKL against uncertainties associated with NRCS forecast error and other factors affecting UKL inflow available for subsequent diversion, and to allow for allocation of a minimum Project Supply on April 1 of each year. The UKL Credit accrues when LRDC and KSD flows in excess of direct diversions for irrigation are utilized to meet IGD flow targets, resulting in a reduction in Link River Dam releases to support river flows. The reduced releases from UKL allow for additional volume to be stored in UKL as a credit to help protect UKL elevations from an early season over-forecast of seasonal inflow, which might result in over-allocation of EWA and Project Supply. It can only be accrued from March 1 through September 30 during controlled flow conditions (i.e., not during flood control operations). This treatment of undiverted flows from the LRDC and KSD is similar between both alternatives.

2.2.8 Flood Control

In addition to irrigation deliveries, Reclamation, through PacifiCorp, makes releases from UKL for Klamath River flows and for flood control. Flood control releases are made when UKL elevations exceed the appropriate "flood control curve". The curves are calculated to maintain adequate storage volume in UKL and avoid flood events. The curves are the same for both alternatives.

2.2.9 Tule Lake Sump 1A

TLNWR receives return flows from Project lands and facilities. Specific minimum elevations for Tule Lake Sump 1A (TLS1A) are included in the USFWS 2019 BiOp for the purposes of flood control, irrigation and to protect Federally-listed suckers. Under both alternatives, the year-round minimum elevation identified in the modified 2018 Operations Plan and analyzed in the USFWS 2019 BiOp would remain 4,034.0 ft (*See Section 4.3.2.2.7. of the modified 2018 Operations Plan)*. As water supply for TLS1A is largely a result of return flows from irrigation deliveries, Reclamation may not be able to maintain these elevations when Project lands receive less than full water deliveries. When Project lands receive full water deliveries, Reclamation, in coordination with Tulelake Irrigation District (TID), would operate to meet these minimums in TLS1A.

2.2.10 Water Rights

In operating the Project to provide water for irrigation purposes, the Reclamation Act[12] requires Reclamation to operate consistent with state law with respect to the diversion, control, and use of water, to the extent not inconsistent with clear Congressional directives. The laws of both the states of Oregon and California provide a means for a water user to establish a right to divert and apply water to a beneficial use, subject to certain requirements and conditions. Operating the Project consistent with such existing water rights of record is an element common to both alternatives.

Water rights associated with the Project, as established under state law, govern the permissible timing, rate, total volume, and sources and location of water storage and diversions. Likewise, water rights prescribe the manner in which beneficial irrigation use can occur, in terms of the timing, rate, total volume, and how water is applied to the land.

Portions of LKNWR and TLNWR hold water rights for both irrigation and refuge purposes. Water within the refuges is commonly used for both purposes, being applied to a field to grow an agricultural crop, then drained off, and used for maintaining wetland areas elsewhere (or vice versa). USFWS is responsible for managing water use within the refuges.

Districts and individuals are also responsible for ensuring that their water use is consistent with state water law, existing water rights of record and federal Reclamation law. Generally, Reclamation's control over the diversion and use of water ends at the point where the water is delivered to the end user. To the extent of Reclamation's direct control and oversight, the operations described under both alternatives would be carried out in a manner consistent with state water law, existing water rights of record, and applicable Federal law.

2.2.11 Water Deliveries to Lower Klamath National Wildlife Refuge

Common to both alternatives, LKNWR receives water consistent with water rights held by the U.S. for the refuge and when available consistent with Reclamation's contractual obligations to other Project water users. Reclamation has an obligation to deliver water to LKNWR when available as a matter of hydrology, water rights, and contracts. The overall quantity of water available to LKNWR is impacted by the Project Supply determined under Reclamation's water management approach.

Under both alternatives, the components of the annual LKNWR water supply consist of fall/winter supply, spring/summer Project Supply, and UKL water in June and July (not part of Project Supply).

For the fall/winter period, both alternatives provide for deliveries to LKNWR of up to 11,000 AF, subject to the UKL control logic. Specifically, if UKL elevation is at or above the adjusted central tendency throughout the fall/winter period, the only modeled constraints to delivery would be the delivery cap (11,000 AF), conveyance capacity, and demand. However, if UKL elevation is below the adjusted central tendency, daily deliveries to LKNWR would be reduced

[12] This is in reference to Section 8 of the 1902 federal Reclamation Act introduced in section 1.3.

incrementally by up to 80 percent (from the delivery rates assumed in the KBPM) (*See Section 4.3.2.2.1 of the modified 2018 Operations Plan for additional details on fall/winter operations*).

For the spring/summer period, LKNWR can receive any portion of the available Project Supply from UKL, consistent with Reclamation's contractual and other legal obligations. There are no formulaic conditions for determining what portion of the available Project Supply is available for delivery to LKNWR. Rather, Reclamation proposes under both alternatives to coordinate with USFWS and other Project water users (e.g., districts) to determine anticipated irrigation water demands within the Project and what portion of Project Supply is available for delivery to LKNWR after Reclamation's contractual and other legal obligations have been met.

LKNWR can also receive water from UKL in June and July that is not part of the Project Supply under certain hydrologic conditions (*see Section 4.3.2.2.2.2 of the modified 2018 Operations Plan for additional details).*

2.2.12 Clear Lake Reservoir, Gerber Reservoir, and the Lost River

Stored water in Clear Lake and Gerber reservoirs is generally used for irrigation purposes in Langell and Yonna valleys, although it can be and occasionally has been used for irrigation in the portion of the Project between Klamath Falls and Tule Lake. Natural flow in the Lost River above Harpold Dam is also primarily used in Langell and Yonna valleys, and both natural flow and released stored water is used by the Project when present in the Lost River below Harpold Dam. In addition to irrigation deliveries, Reclamation makes flood control releases from Clear Lake and Gerber reservoirs when conditions necessitate. Similar to UKL, certain water levels in both Gerber and Clear Lake reservoirs are required for ESA-listed LRS and SNS. Operational procedures, resultant water deliveries and releases, and reservoir elevations at Clear Lake and Gerber reservoirs would be the same under both the No Action and Proposed Action alternatives.

2.2.13 Operation and Maintenance

To ensure functionality of the Project, various O&M activities are carried out by Reclamation or local districts under a contract with Reclamation. In general, O&M activities include, but are not limited to: exercising dam gates, stilling well gage maintenance, repairs, inspections, and clearing of canals, laterals, and drains, equipment (e.g., pump, headgate, valves, etc.) replacement, fish screen/ladder maintenance, road, dike, and pumping facility upkeep. These actions have been ongoing throughout the history of the Project. O&M activities under both alternatives remains the same with no new activities proposed (*See Section 4.3.3. of the modified 2018 Operations Plan for additional details on ongoing O&M on Project facilitie*s). Though not evaluated in this EA, the O&M activities needed to operate the Project would be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA, the National Historic Preservation Act (NHPA) and other applicable laws are required prior to the activity(ies) being implemented.

2.2.14 Conservation Measures

Under both alternatives Reclamation would continue to implement, in coordination with the Services, several conservation measures intended to minimize the Project's effects on ESA-listed species. Conservation measures under both alternatives include:

Canal Salvage for Suckers: Fish salvage of Project canals would occur when canals are: (1) temporarily dewatered for a discrete action related to maintenance and/or repairs at Project facilities, and (2) when canal systems are dewatered at the end of each irrigation season. Under both circumstances, suckers are salvaged from isolated pools.

Sucker Captive Rearing Program: Reclamation would continue to support the USFWS Captive Rearing program for LRS and SNS with approximately $300,000 annually contingent upon Reclamation's annual budget process and appropriations. The intent is to improve the numbers of suckers reaching maturity in UKL. Ultimately, the function of a captive rearing program would be to promote survival and recovery of sucker populations that suffer losses from entrainment as a result of Project operations or other threats.

Sucker Monitoring and Recovery Implementation: In coordination with USFWS, Reclamation would continue to support efforts to monitor adult suckers in UKL, Clear Lake and Gerber reservoirs and fund Sucker Recovery Implementation Projects. Reclamation anticipates annual funds of approximately $1.5 million for both monitoring and recovery projects under the term of the No Action Alternative through 2022 contingent upon Reclamation's annual budget process and appropriations. Under both alternatives, contingent upon Reclamation's annual budget process and appropriations, Reclamation anticipates annual funds of approximately $1.5 million base funding annually with an additional $700,000 provided for in fiscal years 2019 and 2020 for UKL adult monitoring, Clear Lake adult monitoring, and juvenile cohort monitoring, research, and recovery projects. Funding in fiscal years beyond 2020 would be supplemented with $700,000 should appropriations materialize. Under both alternatives the purpose and related support remains similar *(See Section 4.5.3 of the modified 2018 Operations Plan for more program specifics).*

Klamath River Coho Restoration: Consistent with Addendum 3 to the modified 2018 Operations Plan dated March 25, 2019, in coordination with NMFS, Reclamation would, under both alternatives, continue to support efforts to improve habitat for coho salmon in the Klamath Basin through the Klamath River Coho Restoration Program (Program). Under both alternatives, Reclamation proposes that funding for the Program would be $700,000 in fiscal year 2020, and $500,000 in each of the successive fiscal years beginning with fiscal year 2021 and ending with fiscal year 2022 contingent upon Reclamation's annual budget process and appropriations. These funds would support Program administration and projects that address limiting factors for SONCC coho salmon in the Klamath Basin and are contingent upon Reclamation's annual budget process and appropriations. The Program would be performed consistent with the *2009 California Department of Fish and Wildlife's California Salmonid Restoration Manual*[13]. Restoration projects minimize habitat related effects of the Project by individually and comprehensively improving critical habitat conditions for coho individuals and populations (*See Section 4.5.4 of the modified 2018 Operations Plan for more program specifics)*.

Though not specifically evaluated in this EA, the conservation measures would be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if

[13] The *2009 California Department of Fish and Wildlife's California Salmonid Restoration Manual* can be accessed here: https://www.wildlife.ca.gov/Grants/FRGP/Guidance

additional compliance with NEPA, NHPA, Clean Water Act, and other applicable laws is required prior to the activity(ies) being implemented.

2.2.15 Terms and Conditions

All Terms and Conditions included in Services' 2019 BiOps (inclusive of any subsequent clarifications from the Services) that are administrative in nature are included in this analysis and assumed to have no effect on the human environment. Any other actions included in the Terms and Conditions that are not specifically evaluated in this EA or otherwise have not completed environmental compliance, would be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA, NHPA, Clean Water Act, and/or other applicable laws is required prior to the activity(ies) being implemented.

2.3 No Action Alternative

Under the No Action Alternative, Reclamation would continue to operate the Project consistent with the common elements described in Section 2.2 and as detailed in the modified 2018 Operations Plan and associated 2019 BiOps for the period 2019 - 2024. Certain components of the operating procedures of the No Action Alternative were modified and form the basis of the Proposed Action Alternative, which for evaluation purposes, are described in more detail below and in Section 2.4.

2.3.1 Klamath River Management

As stated above in Section 2.2.5 as a common element between both alternatives, the minimum EWA is 400,000 AF which occurs when UKL Supply[14] [the end of February UKL storage] + [NRCS forecasted UKL inflow for March through September] - [UKL Reserve] is less than 670,000 AF. When UKL Supply is greater than 1,035,000 AF, EWA is calculated as UKL Supply minus the maximum Project Supply (342,564 AF). Refer to the *modified 2018 Operations Plan, Appendix 4 (Section 4.3.2.2.2.3*) for EWA calculations when UKL Supply is between 670,000 AF and 1,035,000 AF. Much like Project Supply, the EWA allocation is calculated on the first of each month from March to June based on the NRCS inflow forecast and observed hydrology. No additional EWA augmentation water is provided under the No Action Alternative, with the exception of the 20,000 AF May/June EWA augmentation which is common to both alternatives.

2.3.2 Upper Klamath Lake Management

Under the No Action Alternative, Reclamation would continue to calculate UKL Supply, as defined above in Sections 2.2.3 and 2.3.1, using the end of February UKL storage, the NRCS forecasted UKL inflow for the spring/summer period, reduced by the UKL Reserve and implement the operational approach of UKL control logic and central tendency. Reclamation's operational objective would continue to focus on filling UKL during the fall/winter months to increase the volumes available for the EWA (*as described in Section 2.2.5 and 2.3.1*), UKL, and Project Supply during the spring/summer operational period. Reclamation would continue to operate such that the UKL control logic allows for the regulation of certain releases relative to

[14] As described in Section 2.2.3

UKL storage and recent hydrologic conditions in a manner that maintains 1) UKL elevations important for suckers, and 2) the UKL Credit in order to buffer the lake against uncertainties associated with NRCS forecast error and other factors affecting UKL inflow available for subsequent diversion.

The specified central tendency described in Section 2.2.4 would remain in place under the No Action Alternative and continue to be based on user-defined end-of-month UKL elevations which are subsequently interpolated to daily values. The current generic annual hydrograph, created based off this operational approach, would continue to account for seasonal needs of suckers, seasonal water demand for the Klamath River and Project, and end-of-season elevations intended to result in (after winter inflows) storage volumes appropriate to meet the next year's demands on UKL. The hydrograph would continue to be adjusted daily, to produce an adjusted central tendency. If UKL elevations drop below the adjusted central tendency, then Reclamation would reduce releases to the Klamath River (*subject to IGD minimums described in Appendix 4 of the modified 2018 Operations Plan*) and winter deliveries to the Project's Area A2 until UKL elevations equal or exceed the adjusted central tendency line. Under the No Action Alternative, the generic central tendency end-of-month UKL elevations were arrived at through the iterative modeling process and are not intended to change during the continued operation of the No Action Alternative. *(See Appendix 4, Section A.4.4.1.1 of the modified 2018 Operations Plan for technical details regarding the UKL control logic).*

2.3.3 Project Water Supply

As stated above in Section 2.2, under the No Action Alternative the maximum Project Supply is 350,000 AF. Project Supply is initially determined in early March as the quantity of water remaining after the end of September target UKL storage and EWA are determined, or a maximum of 350,000 AF, whichever is less. Project supply is recalculated in April, May, and June. The April 1 Project Supply establishes the minimum Project Supply for the irrigation season, with Project Supply recalculated again in May and June. While the Project Supply cannot decrease below the April 1 allocation (unless enhanced May/June flows are triggered in May), it may increase in May and June based on hydrologic conditions.

When Project Supply is recalculated in early May using the NRCS inflow forecast and the May EWA allocation is less than 576,000 AF, the calculated Project Supply is further reduced by up to 10,000 AF in order to support augmented May/June river flows. As stated above in Sections 2.2.4 and 2.3.1, EWA augmentation for May/June flows is split evenly at all enhancement volumes between Project Supply and from UKL.

2.4 Proposed Action Alternative

The Proposed Action Alternative includes the elements common to both Alternatives described in Section 2.2 but is modified from the No Action Alternative by including deviations from Reclamation's modified 2018 Operations Plan for an interim period of time. These deviations are specific to the augmentation of the EWA in certain WY types and specified UKL minimum spring/fall elevations. Specifically, Reclamation would implement the Proposed Action Alternative until March 1, 2023, after the completion of the November 13, 2019, reinitiated ESA Section 7 consultation on Project operations has concluded (anticipated on September 30, 2022) and all associated environmental compliance (i.e., NEPA) has been completed (anticipated no later than March 1, 2023). Additionally, for WY 2020 only (though it is reasonably foreseeable that subsequent, similar actions may take place in the future), the Proposed Action Alternative includes Reclamation entering into one or more contracts with districts within the Project to acquire Project water for fish and wildlife purposes within Lower Klamath and Tule Lake NWRs. Specific details on these elements are discussed below.

2.4.1 Klamath River Management

As stated in Sections 2.2.4 and 2.3.1 the base EWA will be calculated in the same way under the No Action and the Proposed Action alternatives. Additionally, both alternatives include a provision for enhanced May/June flows (although minor deviations to the augmentation scheme) exist between the two alternatives and surface flushing flow implementation criteria remain the same.

However, under the Proposed Action Alternative, Reclamation would provide an additional 40,000 AF in base EWA augmentation in WYs with an UKL Supply at or above 550,000 AF and at or below 950,000 AF. The 40,000 AF of EWA augmentation would be comprised of 23,000 AF from Project Supply and 17,000 AF from volume within UKL. An initial determination on whether the 40,000 AF of EWA augmentation would occur would be based on the March 1 NRCS UKL inflow forecast and the resulting UKL Supply. A final determination of EWA augmentation would be made in early April, with the April 1 NRCS inflow forecast and the resulting UKL Supply. In the rare instance that a portion of the EWA augmentation volume is utilized in March, that volume would be subtracted from that available beyond March. If a volume of EWA augmentation is used in March and the subsequent April 1 EWA augmentation calculation does not provide EWA augmentation, then all water utilized in March above and beyond formulaic release of EWA (i.e., augmentation volume) would be counted against the EWA.

The 40,000 AF of EWA augmentation included in the Proposed Action Alternative is in addition to an enhanced May/June flows (20,000 AF) provision described in the No Action Alternative above and in the modified 2018 Operations Plan, although slight modifications (e.g., Klamath River “ramp up” and “ramp down” flows), to this provision are proposed below.

As described in the 2018 Operations Plan, and as will continue under the Proposed Action Alternative, Reclamation proposes to provide up to a full enhancement volume of 20,000 AF, split evenly between Project Supply and from UKL (the split is even at all enhancement volumes). Reclamation would utilize the May UKL Supply volume, based on the May 1 NRCS inflow forecast and the resulting UKL Supply, to determine whether enhanced May/June flows would occur, and the actual volume available for flow enhancement. The enhanced May/June flows would begin to increase linearly relative to UKL Supply from zero at a UKL Supply of 625,000 AF, reaching a maximum volume of 20,000 AF between a UKL Supply range of 717,000 and 858,000 AF, then decreasing linearly relative to UKL Supply to zero at an UKL Supply volume of 950,000 AF.

As described in Reclamation’s 2018 Operations Plan (as analyzed in the Services’ 2019 BiOps), Reclamation would maintain a flexible approach to utilizing the proposed 40,000 AF of EWA augmentation and enhanced May/June flows. With the exception that the EWA augmentation water and enhanced May/June flows would be utilized within the March through June timeframe, Reclamation would allow for flexibility in the timing and distribution of augmentation volumes. EWA augmentation and enhanced May/June water use would be tracked separately from formulaic use of EWA during March through June. Any unused portion of the augmentation water would remain in the EWA after June and the formulaic approach to EWA release would be followed in the July through September period. The existing FASTA (*as described in section 2.2.5*) process would be used to allow salmon and sucker biologists from Reclamation and the Services, as well as other Klamath Basin experts, to provide real-time operational input into the use of this water to maximize ecological benefits to SONCC coho and SRKWs, whether those benefits be improved habitat conditions, minimized disease conditions, or both, while maintaining UKL elevations and conditions protective of LRS and SNS.

To provide additional certainty that the proposed 40,000 AF EWA augmentation volume can be utilized at the time and in the manner appropriate to address disease and habitat concerns for coho salmon, Reclamation has coordinated with PacifiCorp on potential springtime water borrowing operations from March to June. The spring operations agreed to with PacifiCorp would assist in providing augmented river flows while safeguarding against UKL elevations below those that are sufficiently protective of spawning suckers, and releases from UKL would repay the PacifiCorp reservoirs later in the season. Reclamation and PacifiCorp have finalized an agreement on how these operations would occur.

In the event PacifiCorp is unable to provide the water, and/or if modeling shows that implementation of the 40,000 AF of EWA augmentation releases is likely to result in UKL elevations below 4,142.0 ft in April or May, despite good faith efforts to rearrange the 40,000 AF of EWA releases within reasonable bounds, Reclamation would coordinate with the Services and PacifiCorp to best meet the needs of ESA-listed species as well as coordinate and obtain input from Yurok and other affected Klamath River Basin Tribes through government-to-government consultation on how to manage water.

If 40,000 AF of EWA augmentation does not occur as described above, EWA and UKL management under the Proposed Action Alternative is the same as the No Action Alternative described in section 2.3 above. Specifically, in the event that April 1, UKL Supply is projected to fall below the threshold for EWA augmentation, Reclamation would not attempt to modify EWA releases or borrow water from PacifiCorp reservoirs to contribute to maintaining UKL elevations above 4,142.0 ft in March, April and May once those elevations have been previously achieved.

2.4.2 Upper Klamath Lake Management

As described in Section 2.2.3, UKL Supply and UKL Reserve calculations remain consistent under both alternatives. However, under the Proposed Action Alternative, when the 40,000 AF EWA augmentation is triggered, it is likely that the range of UKL elevations (that were anticipated to occur under the No Action Alternative’s UKL KBPM simulations and analyzed in the USFWS 2019 BiOp) would be altered. As these elevations are important to Federally-listed suckers, Reclamation proposes, for the protection of spring sucker spawning, that when the 40,000 AF EWA augmentation is triggered under the Proposed Action Alternative, UKL surface elevation would be maintained above 4142.0 ft[15] through the end of May, once this elevation has been achieved earlier in the spring. In certain WY types like those experienced in 2005 and 2015 (dry/very dry), the simulated modeled output suggests that UKL surface elevations would be maintained above 4142.0 ft for portions of the April-May spring spawning period but would drop below this benchmark for multiple consecutive days. As such, Reclamation proposes to work with PacifiCorp to borrow water from their hydroelectric reservoirs or modify EWA augmentation releases in coordination with the FASTA process so that UKL elevations would not fall below 4,142.0 ft during April and May. The borrowed water would need to be returned in June (from volume within UKL) so that PacifiCorp's reservoirs can be returned to normal operating levels.

Reclamation proposes to manage UKL elevations in a way that does not cause water surface elevation below 4,142.0 ft in March, April, or May, when possible, or annual minimums below 4,138.0 ft. These are changes from the No Action Alternative where Reclamation would manage UKL in a manner that does not result in water surface elevations below 4,142.0 in April or May or below an annual minimum of 4,138.26 ft.

Overall, Reclamation proposes under the Proposed Action Alternative an average decrease of 0.07 ft during sucker spawning from February to May and an average decrease of 0.15 ft for August and September, as compared to the No Action Alternative.

2.4.3 Project Supply

Project Supply from UKL is calculated and available for delivery the same way under both the No Action and Proposed Action alternatives. However, under the Proposed Action Alternative, when the EWA augmentation (*as discussed above*) is triggered, an additional reduction to Project Supply would occur that is limited to, and would not exceed, 23,000 AF. The EWA augmentation would not otherwise affect Project operations, including Project diversion rates and timing beyond what is described in the No Action Alternative.

2.4.4 Acquisition of Project Water for Fish and Wildlife Purposes (Refuge Water Acquisition)

Under the Proposed Action Alternative, in 2020, Reclamation proposes to enter into one or more temporary water contracts with willing district entities within the Project (or their authorized representatives) for the acquisition of up to 25,000 AF of Project water[16] for use for fish and wildlife purposes within TLNWR and LKNWR (*see Appendix A for map*). These contracts would be executed in 2020 and would expire before December 31, 2020. Water acquired from district entities would be used within the refuges for fish and wildlife purposes consistent with USFWS' existing management plans for those lands.

The volume, timing, and location of Project water acquired under the temporary water contract(s) would vary. Project water may include seepage and return flows, live flow in the Klamath and Lost rivers, or stored water from UKL. (*See Appendix E for the types of water acquisitions that could result if the Proposed Action Alternative is implemented*).

[15] A key UKL elevation for protecting sucker spawning habitat in the spring months is 4142.0 ft or above.
[16] See Part 4.3.2 of the modified 2018 Operational Plan for the definition of the term "Project water".

The Project water Reclamation would acquire from willing sellers would be based on the seller's foregone diversion of Project water based on their reduction in diversions and/or consumptive use, thereby making water available to the U.S. that would otherwise be diverted and applied to beneficial irrigation use. Districts would make this water available through a number of measures, including delay or deferment of late season irrigation practices (to deal with pests or saturate soil for subsequent growing season). For example, under a similar contract in 2018, districts within the Project made approximately 3,500 AF of Project Supply available for delivery to LKNWR. The districts would have otherwise diverted and used this water during the irrigation season, but instead it was delivered to LKNWR through the Ady Canal, to support the fall/winter waterfowl migration. These deliveries to the refuge were made consistent with historical operations and applicable operating requirements.

The water acquired would be used for fish and wildlife purposes at LKNWR and TLNWR, consistent with existing water rights of record and in compliance with any necessary water right changes, transfers, or other authorizations under applicable state law.

Based on a similar action taken by Reclamation in 2018, Reclamation anticipates that district entities within the Project would likely attempt to use funds that may be acquired under these contracts to engage in non-federal demand management and compensation activities, such as supplemental groundwater pumping and paying landowners, either before or after the fact, for not using Project water and idling normally irrigated lands. Reclamation has no role in planning or carrying out these subsequent non-federal activities. A summary of these activities from the 2018 water acquisition effort are included in Appendix E, and these types of indirect effects are considered here for purposes of analyzing the Proposed Action Alternative.

Reclamation's discretionary action is limited to contracting to acquire water that is needed and can be used for fish and wildlife purposes. Under this action, Reclamation proposes to only change the place of use of existing Project water supplies as necessary; Reclamation would not acquire water outside of Project water sources. No new construction or modification of existing facilities would occur in order to complete the Proposed Action Alternative. Reclamation's action is administrative in nature.

Similar contracts for future years, beyond 2020, would be subject to reauthorization of the Reclamation States Emergency DRA of 1991, as amended. Although the authority and funding for drought relief activities is uncertain in future years, given the downward trend in Project water supply due to drought and other causes, it is reasonably foreseeable that similar programs and activities would be carried out over the term of the Proposed Action Alternative.

Section 3 Affected Environment

This section summarizes the existing environment that could be affected by the No Action and Proposed Action alternatives.

3.1 Water Resources

3.1.1 Surface Water

The Upper Klamath Basin drains approximately 4,630 square miles above IGD. The region encompasses two watersheds, the Klamath River watershed and the Lost River watershed. The Lost River system includes Clear Lake Reservoir, Gerber Reservoir, Lost River, and Tule Lake (including Sump 1A and Sump 1B). UKL, a main component of Project operations, is fed by three major tributaries, including the Williamson, Wood and Sprague rivers and is the start of the Klamath River which ultimately flows through Southern Oregon into Northern California out to the Pacific Ocean.

3.1.1.1 Upper Klamath Lake

Hydrology
UKL is the largest lake by surface area in Oregon (approximately 67,000 acres) and is fed by a watershed of 3,768 square miles, including the Williamson, Wood, and Sprague rivers. Outflow from UKL is controlled by Link River Dam, which releases water into the Link River at the south end of the lake. UKL varies in width from six to 14 miles and is approximately 25 miles long. The mean surface elevation is 4,140 ft above sea level Reclamation Datum (Neuman 2017), at which the mean depth is approximately 14 ft and the maximum depth is 49 ft. Current bathymetric data (Neuman 2017) indicates that UKL has an active storage capacity of 562,000 AF between the elevations of 4,136.0 and 4,143.3 ft above sea level, which is the range within which UKL has been operated since completion of Link River Dam in 1921. Naturally occurring water surface elevations prior to completion of Link River Dam generally fluctuated between approximately 4,140 and 4,143 ft above sea level (USBR datum, 1904-1919 POR). For the WYs from 1981 through 2019, the mean annual net inflow to UKL was 1,198,000 AF, ranging from 593,000 to 1,978,000 AF depending on hydrologic conditions.

Water Quality
Water quality in UKL is considered poor, primarily as a result of eutrophication. UKL is considered a hypereutrophic system, characterized by excessive nutrient concentrations and frequent large algal blooms and subsequent bloom crashes (Oregon Department of Environmental Quality (ODEQ) 1998). The Total Maximum Daily Load (TMDL) for UKL estimates the external load to the lake to be approximately 40 percent lake (Boyd et al. 2002). The source of excessive nutrients (primarily phosphorus) is a combination of relatively high background concentrations, internal sediments, and anthropogenic factors, such as the conversion of wetlands and marshlands to agricultural lands and the drainage of agricultural lands into UKL and its tributaries (Boyd et al. 2002).

The ODEQ has developed TMDLs targeting total phosphorus for UKL and Agency Lake (*See Appendix A for map*) (Boyd et al. 2002). The TMDLs were developed to address impairments to dissolved oxygen (DO), pH, and chlorophyll-a (nuisance phytoplankton growth) specific to the summer months of the year.

3.1.1.2 Link River

Hydrology
The Link River is an approximately 1.5-mile long waterbody connecting UKL and the Klamath River. The Link River begins at the outlet of UKL, just upstream of Link River Dam, and runs through a narrow canyon to Lake Ewauna, which constitutes the beginning of the Klamath River. The Link River drops 44 ft over its course, including a series of small rapids approximately 500 ft below Link River Dam. Two canals which were historically used primarily for hydroelectric purposes divert water at Link River Dam and run along the east and west sides of the river itself. PacifiCorp continues to intermittently operate the East Side and West Side powerhouses that are supplied by these two canals. From 1962 through 2018, the mean annual rate of flow from Link River Dam into the Link River was approximately 1,250 cfs, and the mean annual volume was approximately 900,000 AF.

Water Quality
Due to the short travel time (generally around two hours), water quality in Link River generally follows conditions in UKL with respect to pH, nutrients, chlorophyll-*a*, and cyanobacteria. During periods when DO levels in UKL are either extremely low or high, aeration of the water in the rapids between Link River Dam and Lake Ewauna returns concentrations closer to saturation.

3.1.1.3 Klamath River

Hydrology
The Klamath River begins at the outlet of Link River and flows approximately 254 miles through southern Oregon and northern California to the Pacific Ocean. The first two miles of the river form a broad, flat body of water known as Lake Ewauna. Water levels remain relatively constant from Lake Ewauna downstream approximately 21 miles to Keno Dam (at approximately river mile 233), which is owned and operated by PacifiCorp. Downstream of Keno Dam, the Klamath River enters a narrow canyon where it descends approximately 1,550 ft over the next 40 miles.

Four additional dams (*see Appendix A*), owned by PacifiCorp and operated for hydroelectric purposes, are located along this reach, between river miles 224 and 190. Downstream of IGD, the river increases in size with the inflow of the Shasta, Scott, Salmon, and Trinity rivers and several smaller tributaries. The natural drainage area of the Klamath River (excluding the Lost River watershed) is approximately 12,700 square miles.

The Upper Klamath Basin is relatively dry, as compared to the Lower Klamath Basin. This distinction is demonstrated by the average annual precipitation of approximately 13 inches in Klamath Falls, Oregon, as compared to approximately 75 inches in Klamath, California. The relative difference in precipitation also is reflected in the dramatic increase in the size of the river as it flows towards the coast. Annual mean flow at the beginning of the Klamath River is approximately 1,250 cfs, compared to approximately 17,000 cfs near the mouth at the Pacific Ocean.

Since 1956, releases from IGD to the Klamath River were governed by flow requirements specified in PacifiCorp's operating license from the Federal Power Commission, now FERC. Since the 1997 listing of SONCC coho salmon in the Klamath River as threatened, flow requirements downstream of IGD have been governed in accordance with the ESA (Section 10 of the ESA of 1973, as amended, (16 U. S.C. § 1531-1543). Reclamation coordinates with PacifiCorp on operations so that IGD are subject to the requirements of the ESA. Currently, PacifiCorp's February 16, 2012, Interim Operations Habitat Conservation Plan and subsequent Incidental Take Statement[17] issued by NMFS requires PacifiCorp to operate IGD, located 63 miles below Link River Dam, in accordance with any required flow releases identified in a BiOp resulting from Reclamation's current or future ESA section 7 consultations (NMFS incidental take of Endangered/Threatened Species Permit Number 17158).

Pursuant to Section 2(a)ii of Wild & Scenic Rivers Act (WSRA; Public Law 90-542; 16 U.S.C. 1271 et seq.), portions of the Klamath River are included in the National Wild and Scenic Rivers System because of their free-flowing conditions and outstandingly remarkable values (Reclamation and California Department of Fish and Game [CDFG] 2012). Specifically, the portion of the Klamath River from the J.C. Boyle Powerhouse to the California-Oregon State border is classified under the WSRA as *scenic* with identified "outstandingly remarkable" fisheries, recreational, scenic, historic, wildlife, American Indian traditional use, and pre-historic values (National Wild and Scenic Rivers System 2020). Additionally, the portion of the Klamath River in California, 3,600 ft below IGD to the Pacific Ocean (250 miles), is designated under the WSRA as *recreational* with "outstandingly remarkable" fisheries values (Reclamation and CDFG 2012).

Water Quality
The approximately 21-mile reach of the Klamath River from the outlet of the Link River to Keno Dam generally exhibits poor water quality conditions on a seasonal basis, including low levels of DO, high temperatures and elevated levels of ammonia, nutrients, chlorophyll-a, and pH. Releases from UKL, particularly during the summer, are the primary cause of these conditions, due to the high concentration of algal biomass exported from UKL. Flows from the KSD, treated municipal sewage effluent, and log storage operations also contribute to excessive nutrient loads and other contaminants in this reach of the Klamath River (Reclamation 2018).

The ODEQ has developed TMDLs targeting total phosphorus, total nitrogen, dissolved inorganic nitrogen, and biological oxygen demand in the Link River to Keno Dam Reach of Klamath River (ODEQ 2018). More recently, ODEQ developed TMDLs for temperature in this reach (ODEQ 2019). The TMDLs were developed to address impairments to DO, pH, ammonia toxicity, nuisance phytoplankton growth, and temperature. The current TMDLs for the Klamath River in California address temperature, DO, nutrient, and microcystin water quality impairments for the Klamath River Hydrologic Unit, Middle Hydrologic Area (Oregon to Trinity River) and Lower Hydrologic Area, Klamath Glen Hydrologic Sub-area (Trinity River to Pacific Ocean) (North Coast Regional Water Quality Control Board (NCRWQCB) 2010).

[17]NMFS' regulations governing ESA -listed species permits (50 C.F.R. §§ 222.301 -222.307) with the Incidental Take Statement issued by NMFS on February 24, 2012 related to PacifiCorp's February 16, 2012, Interim Operations Habitat Conservation Plan available here: https://archive.fisheries.noaa.gov/wcr/publications/habitat/hcp_swr/pacificorps_hcp/pacificorp_hcp_itp.pdf

Total phosphorus loads tend to remain elevated through the hydroelectric reservoirs of the middle and lower Klamath River reaches (*See Appendix A*). Excess phosphorus in proportional combination with nitrogen contributes to algal blooms in this reach, which cause seasonally elevated pH, ammonia, chlorophyll-*a*, and microcystin levels upstream of IGD. Nitrification downstream of IGD causes a decrease in ammonia and organic nitrogen levels and a corresponding increase in nitrate, which is less harmful to aquatic life. However, water quality in the Klamath River below IGD is still impaired during the summer due to high levels of phosphorus, nitrogen, and other organic material, and corresponding low DO levels.

3.1.1.4 Lost River

Hydrology

The approximately 60-mile long Lost River begins at the outlet of Clear Lake Reservoir, in Modoc County, California, and flows northward into Klamath County, Oregon. After flowing through Langell Valley, the river turns westerly near the town of Bonanza, and then after passing through Olene Gap, turns southward and flows back into California, where it terminates at Tule Lake. In its natural condition, the Lost River constituted a mostly closed basin, with a drainage area of approximately 3,000 square miles. Historically, during periods of high flow, the Klamath River would flow through the Lost River Slough, into the Lost River, and eventually Tule Lake. Major tributaries to the Lost River include Miller Creek, Rock Creek, and the East Branch of the Lost River.

To reclaim lands underlying Tule Lake, between 1910 and 1912, Reclamation constructed the Lost River Diversion Dam and Channel, approximately four miles southwest of Olene Gap. The Lost River Diversion Dam diverts the flow of the Lost River into the LRDC, where it can be conveyed approximately eight miles to the Klamath River, just downstream of Lake Ewauna. The LRDC, which roughly follows the course of the former Lost River Slough, has a current capacity of 3,000 cfs.

Throughout the year, all flows in the Lost River that reach the Lost River Diversion Dam, up to approximately 3,000 cfs, are diverted into the LRDC. During the irrigation season (March 1 to November 15), these flows are relatively small (i.e., 50-150 cfs) and generally are re-diverted from the LRDC for irrigation purposes prior to reaching the Klamath River. At other times of the year, the entire flow in the Lost River, up to the capacity of the LRDC, is diverted to the Klamath River (during the fall/winter period). During the fall/winter period, flows in the lower Lost River primarily consist of tributary runoff, irrigation return flows, and stored water from UKL (conveyed and released into the Lost River through the LRDC). When flows in the Lost River exceed the capacity of the diversion channel, the excess water is spilled over the Lost River Diversion Dam to the lower Lost River and Tule Lake.

In 1942, as part of a coordinated plan with the Bureau of Biological Survey (now USFWS), Reclamation constructed Pumping Plant D, the Tule Lake Tunnel, and the P Canal system, to convey excess water from Tule Lake to the Lower Klamath Lake area. Through operation of the LRDC, Pumping Plant D, and the KSD, water from the Lost River, of varying rates and volumes, is currently exported to the Klamath River. The rate and volume of these diversions are influenced by a variety of conditions, including reservoir storage levels in the Lost River watershed, existing water levels in Tule Lake and LKNWR, flows in the Klamath River, and available capacity in both LRDC and KSD. Overall, from October 1, 1980, to September 30, 2016, average flows from the LRDC and the KSD were approximately 21 percent of the annual volume released from Keno Dam.

In recent years, declining water availability from UKL and increasing power costs have altered operation of Pumping Plant D and KSD. Over the first six decades of operation (1942-2002), Pumping Plant D conveyed approximately 84,000 AF annually from the Tule Lake Sumps to LKNWR, ranging from 24,000 to 145,000 AF in any given year. Since 2002, annual discharges from Pumping Plant D into LKNWR have decreased to approximately 36,000 AF, with the recent 5-year average (2014-2019) of 23,000 AF.

The decrease in the amount of water LKNWR receives from Pumping Plant D, as well as from UKL and the Klamath River, has resulted in less drainage from LKNWR into the KSD (and subsequently the Klamath River). Whereas historically, approximately 50,000 AF was drained annually from LKNWR into the KSD, since 2010, that figure has not exceeded 1,000 AF in any year, except when water was drained for the purpose of assisting the Project in meeting required IGD flows (2013, 2018, and 2019).

On the Lost River, there are three other major impoundments on the main stem of the Lost River in addition to the Lost River Diversion Dam. Malone Diversion Dam, twelve miles downstream of Clear Lake Reservoir and just over the Oregon border, diverts water for irrigation purposes in Langell Valley. Approximately three miles west of the town of Bonanza, Harpold Dam, which is owned and operated by Horsefly Irrigation District, regulates upstream water levels to facilitate pumping from the river for irrigation purposes in Yonna Valley. Anderson-Rose Dam, two miles south of the town of Merrill, diverts water from the Lost River four miles upstream from the terminus of the Lost River at Tule Lake.

Water Quality

Similar to the tributaries to UKL, land use practices in the Lost River watershed, including modifications to the river channel and adjacent riparian areas, contribute to the current conditions in the Lost River (ODEQ 2018). Nutrient loading, greatest in the middle and lower portions of the watershed, produces algal blooms in the summer months and the associated low DO and high pH and ammonia levels (ODEQ 2018). Additionally, the ODEQ has documented potential water temperature exceedances in the Lost River and Lost River tributaries (ODEQ 2019).

The ODEQ has developed TMDLs targeting dissolved inorganic nitrogen, carbonaceous oxygen demand (ODEQ 2018) and water temperature (ODEQ 2019). The TMDLs were developed to address impairments to DO, pH, ammonia toxicity, nuisance phytoplankton growth, and temperature specific to various reaches of the Lost River and its tributaries.

3.1.2 Groundwater

The Upper Klamath Basin covers a broad volcanic plateau between the Cascade Range and the Basin and Range geologic provinces in south-central Oregon and northern California. Despite low precipitation levels, tributary runoff and groundwater recharge from the Cascade Range on the western margin and volcanic uplands on the eastern margin contribute to local groundwater levels. As a result, the permeable volcanic bedrock in the basin contains an extensive groundwater system that contributes to surface water supplies and serves as a water source for natural spring flows as well as irrigation, municipal, domestic and other uses (Gannett et al. 2012).

Groundwater originates as recharge in the Cascade Range and upland areas in the basin interior and eastern margins and flows toward stream valleys and interior sub-basins. Natural springs discharge groundwater into streams and lakes throughout the basin, particularly in the Wood River and lower Williamson River watersheds, along the margins of the Cascade Range, and directly into UKL. Natural springs also occur in the eastern part of the basin, including the Lost River watershed. As the permeability of soils in the Lower Klamath Basin (below IGD) is less than the soils in the Upper Klamath Basin, there is negligible groundwater flow between the upper and lower basins (Gannett et al. 2012). The groundwater system in the basin is most directly affected by basin-wide, decadal-scale climatic cycles.

Groundwater pumping has increased throughout the basin over the last half-century, and particularly over the last two decades within the Project service area, primarily in support of agricultural irrigation (Gannett et al. 2012). Oregon groundwater levels, monitored by the Oregon Water Resources Department (OWRD), have experienced declines since the advent of widespread groundwater pumping in 2001. OWRD reports that following declines in groundwater levels between 2001 and 2011 due to increased irrigation use, groundwater levels further declined between 2011 and 2015 under reported average pumping of 60 thousand acre-feet (TAF) annually. Between 2015 and 2019, groundwater levels increased under reported average pumping of 20 TAF; however, slight decreases were observed in 2018 under 30 TAF of reported pumping. However, not all groundwater use within the Project is reported; OWRD estimates it records approximately 40 to 60 percent of actual pumping volume in Oregon. California's groundwater use is well represented by pumping records from TID [18]. In summary, changes in groundwater levels are the result of groundwater utilization for all uses, including irrigation both within and outside the Project in both Oregon and California, both monitored and unmonitored.

Groundwater use is governed, authorized, and regulated under the laws of the respective states; Reclamation has no role in regulation of groundwater use. In Oregon, the extent of impacts to groundwater (e.g., drawdown) is monitored and regulated by the OWRD, which has the responsibility, policies, and procedures to determine and enforce acceptable levels of impact to groundwater resources.

Groundwater pumping in Oregon occurs under a regulatory system that includes primary rights, supplemental rights, and drought permits. Landowners with primary groundwater rights may use them in any year regardless of drought conditions. When Project surface water is unavailable, landowners holding supplemental groundwater rights may irrigate using groundwater. In addition, landowners with wells lacking primary or supplemental water rights may apply to OWRD for a drought permit to use groundwater. OWRD limits issuance of drought permits in

[18] Given its contractual priority to Project water and its location with respect to Project drainage, TID is generally the last contractor to be impacted by shortages in Project water and therefore the last to need to initiate groundwater pumping. Groundwater pumping is expensive under full tariff electricity rates in California, further suppressing the desire to pump groundwater, particularly for private parties. Groundwater pumping is only anticipated in concurrence with government-funded drought relief programs, which provide compensation for substituting groundwater for Project surface water.

order to reduce or eliminate impacts to third parties and/or the groundwater resources in accordance with Oregon water law.

In California, groundwater use is governed by the 2014 Sustainable Groundwater Management Act (SGMA), which calls for the statewide establishment of Groundwater Sustainability Agencies (GSA) and Groundwater Sustainability Plans by 2022, with a goal of sustainability by 2042. In the medium priority Tule Lake Subbasin[19], TID, Siskiyou and Modoc counties, and the City of Tulelake formed a joint GSA in 2017 to achieve compliance with the SGMA; Reclamation is not a member of the GSA and has no role in groundwater management in California. For the purposes of this Proposed Action Alternative and EA, and to the extent that actions by the GSA may impact groundwater availability in California, only 2022 falls within the scope of the Tule Lake Subbasin GSA and Groundwater Sustainability Plan.

3.2 Biological Resources

3.2.1 Upper Klamath River Basin/ Upper Klamath Lake Federally Protected Species

Several fish species are located and carry out their life cycles in the Upper Klamath Basin/UKL. The LRS and SNS (both endangered under the ESA) are the species in the Upper Klamath Basin of interest in this EA due to the level of potential impact caused by either of the alternatives. Critical habitat for LRS was designated in 2011 as UKL and its tributaries, inclusive of Keno Impoundment, and Clear Lake Reservoir and its tributaries (76 FR 76337). Critical habitat for the SNS was also designated in 2011 and includes the same bodies of water as LRS with the inclusion of Gerber Reservoir and its tributaries (76 FR 76337). These habitats were identified as providing constituent elements along shorelines and in deeper water that gives suckers food, shelter, and access to spawning. Greater detail on life history timing is below.

Lost River sucker

The LRS, an endemic species to the Klamath Basin, is listed under ESA as an endangered species (50 CFR 17). Habitat loss, population isolation, poor water quality, competition and predation are several explanations for this species decline.

LRS are limited in distribution to UKL, Clear Lake Reservoir, and Tule Lake Sumps in the Upper Klamath Basin. The largest remaining populations of LRS are in UKL. Despite high survival for most years from 1999 to 2015, the abundance of LRS males in the lakeshore-spawning subpopulation declined approximately 64 percent and the abundance of females declined by approximately 56 percent (Hewitt et al. 2018). Additionally, data from U.S. Geological Survey (USGS) summarizes that tributary-spawning LRS have experienced dramatic declines of approximately 50 percent from 2016 to the spring of 2018 (Janney and Hewitt 2018,

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[19] Basin Prioritization is a technical process that utilizes the best available data and information to classify California's 515 groundwater basins into one of four categories high-, medium-, low-, or very low-priority. Each basin's priority determines which provisions of California Statewide Groundwater Elevation Monitoring (CASGEM) and the Sustainable Groundwater Management Act (SGMA) apply. SGMA requires medium- and high-priority basins to develop groundwater sustainability agencies (GSAs), develop groundwater sustainability plans and manage groundwater for long-term sustainability.

USGS, personal communication). The abundance of tributary-spawning LRS is likely 30 percent of what it was in 2001 (Janney and Hewitt 2018, USGS, personal communication). The total number of LRS is estimated to be less than 40,000; approximately 7,200 lakeshore spawners and approximately 32,000 tributary spawners. Individuals in this population have exceeded the average life expectancy for LRS in UKL. Meaningful recruitment[20] for LRS in UKL has not occurred since the early 1990s (Hewitt et al. 2018). A surface elevation in UKL of at least 4142.00 ft in UKL from March, April, and May has been identified as important for maintaining adequate depth along the eastern shore of UKL for spawning LRS and subsequent egg development (USFWS 2019). For larval LRS, vegetated wetland edge habitat that is inundated to at least one-foot depth is considered beneficial habitat into July. Young juvenile suckers (age 0) typically utilize diverse lake habitats in UKL. Some nearshore habitats become less abundant as lake surface elevation recedes. Older juvenile and adult suckers typically use deeper water areas in the portion of UKL north of Bare Island with a depth preference between 6.6 and 9.9 ft during late summer and fall months.

Populations in the Tule Lake Sumps are not well studied, and it is estimated that there are only several hundred suckers. Of recently Passive Integrated Transponder-tagged suckers in TLS1A, only 53, 56, and 43 LRS were detected on an antenna array in Tule Lake in 2015, 2016, and 2017, respectively (Hayes 2018, USGS, personal communication). It is unknown what percent of suckers are tagged in Tule Lake; thus, it is not possible to accurately estimate population size. Historic records suggest sucker populations in Tule Lake were among the largest in the region. Historically, Tule Lake had enormous populations of both sucker species but now likely number less than several hundred adults of both species in Tule Lake sumps (USFWS 2002a). Spawning grounds from the Tule Lake Sumps are limited to the area below Anderson Rose Dam. Spawning events are not well documented, though spawning has occurred in some years. The remaining sucker populations in TLS1A is small, isolated, and likely limited by lack of successful recruitment into the adult population (USFWS 2002a).

Shortnose sucker

The SNS, an endemic species to the Klamath Basin, is listed under ESA as an endangered species (50 Code of Federal Regulations (CFR) 17). Habitat loss, population isolation, species hybridization, poor water quality, competition and predation are several explanations for this species decline.

SNS occur in most lakes in the Upper Klamath Basin. The largest remaining population of SNS is in UKL. Between 2001 and 2016, the abundance of male SNS declined by 78 percent and the abundance of females declined 77 percent (Hewitt et al. 2018). Data from USGS summarizes that SNS have experienced declines of approximately 40 percent from 2016 to the spring of 2018(Janney and Hewitt 2018, USGS, personal communication). Individuals in this population have exceeded average life expectancy and are near the maximum known age for the species (33 years). Meaningful recruitment for SNS in UKL has not occurred since the early 1990s (Hewitt et al. 2018). For larval SNS, vegetation wetland edge habitat this is inundated to at least a one-foot depth is considered beneficial habitat into July. Later in the summer months, young juvenile

[20] Meaningful recruitment in this instance infers more recruitment than what has been observed each year in the last 20 or 30 years. Few new individuals are detected each year, often fewer than 20, and not considered (small numbers fewer than a dozen). This amount is not considered “meaningful.” to the population.

SNS (age 0) typically utilize diverse lake habitats in UKL. Older juvenile and adult SNS use deeper water areas in UKL north of Bare Island with a depth preference of 6.6 to 9.9 ft in late summer and fall months. The amount of each of these habitats can be influenced by surface elevations in UKL.

Populations in the Tule Lake sumps are not well studied, and it is estimated that there are only several hundred suckers remaining. Of recently Passive Integrated Transponder -tagged suckers in TLS1A, only 30, 30, and 24 SNS were detected in Tule Lake sumps in 2015, 2016, and 2017, respectively (Hayes 2018, USGS, personal communication). It is unknown what percent of suckers are tagged in Tule Lake sumps; thus, it is not possible to accurately estimate population size. Historic records indicate sucker populations in Tule Lake sumps were among the largest. Historically, Tule Lake had enormous populations of both sucker species but now likely number less than several hundred adults of both species in Tule Lake sumps (USFWS 2002a). Similar to LRS, the SNS population in TLS1A is small, isolated, and likely limited by lack of recruitment to adult life history stage (USFWS 2002a).

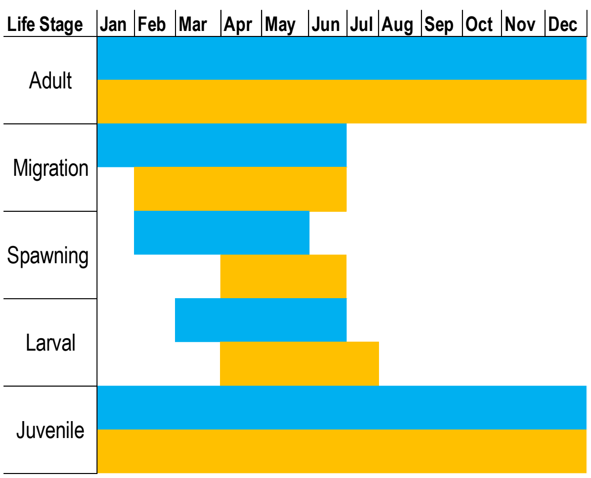

Figure 3-1. Seasonal timing of various life history stages for Lost River (blue) and shortnose (yellow) suckers.

Bull Trout

Bull trout (*Salvelinus confluentus*) are listed under the ESA as a threatened species in the Klamath River basin due to habitat isolation, loss of migratory corridors, poor water quality, and the introduction of nonnative species (USFWS 1999, 64 FR 58910). Bull trout are native to the Pacific Northwest and occurred historically throughout much of the Oregon portion of the Klamath Basin with observations in several tributaries to UKL, including Sevenmile Creek and the Wood River. The USFWS designated critical habitat for the Klamath River and Columbia River distinct population segments (DPS) of bull trout in 2002. In the Klamath Basin, USFWS revised critical habitat designation to protect foraging, migration, and overwintering habitat considered essential to re-connect isolated bull trout populations (USFWS 2010, 75 FR 63898). The three critical habitat subunits in the Klamath Basin are identified as the UKL, Sycan River, and Upper Sprague River critical habitat subunits (Reclamation 2020).

Bull trout exhibit a number of life history strategies. Stream-resident bull trout complete their entire life cycle in the tributary streams where they spawn and rear. Most bull trout are migratory, spawning in tributary streams where juvenile fish usually rear from one to four years before migrating to either a larger river (fluvial) or lake (adfluvial) where they spend their adult life, returning to the tributary stream to spawn (Fraley and Shepard 1989; Reclamation 2020).

Oregon Spotted Frog

The Oregon spotted frog (OSF) was listed as threatened under the ESA in 2014 and have historically ranged from British Columbia to the Pit River drainage in northeastern California. OSF habitat in Oregon was historically found in Deschutes, Klamath, Lane, Wasco, and Jackson counties (Reclamation 2020).

Critical habitat for OSF was designated in 2016 and includes three occupied habitat units in Klamath Basin (USFWS 2016b, 81 FR 29336). The Williamson River unit (Unit 12) consists of the Williamson River (and a tributary, Jack Creek) and seasonally wetted areas along the river in Klamath Marsh NWR to the northeast of UKL. UKL (Unit 13) includes the Wood River and its adjacent seasonally wetted areas from its headwaters downstream to the confluence with Agency Lake as well as the length of the Wood River Canal (USFWS 2016b). The Upper Klamath unit (Unit 14) consist of lakes and creeks in Jackson and Klamath counties near Buck Lake and Spencer Creek and Parsnip Lakes and seasonally wetted areas near Keene Creek (Reclamation 2020).

The UKL unit includes multiple areas in the Wood River and Sevenmile Creeks areas north of UKL. The UKL unit has all of the essential physical or biological features found within the unit but are impacted by invasive plants, woody vegetation plantings and succession, hydrological changes, and nonnative predators (USFWS 2016b).

OSF is an aquatic frog that seldom strays from areas of standing water. Upland habitat is avoided by the OSF relative to wetland habitats. OSFs are generally found in slow-moving aquatic edge habitat along streams and marshes or beaver ponds. OSFs use shallow oviposition sites consistently across their range, with average depths per site ranging from 5.9 to 25.6 cm (Reclamation 2018). This frog is often associated with submergent, floating, and low emergent vegetation, which it uses for basking sites and escape cover. Springs and spring-fed stream reaches are likely overwintering sites and may be a key habitat component (Reclamation 2020).

During the breeding season (February through May), OSF prefer sedge-dominated and sedge/rush mix (*Carex* spp. and *Juncus* spp.) wetland vegetation for oviposition. Adults are thought to return to the same general breeding location across years, although actual locations of eggs shift within these regularly used areas based on water depth at the time of breeding.

Applegate's Milkvetch

Applegate's milkvetch was federally listed as endangered without critical habitat in 1993 with a USFWS recovery plan for Applegate's milkvetch published in 1998 (Reclamation 2020).

Applegate's milkvetch is a slender, low growing, vine-like herbaceous perennial plant in the Fabaceae (pea) family. The plant's physical appearance is characterized with multiple sprawling stems 12 to 36 inches long and small white to light pink to lavender pea-like flowers, measuring up to 7mm (0.3 inch) with flowers present from June to September. Plants produce 0.3- to 0.5-inch seed pods during June and July and are widely spreading or declined (Reclamation 2020).

Applegate's milkvetch is a narrowly distributed endemic plant known to occur only in southern Klamath County, Oregon, with currently 8 occupied sites located within 13 miles of the city of Klamath Falls. Applegate's milkvetch was believed extinct up until its re-discovery in 1983. Populations today are known to primarily colonize three large sites; however, presence has also been documented at several smaller sites south of Klamath Falls, Oregon. Urban development, agriculture, weeds, fire suppression, flood control and land reclamation have contributed to the decline of this species (Reclamation 2020).

3.2.2 Lower Klamath Basin/Klamath River Federally Protected Species

Several anadromous (migratory) fish species use the Klamath River to complete their life cycles (Reclamation 2012). These species are also listed under the ESA and/or considered for evaluation under the Magnuson-Stevens Fishery Conservation and Management Act Public Law 94-265, as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (P.L. 109-479) (MSA or Magnuson-Stevens Act). The SONCC coho salmon; threatened under the ESA/evaluated under MSA in an Essential Fish Habitat (EFH) assessment, (*see Section 5.3*), Southern DPS Eulachon (*Thaleichthys pacificus*; threatened under ESA), Southern DPS Green sturgeon (*Acipenser medirostris*; threatened under ESA), SRKW DPS (*Orcinus orca*; endangered under the ESA), and Chinook salmon (*Oncorhynchus tshawytscha*; evaluated under MSA EFH) are the species in the Lower Klamath Basin considered in this EA. For these species, greater detail on life history timing is below.

Coho Salmon

Adult coho salmon are anadromous and semelparous[21], most commonly having a 3-year life cycle, although it can vary. This life cycle is characterized by the first 14 to 18 months spent in freshwater, followed by ocean residence, and a return to freshwater to spawn (Table 3-1; Sandercock 1991; Quinn 2005). Coho generally spend between 16 and 20 months rearing in the marine environment, though some early-maturing males may only rear for one year. Adult coho salmon migrate into the Klamath River in September, with peak migration in mid-October (Ackerman et al. 2006). Upon entry into the Klamath River estuary, adult coho salmon quickly migrate upstream, without extensive estuarine residence. Most spawning occurs in large tributaries such as the Scott, Shasta, and Trinity Rivers, as well as some higher order tributaries from November through January, most often during relatively high fall flows (Koski 1966).

Within the Klamath River Basin, fry begin emerging in mid-February and continue through mid-May (Leidy and Leidy 1984). After emergence from spawning gravels, coho salmon fry distribute themselves upstream and downstream, seeking favorable rearing habitat (Sandercock 1991), including slower velocities, cool water temperatures, and in-stream cover such as large woody debris (Nielsen 1992; Hardy et al. 2006). Juvenile coho salmon in the Klamath Basin redistribute to suitable habitat in the spring, summer, and fall (Lestelle 2010; Sutton and Soto 2012; Soto et al. 2016; Manhard et al. 2018). Juvenile coho begin downstream migration as smolts between February and June, the timing of which is a response to fish-size, flow

[21] Salmonids which are semelparous experience a single reproductive episode before death.

conditions, water temperature, DO, photoperiod,[22] and food availability (Shapovalov and Taft 1954).

Coho salmon populations in the Klamath River Basin are severely reduced from historic levels. Ten SONCC coho salmon populations in the Klamath River Evolutionary Significant Unit (ESU) are at high risk of extinction because they are below, or likely below, their depensation[23] threshold (NMFS 2016). The number of adult coho successfully reaching major spawning areas in the Shasta and Scott rivers has been variable during recent years and appear to be declining, with only 39 and 739 adult coho, respectively, being observed in 2018 (Giudice and Knechtle 2019; Knechtle and Giudice 2019). The Middle Klamath River, Scott River, and Upper Trinity River populations are classified at a “moderate” risk of extinction. Populations that are under depensation have increased likelihood of being extirpated, and because the population abundance of most independent populations are below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is currently not viable (NMFS 2014).

Several factors influence survival and population viability throughout the coho life cycle. Marine survival is a major source of mortality and is influenced by a number of interacting factors including ocean conditions (Wainwright and Weitkamp 2013; Peterson et al. 2017), prey availability (Daly et al. 2009), predator abundance (Emmett et al. 2006), degree of intra-specific competition (including hatchery fish) (King and Beamish 2000; Malick et al. 2009), and sport and commercial fisheries (Pacific Fishery Management Council (PFMC) 2020). The relative importance of these factors is directly affected by ocean conditions (NRC 2004). Increased water temperatures directly impact survival at most life-stages of coho via heat stress, changes in growth and development rates, and lowering resistance to disease (NMFS 2016).

Disease is another factor influencing coho salmon populations in the Klamath River Basin. The native parasite *C. shasta* is of particular concern because it can be fatal to salmonids. High infection rates of *C. shasta* have been linked to declines in salmonid populations (Hillemeier et al. 2017). The *C. shasta* life cycle includes the salmon and annelid worm host. The annelid is attached to the streambed substrate.

Table 3-1. Life-history of coho salmon in the Klamath River Basin downstream of Iron Gate Dam. Peak activities are indicated in black. Source: (Stillwater Sciences 2009; Reclamation 2016).

Life stage (citations)	**Jan**	**Jan**	**Feb**	**Feb**	**Mar**	**Mar**	**Apr**	**Apr**	**May**	**May**	**Jun**	**Jun**	**Jul**	**Jul**	**Aug**	**Aug**	**Sep**	**Sep**	**Oct**	**Oct**	**Nov**	**Nov**	**Dec**	**Dec**
Incubation																								
Emergence [1, 2, 3]																								
Rearing [4]																								

[22] Photoperiod is defined as the duration of time in a 24-hour period that an organism is exposed to daylight.
[23] In Population dynamics, “depensation” is the effect on a population (such as fish stock) whereby, due to certain causes, a decrease in the breeding population (mature individuals) leads to reduced production and survival of individuals or offspring.

Life stage (citations)	Jan	Jan	Feb	Feb	Mar	Mar	Apr	Apr	May	May	Jun	Jun	Jul	Jul	Aug	Aug	Sep	Sep	Oct	Oct	Nov	Nov	Dec	Dec
Juvenile redistribution [5]																								
Juvenile outmigration [6, 7, 8, 9, 10]																								
Adult migration [9]																								
Spawning [9, 11]																								

[1] CDFG (2000, unpubl. data as cited in NRC 2004), [2] CDFG (2001, unpubl. data as cited in NRC 2004); [3] CDFG (2002, unpubl. data as cited in NRC 2004); [4] Sandercock (1991), [5] T. Soto, Fisheries Biologist, Yurok Tribe, pers. comm., August 2008; [6] Scheiff et al. (2001); [7] Chesney and Yokel (2003), [8] T. Shaw (USFWS, unpubl. data, 2002, as cited in NRC (2004); [9] NRC (2004); [10] Wallace (2004); [11] Maurer (2002)

Eulachon, Southern Distinct Population Segment

In the Klamath River, eulachon were once abundant, but have declined to the point where detecting them has become difficult (NMFS 2010). There have been no long-term monitoring programs targeting eulachon, making estimates of historical abundance and abundance trends difficult to generate (Gustafson et al. 2008).

Green Sturgeon, Southern Distinct Population Segment

Both southern and northern DPS of Green sturgeon are present within the Klamath River Basin downstream of IGD, only the southern DPS is ESA-listed. Where information is lacking, information on the northern DPS green sturgeon is used to describe southern DPS green sturgeon in the Klamath River. Using Klamath River tribal fishery harvest data for green sturgeon and assuming that adults represent 10 percent of the population at equilibrium, the Klamath green sturgeon population (Northern DPS) estimate is <20,000 individuals (Reclamation 2008). Furthermore, the number of individuals in the Southern DPS is approximately 15,000 individuals, or somewhat smaller than the estimate for the Klamath population (northern DPS), both likely less than historic levels. Life history timing for green sturgeon in the Klamath River are provided in Table 3-2 (Stillwater Sciences 2009).

Table 3-2. Life-history of green sturgeon in the Klamath River Basin downstream of Iron Gate Dam. Peak activities are indicated in black. Source: (Stillwater Sciences 2009; Reclamation 2016)

Life stage (citations)	Jan	Jan	Feb	Feb	Mar	Mar	Apr	Apr	May	May	Jun	Jun	Jul	Jul	Aug	Aug	Sep	Sep	Oct	Oct	Nov	Nov	Dec	Dec
Incubation/ emergence [1]																								
Rearing [1, 2, 3]																								
Juvenile outmigration [4, 5, 6, 7, 8]																								

Life stage (citations)	Jan	Jan	Feb	Feb	Mar	Mar	Apr	Apr	May	May	Jun	Jun	Jul	Jul	Aug	Aug	Sep	Sep	Oct	Oct	Nov	Nov	Dec	Dec
Adult migration [1, 2, 9, 10, 11, 12, 13]																								
Spawning [2, 3, 4, 13]																								
Post-spawning adult holding [13]																								

[1] CALFED ERP (2007), [2] NRC (2004), [3] FERC (2006), [4] Emmett et al. (1991, as cited in CALFED ERP 2007), [5] CH2M Hill (1985), [6] Hardy and Addley (2001), [7] Scheiff et al. (2001), [8] Belchik (2005, as cited in CALFED ERP 2007), [9] KRBFTF (1991), [10] Moyle (2002), [11] Pacificorp (2004), [12] Van Eenennaam et al (2006), [13] Benson et al (2007).

Chinook Salmon

Spring-run Chinook salmon in the Klamath Basin are distributed mostly in the Salmon and Trinity rivers and in the mainstem below these tributaries only during migratory periods, although a few fish are occasionally observed in other areas (Stillwater Sciences 2009). Spring-run Chinook salmon adults spawn from mid-September to late-October in the Salmon River and from September through early November in the South Fork Trinity River (Stillwater Sciences 2009). Fry emergence takes place from March and continues until early-June (West et al. 1990). There appears to be three juvenile life-history types for spring-run Chinook salmon in the Klamath Basin: Type I (ocean entry at age 0 in early spring within a few months of emergence); Type II (ocean entry at age 0 in fall or early winter) (Olson 1996); and Type III (ocean entry at age 1 in spring) (Sullivan 1989). Spawning, incubation, rearing, and smolting habitat characteristics for spring-run Chinook salmon are similar to fall-run Chinook salmon.

Fall-run Chinook salmon are distributed throughout the Klamath River downstream of IGD and spawn later in the year in the mainstem as well as in several tributaries. Adult upstream migration through the estuary and lower Klamath River peaks in early September and continues through late October (Moyle 2002; FERC 2007; Strange 2010). Spawning peaks in late October and early November. Fall-run Chinook salmon fry in the Klamath River emerge from redds between December and late February (Reclamation 2011). Fall-run Chinook salmon in the Klamath Basin exhibit three juvenile life-history types: Type I (ocean entry at age 0 in early spring within a few months of emergence), Type II (ocean entry at age 0 in fall or early winter), and Type III (ocean entry at age 1 in spring) (Sullivan 1989).

Wild spring-run Chinook salmon populations are reportedly a remnant of their historical abundance and primarily occur in the South Fork Trinity River and Salmon River Basins (NMFS 2011), with returns below 1,000 fish. NMFS (2011) indicates fall run Chinook in the last several decades have ranged from below 50,000 to 225,000 fish. Naturally produced (i.e., non-hatchery) smolt production is largely unknown but has also dropped due to the decline in wild adult Chinook salmon runs over the last several decades. Oregon considers Klamath Chinook as “extinct” or “extirpated” because they are no longer present in the upper basin. California considers the spring-run Chinook salmon as a candidate endangered species

Southern Resident Killer Whale

The SRKW DPS consist of three pods (identified as J, K, and L pods) which reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall, pods visit coastal sites off Washington and Vancouver Island and are known to travel as far south as central California and as far north as Southeast Alaska (Ford et al. 2000). A primary food source for SRKW includes Klamath River salmon with the largest component of their diet being fall run Chinook salmon. Ward et al. (2013) considered new stock-specific Chinook salmon indices and found strong correlations between the indices of Chinook salmon abundance, such as the West Coast Vancouver Island used by the Pacific Salmon Commission, and killer whale demographic rates. However, no single stock or group of stocks was identified as being most correlated with the whales' demographic rates. Further, they stress that the relative importance of specific stocks to the whales likely changes over time (Ward et al. 2013)

Current understanding is that the SRKW population has declined to the lowest levels seen in over 30 years. Oleisuk et al (1990). Since censuses began in 1974, J and K pods have steadily increased their sizes. However, the population suffered an almost 20 percent decline from 1995-2001 (from 98 whales in 1995 to 81 whales in 2001), largely driven by lower survival rates in L pod. The overall population had increased slightly from 2002 to 2010 (from 83 whales to 86 whales). During an international science panel review of the effects of salmon fisheries (Hilborn et al. 2012), the panel stated that during 1974 to 2011, the population experienced a realized growth rate of 0.71 percent, from 67 individuals to 87 individuals. In 2014 and 2015, there was a return to normal recruitment (a normal population has 5 percent calves of the year in the SRKWs population that was the result of multiple successful pregnancies that occurred in 2013 and 2014. However, as of July 2019, the population has decreased to only 73 whales, a historical low in the last 30 years. This conflicts with projections by the science panel of population increase, and Lacy et al. (2017), of slow decline to 75 by 2015, emphasizing the relevance of shifting baselines to understanding the status of the population (Reclamation 2020). There were 22 whales in J pod, 18 whales in K pod and 34 whales in L pod at the end of 2018 (Reclamation 2020).

3.2.3 Other Fish and Wildlife Species (Non-Endangered Species Act Listed)

The Project area is home to a large number of wildlife species with great diversity. Previous surveys have identified more than 200 vertebrate species, including amphibians, reptiles, mammals, and birds. Appendix B lists the species that may be present within the geographic scope of both alternatives (Reclamation and CDFW 2012).

Of specific note is the presence of bald eagles (*Haliaeetus leucocephalus)* in the Upper Klamath Basin. USFWS (2016a) notes that due to the relatively mild winters and abundant food resources, the Upper Klamath Basin attracts the largest wintering population of bald eagles in the U.S. outside of Alaska. Starting in November, eagles begin arriving with the peak of populations occurring in February. Areas of Lower Klamath and Tule Lake are known to serve as communal night roosts.

3.2.4 Wetland and Riparian Areas

Upper Klamath Lake and Upper Klamath National Wildlife Refuge
Upper Klamath National Wildlife Refuge (UKNWR) is comprised of 24,762 acres divided into three units: Hanks Marsh (approximately 1,191 acres), Upper Klamath Marsh (approximately 13,775 acres), and the Barnes-Agency Unit (approximately 9,796 acres). Wetlands in UKNWR constitute some of the last remnant marshes adjacent to UKL, and are dominated by emergent plant species including sedges, wocus, hardstem bulrush, cattail, and willow. The Agency-Barnes Unit, which is surrounded by remnant dikes, is comprised primarily of wet meadow with interspersed marshy areas. Wetlands in the other two units, which are not diked, are generally flooded when UKL water levels are above 4,139.5 ft in elevation (USFWS 2016a).

UKNWR serves as an important breeding ground for several species of diving ducks, including canvasback, redheads, and ringnecks, and as a staging area for migratory waterfowl of the Pacific Flyway. UKNWR also represents one of the few remaining nesting areas for American pelicans in the western U.S. A number of species of waterbirds also use UKNWR as a nesting area. Klamath Basin redband trout rely upon wetlands and adjacent creeks within UKNWR as a spawning ground and for a thermal refugia in the summer (USFWS 2016a).

Link and Klamath Rivers and the Hydropower Reach
There are riparian wetland areas of varying sizes within the existing floodplain of the Link and Klamath rivers. The National Wetland Inventory, as well as more site-specific data (e.g., (Forney et al. 2013; KRRC 2017, 2018), describe the floodplain vegetation along the Link and Klamath Rivers (down to the lower Klamath River below IGD) as ribbons of emergent wetlands (dominated by hardstem bulrush, cattail, sedges, and rushes) along the shorelines of the reservoirs and mixed with forested/shrub wetlands on the slopes beyond the Klamath River.

Several different associations are present including Klamath mixed conifer forest dominated by ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), and black oak (*Quercus kelloggii*). On drier slopes, such as those along Copco No. 1 and No. 2, the reservoir shorelines are dominated by Oregon oak (*Quercus garryana*) and western juniper (*Juniperus occidentalis*). Other communities include coyote willow (*Salix exigua*), red and white alder (*Alnus rubra, A. rhombifolia*), Fremont's and black cottonwoods (*Populus fremontii, P. trichocarpa*), bigleaf maple (*Acer macrophyllum*), and reed canarygrass (*Phalaris arundinacea*).

Lower Klamath National Wildlife Refuge
LKNWR occupies 51,247 acres within and surrounding the former bed of Lower Klamath Lake, on the border between Oregon and California. Of the total area, approximately 24,000 acres is wetland habitat, with range/pasture lands and croplands comprising the remainder. Through dikes and other improvements, LKNWR is divided into a number of smaller units, ranging from 63 acres to over 4,000 acres, which can be managed to produce a variety of vegetative communities, which in turn provide food resources and habitat for wildlife, particularly for waterfowl and other migratory birds (USFWS 2016a).

LKNWR has historically received water primarily from three sources – Tule Lake Sumps, Klamath River, and UKL. Water from the Tule Lake Sumps is pumped via Pumping Plant D and the Tule Lake Tunnel and then delivered to various units on the eastern side of the refuge through the P Canal system. As discussed previously in part 3.1.1.4, in recent years, deliveries to LKNWR from the Tule Lake Sumps via Pumping Plant D have dramatically decreased. As a result, LKNWR has increasingly become dependent on water from the Klamath River and UKL to maintain wetland areas and provide adequate habitat for migratory waterfowl. Water from the Klamath River and UKL is delivered to LKNWR via the Ady Canal, into Unit 2, on the west side of the refuge (*see map in Appendix A*). Deliveries to LKNWR via the Ady Canal began in 1950 and over the next half century, averaged approximately 16,000 AF annually, ranging from 900 AF (1965) to 38,500 AF (1994). Since 2001, Ady Canal deliveries to LKNWR have averaged 24,500 AF, ranging from 4,600 AF (2015) and 39,900 (2002). In recent years, constraints on water supplies from UKL and the Klamath River have prevented USFWS from making up for the decline in Pumping Plant D discharges, resulting in frequent water shortages for LKNWR (USFWS 2016a)

Wetland areas within LKNWR consist of permanently flooded wetlands (up to 10,000 acres) and seasonally flooded wetlands (up to 16,000 acres). Seasonally flooded wetlands are characterized by a partial flooding regime of at least six months, of which two months occur during the growing season. Vegetation in both wetland areas is composed of emergent vegetation consisting primarily of hardstem bulrush and cattail. Submergent vegetation, predominantly sago pondweed, is also a key characteristic of these shallowly flooded wetland areas (USFWS 2016a).

LKNWR supports one of the densest breeding populations of waterfowl in the NWR system across the U.S., producing between 30,000 and 60,000 waterfowl annually. A variety of colonial waterbirds, such as white pelicans, double-breasted cormorants, great blue herons, and eared and western grebes, also nest in LKNWR (USFWS 2016a). Additionally, LKNWR also hosts the highest number of migrating waterfowl within the Klamath Basin Refuge Complex, through which 80 percent of the birds in the Pacific Flyway pass each spring and summer. Permanently flooded areas also serve a critical role for molting waterfowl during the summer, when the birds are flightless for several weeks. The submergent plant community in wetlands, and the fish, invertebrates, and amphibians it supports, are the primary food source for migrating birds, along with grain and other crops produced on the surrounding agricultural lands (USFWS 2016a).

Tule Lake National Wildlife Refuge (Tule Lake Sumps 1A and 1B)

TLNWR comprises 39,116 acres in Siskiyou and Modoc counties, California, encompassing the reclaimed lands from the historic Tule Lake. The refuge consists of two open water sumps (Sump 1A and 1B) (totaling 13,000 acres), surrounded by cropland and upland areas. Sumps 1A and 1B receive water from the Lost River, agricultural return flows, and precipitation. Return flows constitute the largest source of the water, occurring primarily during the spring/summer irrigation season. Water is diverted from the sumps for agricultural purposes on surrounding croplands, and pumped from the sumps for flood control purposes via Pumping Plant D.

Water surface elevations in the Sumps are managed by TID, consistent with operating criteria established by Reclamation, including minimum elevations required under the ESA. Water surface elevations in the Sumps can be operated between 4,034.0 and 4,035.5 ft. At the lower elevation, the combined storage capacity of TLS1A and 1B ranges between approximately 23,000 AF (at 4,034.0 ft) and 41,000 AF (at 4,035.5), with TLS1A comprising approximately 70 percent of this volume.

TLS1A and 1B consist of a combination of permanently flooded wetlands and open water with submerged vegetation. Vegetation is dominated by emergent plants, such as hardstem bullrush and cattail, and submerged plants, such as sago pondweed. Plant diversity is lower in Sumps 1A and 1B compared to wetland areas in LKNWR; however, these areas provide an important food source and habitat for breeding and migrating waterfowl. The sumps support a substantial population of breeding waterfowl (5,000 ducks on average), and during the late summer, they become a focal point for molting waterfowl, hosting between 50,000 and 100,000 flightless birds that use emergent wetland vegetation for cover and protection (USFWS 2016a).

3.2.5 Migratory Birds

The USFWS manages the NWRs, as part of the Klamath Basin Refuge Complex, in accordance with the National Wildlife Refuge System Improvement Act of 1997 (Pub. L. 105-57, 16 U.S.C. §668dd) and other federal laws and regulations including the Migratory Bird Treaty Act (codified as 16 U.S.C. 703-712). The NWRs within the geographic scope of the Proposed Action Alternative, as part of the Klamath Basin Refuge Complex, are internationally known for their great abundance and diversity of birdlife, particularly migratory birds. These refuges (primarily the LKNWR and the TLNWR) support numerous fish and wildlife species and provide habitat and resources for migratory birds with refuges situated on a major Pacific Flyway migration corridor between breeding grounds in the north and wintering grounds in the south. Approximately 80 percent of the migrating waterfowl on the Pacific Flyway come through the Klamath Basin on both spring and fall migrations (Reclamation 2020). Migratory birds that pass through these NWRs include waterfowl, shorebirds, gulls, terns, cranes, rails, herons, grebes, egrets, songbirds, and raptors (USFWS 2016a).

Over the long term, waterfowl abundance (birds per day) in the Klamath Basin Refuge Complex averaged about one million birds in the fall and 360,000 in the spring, with the majority of these birds in Lower Klamath and Tule Lake NWRs (USFWS 2016a). Population numbers of waterfowl have fluctuated. After record levels in the 1950s and early 1960s, there was a period of decline into the 1980s. A gradual recovery occurred in the 1990s, but since 2000, there has been a decline in total waterfowl abundance in the autumn, likely because of reduced diversity and productivity of wetland areas within the refuges (USFWS 2016a). In addition to the spring and fall migration, waterfowl and other migratory birds utilize the NWRs for breeding and molting during the summer.

Due to the relatively mild winters and abundant food resources, the Upper Klamath Basin also attracts the largest wintering population of bald eagles (*Haliaeetus leucocephalus)* in the U.S. outside of Alaska. Starting in November, eagles (bald and golden (*Aquila chrysaetos)* begin arriving with the peak of populations occurring in February. Protected under the Bald and Golden Eagle Protection Act (Eagle Act, 16 U.S.C. 668a-668d) eagles use areas of Lower Klamath and Tule Lake NWRs as communal night roosts.

3.3 Recreation

The recreational setting within the entire Klamath River watershed is characterized by an expansive rural landscape that offers a myriad of outdoor recreational opportunities (Reclamation and CDFW 2012). Within the geographic scope of the Proposed Action

Alternative there are three national forests (Klamath, Rogue River-Siskiyou, Six Rivers), one joint national and state park (Redwood), and four NWRs (*see Section 1.2).* The area of analysis (*see Appendix A*) of the alternatives includes recreation areas along the Klamath River from its headwaters in Oregon at UKL to the mouth of the river at the Pacific Ocean (Reclamation and CDFW 2012). Generally, fishing, rafting, camping, hunting, birdwatching, photography, and use of recreational trails are common throughout the geographic scope of both alternatives, with fishing, boating, hiking, biking, and whitewater boating opportunities available throughout the entire Klamath River Basin.

As described in Section 3.1.1.3, the portion of the Klamath River from the J.C. Boyle Powerhouse to the California-Oregon State border is classified under the WSRA as *scenic* with one of the "outstandingly remarkable" categories identified as recreation and the portion of the Klamath River in California, 3,600 ft below IGD to the Pacific Ocean (250 miles), is designated as *recreational* with "outstandingly remarkable" fisheries values (Reclamation and CDFG 2012).

3.4 Land Use

The Proposed Action Alternative area, shown in Appendix A, includes portions of Klamath County in Oregon and Siskiyou, Modoc, Humboldt, and Del Norte counties in California. Land use in the Proposed Action Alternative area is dominated by agriculture (e.g., farming and ranching) and forestry; municipal and industrial land uses are minor. The largest urban areas are Klamath Falls and Eureka.

Counties

Klamath County, Oregon

Klamath County is in south-central Oregon. The county is bordered on the south by the State of California, on the east by Lake County, on the north by Deschutes County, and on the west by Jackson and Douglas counties. The county, Oregon's fourth largest, covers 6,135 square miles. Klamath County was home to about 67,653 people in 2018, with about 21,359 of those people residing in the city limits of Klamath Falls (U.S. Census Bureau 2019a). Approximately 73 percent of the county is managed by federal and state agencies, including USFWS, National Park Service, the Bureau of Land Management, and the Oregon Department of State Lands (Reclamation and CDFG 2012).

Siskiyou County, California

Siskiyou County is in inland northern California, adjacent to the Oregon border. It is the fifth largest county in the state, with an area of approximately 6,340 square miles and a population in 2018 of 43,724 (U.S. Census Bureau 2019a). The largest urban population in Siskiyou County resides in Yreka, with a population of 7,600 (U.S. Census Bureau 2019a). More than 60 percent of the County is managed by federal and state agencies, including the U.S. Forest Service, Bureau of Land Management, the USFWS, and California Department of Fish and Wildlife. These lands are maintained in various National Forests, Parks, Wilderness Areas, National Grasslands, NWRs, other public lands and State Wildlife Areas (Reclamation and CDFG 2012). Part of the Tule Lake NWR and the Project is in eastern Siskiyou County.

Modoc County, California

Modoc County is just east of Siskiyou County in the northeastern corner of California, where it borders Oregon to the north and Nevada to the east. The county is 4,203 square miles and in 2018 had approximately 8,777 residents (U.S. Census Bureau 2019a); the largest urban population in the county resides in Alturas, population 2,827 (U.S. Census Bureau 2019a). Almost 70 percent of the county is federally owned in the Modoc National Forest, the Modoc National Wildlife Refuge and TLNWR, and Bureau of Land Management. Approximately 29 percent of the county is in private ownership. Part of the Tule Lake NWR and the Project is in western Modoc County (Reclamation and CDFG 2012).

Humboldt County, California

Humboldt County lies along the northern coast of California, bounded by Del Norte County on the north, Siskiyou and Trinity counties on the east, and Mendocino County on the south. The county covers 4,052 square miles and in 2018 had a population of 136,373 (U.S. Census Bureau 2019a). The largest urban area is Eureka, the county seat, with a 2017 population of 27,177 (U.S. Census Bureau 2019a). About 28 percent of the county is in public ownership; the Yurok and Hoopa tribal lands occupy about 5.6% of the land area of the county. Timberlands are the cornerstone of the Humboldt County economy (Humboldt County 2017). The Proposed Action Alternative area within Humboldt County consists of the Klamath River corridor.

Del Norte County, California

Del Norte County is the northernmost county on the California coast, bordered by Oregon on the north, Siskiyou County on the east, and Humboldt County on the south. The county covers 1,230 square miles and in 2018 had a population of 27,828 (U.S. Census Bureau 2019a). The largest urban area is Crescent City, the county seat, with a 2017 population of 6,399 (U.S. Census Bureau 2019a). The Proposed Action Alternative area within Del Norte County consists of the Klamath River corridor.

Table 3-3 shows the relative distribution of land use within the five-county area (U.S. Department of Agriculture (USDA) 2012). Pastureland predominates in all counties except Del Norte, where cropland dominates. Cropland is the second-most widespread land use in the five counties containing the Project.

Table 3-3. Land use distribution in the five-county Proposed Action Alternative area. Source: (U.S. Department of Agriculture (USDA) 2012)

Land Use	Klamath	Siskiyou	Modoc	Humboldt	Del Norte
Pastureland	56.1%	48.7%	60.6%	62.8%	38.5%
Cropland	31.5%	27.0%	29.6%	-0-	41.9%
Woodland	9.3%	15.2%	5.5%	30.5%	10.8%
Other Uses*	3.0%	9.1%	4.3%	6.6%	8.8%

*Land not classified as cropland, pastureland, or woodland.

Between 2014 and 2018, an average of 180,000 acres were irrigated and harvested within the Project (*Table 3-4*). Approximately 46 percent of the land is used to grow animal feed in the form of alfalfa and pasture; about 26 percent is non-agricultural land (wetland and other) or idle; about 15 percent grows wheat and other small grains. The remaining 13 percent of land in active production is used to grow high valued potatoes, onions, peppermint, and other specialty crops.

Table 3-4. Project Irrigated Acres by Aggregate Crop within the Project.

Crop	2014	2015	2016	2017	2018	5-Year Average
Alfalfa Hay	54,990	54,215	59,849	64,636	65,471	59,832
Small Grain	42,480	37,740	50,297	48,588	46,266	45,074
Wetlands	42,488	39,567	45,651	49,157	40,018	43,376
Irrigated Pasture	33,823	28,021	37,962	44,034	41,322	37,032
Fallow/Idle	26,144	36,993	4,663	4,340	11,375	16,703
Other Hay	15,605	17,667	18,529	11,292	10,408	14,700
Potatoes	12,533	18,643	13,254	12,561	11,697	13,738
Other	5,082	2,636	5,805	4,871	5,972	4,873
Onions	2,949	2,523	2,817	2,508	3,471	2,854
Peppermint	2,474	2,421	2,420	2,272	2,167	2,351
Total	238,568	240,426	241,247	244,259	238,167	240,533
Alfalfa %	23%	23%	25%	26%	27%	25%
Other Hay %	7%	7%	8%	5%	4%	6%
Irrigated Pasture %	14%	12%	16%	18%	17%	15%
Small Grain %	14%	12%	16%	18%	17%	15%
Potatoes %	5%	8%	5%	5%	5%	6%
Peppermint %	1%	1%	1%	1%	1%	1%
Onion %	5%	8%	5%	5%	5%	6%
Fallow/Idle %	11%	15%	2%	2%	5%	7%
Wetland %	18%	16%	19%	20%	17%	18%
Other %	2%	1%	2%	2%	3%	2%

Comprehensive Conservation Plan

As discussed in Section 1.4.3, USFWS has developed the CCP for Federal lands within Lower Klamath, Clear Lake, Tule Lake, Upper Klamath, and Bear Valley NWRs[24], which together comprise the Klamath Basin Refuge Complex. The CCP provides a comprehensive 15-year management plan for the Refuge Complex, consistent with refuge purposes and applicable laws, regulations, and policies, the CCP describes and governs land management functions.

3.5 Socioeconomic Resources

This section describes regional socioeconomic conditions and information for the specific economic sectors within the geographic scope of this analysis.

The study area includes five counties: Klamath County, Oregon, and Siskiyou, Modoc, Humboldt, and Del Norte counties in California. In general, the action area has had a relatively stable population over the last decade (averaging 282,500, *Table 3-5.*), has a higher percentage of

[24] Bear Valley and Clear Lake NWRs are described in the CCP. Neither refuge is discussed in this EA because Bear Valley NWR is outside the geographic scope of analysis and Reclamation's Proposed operations for Clear Lake Reservoir are not altered from the No Action Alternative.

farm jobs compared to the two states as a whole (*Table 3-7.*), and has a relatively diversified industry base that has seen little change in the past five years (*Table 3-7. and Table 3-8.*).

Table 3-5. Proposed Action Alternative Study Area Population by County (thousands of persons).

Year	Klamath	Siskiyou	Modoc	Humboldt	Del Norte	Total
2018	67.6	43.7	8.8	136.4	27.8	284.3
2017	66.9	43.8	8.8	136.8	27.5	283.8
2016	66.3	43.5	8.9	136.4	27.5	282.6
2015	65.8	43.3	9.1	135.2	27.3	280.7
2014	65.4	43.4	9.1	134.6	27.2	279.7
2013	65.7	43.5	9.1	134.4	27.8	280.5
2012	65.9	44.1	9.4	134.6	28.2	282.2
2011	66.3	44.6	9.5	135.2	28.4	284.0
2010	66.3	44.9	9.7	135.0	28.6	284.5

Source: (U.S. Census Bureau 2019b), Annual Estimates of the Resident Population April 1, 2010 to July 1, 2018.

With the exception of Humboldt County, unemployment in the five-county action area is consistently higher than the respective state unemployment rate (Table 3-6.). For example, in 2019 the unemployment rate in Klamath County was 6.6 percent, compared to Oregon’s unemployment rate of 3.8 percent, or 174 percent of Oregon’s rate. Unemployment rates in the remaining four counties generally are within one to two points of each other. For example, in 2019 the unemployment rate in Klamath, Siskiyou, Modoc, and Del Norte counties ranged from 7.2 percent (Modoc County) to 5.7 percent (Del Norte).

About 80 percent of employment in the five-county area is supported by private (both nonfarm and farm) employment (Table 3-7.). Approximately five percent of all private industry jobs are farm jobs, a trend that has been relatively steady over the period 2013-2017.

Table 3-6. Proposed Action Alternative Study Area Unemployment Rate by County and State (percent), 2008-2017.

Year	Klamath	Siskiyou	Modoc	Humboldt	Del Norte	Oregon	California	Klamath relative to Oregon (%)	Siskiyou relative to California (%)	Modoc relative to California (%)	Humboldt relative to California (%)	Del Norte relative to California (%)
2019	6.6	6.5	7.2	3.6	5.7	3.8	4.1	174%	159%	176%	88%	139%
2018	6.4	6.7	7.6	3.6	5.5	4.1	4.3	156%	156%	177%	84%	128%
2017	5.9	8.5	7.8	4.2	6.4	4.1	4.8	144%	177%	163%	88%	133%
2016	6.7	8.5	7.8	4.9	7.5	4.8	5.5	140%	155%	142%	89%	136%
2015	7.8	8.6	9.4	5.6	8.5	5.6	6.2	139%	139%	152%	90%	137%
2014	9.3	11.1	10.3	6.7	10.1	6.8	7.5	137%	148%	137%	89%	135%
2013	10.8	13.1	12.3	8.1	11.8	7.9	8.9	137%	147%	138%	91%	133%
2012	11.7	15.6	14.4	9.6	13.5	8.8	10.4	133%	150%	138%	92%	130%
2011	12	17	16	10.6	13.3	9.5	11.7	126%	145%	137%	91%	114%
2010	12.9	16.8	15.2	10.6	13.2	10.6	12.2	122%	138%	125%	87%	108%
2009	14.1	14.2	12.1	10.7	11.8	11.2	11.3	126%	126%	107%	95%	104%
2008	9.2	10.2	9.7	7.3	8.8	6.5	7.3	142%	140%	133%	100%	121%

Sources:(U.S. Bureau of Labor Statistics n.d.), Local Area Unemployment Statistics

Table 3-7. Employment by Farm and Non-farm Industry Type in the Five-County Proposed Action Alternative area 2013-2018.

Industry Type	Unit of Measure	2013	2014	2015	2016	2017	2018
Five-County Total							
Private nonfarm employment	000s jobs	100.6	102.1	103.2	104.7	106.9	108.9
Percent of Total	*Percent*	*76%*	*76%*	*76%*	*76%*	*76%*	*76%*
Farm employment	000s jobs	5.0	5.0	4.9	5.0	5.1	5.1
Percent of Total	*Percent*	*4%*	*4%*	*4%*	*4%*	*4%*	*4%*
Government	**000s jobs**	26.9	27.0	27.7	28.6	28.3	28.7
Percent of Total	***Percent***	*20%*	*20%*	*20%*	*21%*	*20%*	*20%*
Total	**000s jobs**	132.5	134.1	135.9	138.4	140.3	142.7
Two-State Total							
Private nonfarm employment	000s jobs	20,410.2	21,097.3	21,801.0	22,282.8	22,758.0	23,397.9
Percent of Total	*Percent*	*87%*	*87%*	*87%*	*87%*	*87%*	*87%*
Farm employment	000s jobs	293.1	305.3	299.8	296.2	297.7	304.5
Percent of Total	*Percent*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
Government	**000s jobs**	2,876.5	2,917.6	2,976.3	3,036.3	3,076.9	3,098.1
Percent of Total	***Percent***	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*
Total	**000s jobs**	23,579.7	24,320.2	25,077.1	25,615.3	26,132.5	26,800.6

Source: (U.S. Bureau of Economic Analysis n.d.) Regional Data, Gross Domestic Product and Personal Income, Total Full-time and Part-time Employment by NAICS Industry.

Non-government employment in the five-county area has grown by about 5.9 percent over the last five years, ranging between 132.5 thousand jobs and 140.3 thousand jobs (*Table*

3-8.). Comparing 2013 to 2018, there has been little change in employment, except for management of companies, which rose 133 percent. Quantitatively, the categories of accommodations and food services, health care, and professional, scientific, and technical services added the most jobs.

Table 3-8. Non-government Employment by Industry in the Five-County Proposed Action Alternative Area, 2013-2018 (thousands).

Industry	2013	2014	2015	2016	2017	2018
Farm employment	5.1	5.1	5	5	5.2	5.1
Accommodation and food services	9.4	9.6	9.9	10.4	11.4	11.6
Admin. and support, waste mgt., remediation	5	5	5.2	5.5	5.4	5.7
Arts, entertainment, and recreation	3	3	3	2.9	3.1	3.1
Construction	6.8	6.9	7.1	7.4	7.4	7.8
Educational services	1.3	1.4	1.3	1.2	1.2	1.3
Federal civilian	2.7	2.7	2.9	2.9	2.9	2.7
Finance and insurance	3.3	3.2	3.2	3.2	3.4	2.6
Forestry, fishing, and related activities	0.2	1.1	2.3	1.9	0.5	0.06
Health care and social assistance	16.4	16.6	17.2	16.2	16.9	17.5
Information	1.3	1.3	1.2	1.2	1.1	1.1
Mgt. of companies and enterprises	0.3	0.3	0.3	0.8	0.8	0.7
Manufacturing	5.9	5.9	6	6.3	6.5	6.4
Military	0.7	0.7	0.7	0.8	0.8	0.8
Mining, quarrying, oil and gas extraction	0	0.1	0.3	0.2	0.1	0.1
Other services (except govt. and govt. enterprises)	9	9.3	9.4	9.2	9	9.3
Professional, scientific, and technical services	4.9	4.9	5.1	6.1	6.3	6.6
Real estate and rental and leasing	4.9	5	4.9	4.9	5.2	5.2
Retail trade	15.7	15.8	16.3	16.3	16.3	16.2
Transportation and warehousing	1.5	2.8	1.5	1.5	1.6	1.8
Utilities	0.2	0.2	0.2	0.2	0.2	0.1
Wholesale trade	2.8	1.6	1.4	2.6	2.6	2.6
Total[a]	133	134	136	138	140	143

[a]Totals include data that was suppressed so as not to reveal information about individual firms.
Source: (U.S. Bureau of Economic Analysis n.d.) Regional Data, Gross Domestic Product and Personal Income, Total Full-time and Part-time Employment by NAICS Industry.

3.6 Air Quality

Air Quality: Section 176 (c) of the Clean Air Act (42 U.S.C. 7506 [c]) requires any entity of the Federal Government that engages in, supports, or in any way provides financial assistance for, licenses or permits, or approves any activity to demonstrate that the action conforms to the applicable State Implementation Plan required under Section 110 (a) of the Federal Clean Air Act (42.U.S.C. 7410 [a]) before the action is otherwise approved.

Air quality in the State of Oregon is regulated by ODEQ under designation by the Environmental Protection Agency (EPA). The National Ambient Air Quality Standards, established under the Clean Air Act (42 U.S.C. § 7401), specify limits of air pollutant levels of several pollutants. Of those pollutants, particulate matter $(PM)_{2.5}$ and PM_{10} have been identified and included in attainment plans for the Klamath Falls area (Klamath County, Oregon). Since 1994, the Klamath Falls area attained the standards associated with PM_{10} (ODEQ 2020). In 2009, with the adoption of a fine particulate ($PM_{2.5}$) matter standard, EPA changed the legal status of the Klamath Falls area from attainment to nonattainment for $PM_{2.5}$ (ODEQ 2020). In 2012, ODEQ adopted an attainment plan to meet $PM_{2.5}$ standards.

Air quality in California counties within the geographic scope of the alternatives are managed by the North Coast United Air Quality Management District (Humboldt and Del Norte counties), Siskiyou County Air Pollution Control District (Siskiyou County), and Modoc County Air Pollution Control District (Modoc County). Table 3-9 identifies the attainment status for air pollutants with regard to the State of California Ambient Air Quality Standards.

Table 3-9. Air pollutants and attainment specific to California counties within the geographic scope of the alternatives. Source (Reclamation and CDFG 2012) (modified).

Pollutant	California Status
Ozone (O_3)	Nonattainment-Transitional (Siskiyou County) Nonattainment (Shasta County) Attainment (Del Norte, Humboldt, and Modoc Counties)
Inhalable particulate matter (PM_{10})	Attainment (Siskiyou County) Nonattainment (Del Norte, Humboldt, and Modoc Counties)
Fine particulate matter ($PM_{2.5}$)	Attainment/Unclassified (All counties)
Carbon monoxide (CO)	Attainment/Unclassified (All counties)
Nitrogen dioxide (NO_2)	Attainment (All counties)
Sulfur dioxide (SO_2)	Attainment (All counties)

3.7 Indian Trust Resources

There are six federally recognized Indian Tribes in the Klamath Basin including The Klamath Tribes in Oregon (which include the Klamath, Modoc, and Yahooskin Tribes; collectively The Klamath Tribes), the Yurok Tribe, the Karuk Tribe, the Hoopa Valley Tribe, the Quartz Valley Tribe, and the Resighini Rancheria in California. Reclamation has a trust responsibility, as a federal agency, for the water and fishery tribal trust resources of three of the six federally recognized tribes: The Yurok, Hoopa Valley, and Klamath Tribes.

An Indian Trust Asset is a legal interest in assets held in trust by the federal government for Indian tribes or individuals. The Department of the Interior’s policy is that when a proposed federal action would likely adversely affect an Indian Trust Asset, the action agency should seek ways to minimize or avoid the adverse effect, or if the effect cannot be avoided, to compensate or mitigate for it.

In the Upper Klamath Basin, a treaty was entered into in 1864 between the U.S. and the predecessors of The Klamath Tribes reserving fishing, hunting, and gathering rights on lands formerly part of the Klamath Indian Reservation in Oregon. The Klamath Tribes' trust resources include fish, specifically the LRS, or *C'waam*, and the SNS, or *Koptu*, as well as wildlife species within or adjacent to the former Klamath Reservation. The *C'waam* and *Koptu* serve as an important traditional food source, as well as a component of cultural, spiritual and economic health for the Klamath Tribes (The Klamath Tribes 2019). *C'waam* and *Koptu*, as well as other fish and plant species like wocus, an aquatic plant species native to the Upper Klamath Basin, are central to the heritage of The Klamath Tribes.

Based on the treaty between the U.S. and The Klamath Tribes, dated October 14, 1864, the Klamath Tribes and the U.S., through the U.S. Bureau of Indian Affairs, have claimed in the Klamath Basin Adjudication federally-reserved water rights to support hunting, fishing, and gathering by The Klamath Tribes within their former reservation boundaries. In 2014, the State of Oregon issued in that Adjudication the Amended and Corrected Findings of Fact and Order of Determination (ACFFOD), an administrative order and determination which identifies specific instream flows in tributaries to UKL within, and adjacent to, the boundaries of the former Klamath Indian Reservation. The ACFFOD also recognizes a water right in UKL, to maintain water surface at various elevations during different times of the year. Under the ACFFOD, these water rights are held by the U.S. of America through the U.S. Bureau of Indian Affairs, on behalf of The Klamath Tribes, and have a priority date of "time immemorial," making them prior ("senior") to all other water rights recognized in the ACFFOD. The ACFFOD is now being judicially reviewed by the Klamath County Circuit Court.

The Yurok and Hoopa Valley Tribes have Federal Indian reserved fishing rights secured to the Tribes by a series of 19th century executive orders and confirmed in the 1988 Hoopa-Yurok Settlement Act, which also established, in connection with an Executive Proclamation in 1855, Executive Orders in 1876 and 1891, the present Yurok and Hoopa Valley Indian Reservations (Reclamation 1998). The Yurok and Hoopa Valley Tribes' fishing rights entitle them to take fish for ceremonial, subsistence, and commercial purposes (Reclamation 1998). These Tribes also hold reserved water rights, held in trust by the U.S., to an instream flow sufficient to: 1) protect the right to take fish within their reservation, 2) prevent others from depleting the stream flow below a protected level and 3) the right to water quality and flow to support all life stages of fish (Reclamation 1998).

As noted by Reclamation (1998), salmon have historically been a central species to the cultures and economies of the Tribes of the Lower Klamath Basin which exceeded other food sources in the traditional diets of the Lower Basin Tribes. Described by Reclamation in 1998, "the significance of the tribes' reliance on, and veneration for nature is evident in all facets of their culture, their traditions, their religions, and their resource use and management. Consequently, increasing resource scarcity over the last century has had a profound effect on the tribes of the Klamath Basin. Tribal cultures are no longer able to fully embrace their traditional ways of life; the declining availability of resources critical to their traditional and spiritual practices has made some of those resources even more precious as a means of sustaining their culture."

3.8 Environmental Justice

Executive Order 12898 (February 11, 1994) mandates Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and lower-income populations.

The Project as well as UKL and the Lost River are within Klamath County, Oregon, and/or Modoc, Siskiyou, counties, California with the Klamath River flowing through rural areas. These counties, considered rural and in general consisting of lower-income populations, rely on cultivation of agricultural land and recreational fishing as important sources of revenue. LRS and SNS reside in UKL and are important resources to The Klamath Tribes. The Klamath River also runs through the Hoopa Valley and Yurok Tribes' reservations and the aboriginal lands of the Karuk Tribe, all of which consist of lower-income households traditionally relying on salmon and steelhead as an important part of tribal subsistence.

Section 4 Environmental Consequences

4.1 Resources Not Considered

Impacts to the following resources were considered and found to be minor or absent. Brief explanations for their eliminations from further consideration are provided below:

- Cultural Resources: The Proposed Action Alternative would not produce any ground disturbances, would not result in the construction of new facilities or the modification of existing facilities, and would not result in land use changes. Neither the Proposed Action nor the No Action Alternative have the potential to cause effects to historical property pursuant to 36 CFR § 800.3(a)(1) (*See Appendix C for Reclamation's determination*).

- Indian Sacred Sites: There would be no impact to Indian Sacred Sites under the Proposed Action Alternative as conditions would remain the same as existing conditions. Similarly, the Proposed Action Alternative would not inhibit access to, or ceremonial use of, an Indian Sacred Site, nor would it adversely affect the physical integrity of such sacred sites.

- Climate Change and Greenhouse Gases: Climate Change and Greenhouse Gases refers to changes in measures of climate (e.g., temperature, precipitation, or wind) lasting for decades or longer. Many environmental changes can contribute to climate change (e.g., changes in the sun's intensity, changes in ocean circulation, deforestation, urbanization, burning fossil fuels) (EPA 2015). Climate change implies a change having important economic, environmental, and social effects in a climatic condition such as temperature or precipitation. Climate change is generally attributed directly or indirectly to human activity that alters the composition of the global atmosphere, additive to natural climate variability observed over comparable time periods. Due to the limited term and the nature of the Proposed Action Alternative (focused on management of water), there would be no measurable impacts contributing to climate change or greenhouse gases.

4.2 Resources Considered

Implementation of either alternative could potentially affect the following resources:

- Water Resources
- Biological Resources
- Recreation
- Land Use
- Socioeconomic Resources
- Air Quality
- Indian Trust Resources
- Environmental Justice

As described above in section 2.2, there are several elements common to the No Action and the Proposed Action alternatives. Under the Proposed Action Alternative, three modifications to the No Action Alternative are proposed: 1) Augmentation of the EWA, 2) ensuring that UKL does not go below specific elevations in the spring and fall months, and 3) potential acquisition of some portion of water available to the Project for fish and wildlife benefits at LKNWR and TLNWR, if needed.

4.3 Water Resources

4.3.1 Surface Water

Analysis of surface water involves modeling west side Project operations using the KBPM. Key components of modeled operations are UKL elevations, Iron Gate flows, and Project and LKNWR diversions. Detailed information about the KBPM can be obtained from Section 4 and Appendix 4 of the modified 2018 Operations Plan. For purposes of presenting and comparing results from the No Action and Proposed Action alternatives, this section makes regular use of POE as a way to summarize simulated outcomes over the entire POR. To do this, WYs 2015-2019 will be examined as they reflect more contemporary WY types experienced in the POR and encompass a wide range of hydrologic conditions. Exceedance probability is an expression of how often a value is exceeded over the time period considered. For example, if model results for UKL elevations at the end of July are considered and the 90 percent POE is computed to be 4,140.56 ft, then 4,140.56 ft can be expected to be exceeded 90 percent of the time at the end of July.

4.3.1.1 Upper Klamath Lake

No Action Alternative

A surface elevation above 4,142.00 ft would be maintained through the end of May (after it has been achieved earlier in the spring) in 35 out of 39 years in the POR. Table 4-1 includes end of month UKL surface elevation exceedance probabilities as determined through analysis of the No Action Alternative simulation. As shown, end of February UKL surface elevation would be at or above 4,142.10 ft in 80 percent of simulated years and 4,141.71 ft in 90 percent of simulated years. As will be further discussed in Section 4.4 while UKL surface elevation does not have to be above 4,142.00 ft at the end of February, higher lake levels at this time contribute to supporting spring-spawning habitat for LRS in UKL with the end of May is recognized as the end of the spawning season for LRS. As shown in Table 4-1, UKL surface elevations would be at or above 4,142.57 ft in 80 percent of simulated years and 4,141.96 ft in 90 percent of simulated years at the end of May. These elevations can be used to evaluate the availability of spawning habitat for a population of LRS in UKL (*for more detail see Section 4.4*).

Annual minimum UKL surface elevation levels for the No Action Alternative are also listed by exceedance probability in Table 4-1. As shown in Table 4-1, annual minimum UKL surface elevation would not drop below 4,138.26 ft and would maintain a minimum surface elevation of 4,138.43 ft at a 90 percent POE. These minimum UKL surface elevations can be used to evaluate the availability of refugial habitat for LRS and SNS in late summer and fall.

Table 4-1. Simulated outcomes for end-of-month Upper Klamath Lake (UKL) surface elevations (feet) for the No Action Alternative. Results are summarized as probability of exceedance (POE), maximum, and minimum UKL elevations by month and annual minimum for the Period of Record.

Month	Max	POE 10%	POE 20%	POE 30%	POE 40%	POE 50%	POE 60%	POE 70%	POE 80%	POE 90%	Min
Oct	4,141.40	4,140.97	4,140.29	4,139.85	4,139.75	4,139.53	4,139.23	4,139.11	4,138.88	4,138.60	4,138.49
Nov	4,141.59	4,141.39	4,140.96	4,140.32	4,140.16	4,139.96	4,139.80	4,139.56	4,139.47	4,139.13	4,138.87
Dec	4,141.79	4,141.79	4,141.69	4,141.22	4,140.99	4,140.72	4,140.66	4,140.48	4,140.24	4,139.89	4,139.75
Jan	4,142.28	4,142.28	4,142.06	4,141.99	4,141.99	4,141.68	4,141.47	4,141.37	4,141.15	4,140.85	4,140.36
Feb	4,142.73	4,142.69	4,142.69	4,142.51	4,142.40	4,142.39	4,142.35	4,142.22	4,142.10	4,141.71	4,140.88
Mar	4,143.09	4,143.09	4,142.98	4,142.82	4,142.80	4,142.79	4,142.79	4,142.77	4,142.46	4,142.30	4,141.33
Apr	4,143.29	4,143.28	4,143.28	4,143.27	4,143.23	4,143.12	4,143.09	4,143.01	4,142.90	4,142.09	4,140.99
May	4,143.30	4,143.26	4,143.24	4,143.16	4,143.05	4,142.94	4,142.78	4,142.77	4,142.57	4,141.96	4,140.58
Jun	4,143.09	4,142.90	4,142.73	4,142.56	4,142.46	4,142.36	4,142.08	4,141.87	4,141.70	4,141.12	4,139.85
Jul	4,142.23	4,141.93	4,141.56	4,141.41	4,141.23	4,141.11	4,140.95	4,140.65	4,140.39	4,140.15	4,139.56
Aug	4,141.38	4,141.05	4,140.45	4,140.31	4,140.19	4,140.06	4,139.76	4,139.53	4,139.40	4,139.14	4,138.87
Sep	4,141.32	4,140.77	4,140.02	4,139.71	4,139.62	4,139.41	4,139.12	4,139.00	4,138.84	4,138.50	4,138.28
Annual min	4,141.12	4,140.68	4,139.88	4,139.63	4,139.57	4,139.31	4,139.00	4,138.92	4,138.79	4,138.43	4,138.26

Proposed Action Alternative

Project Operations

Simulation of the Proposed Action Alternative within the KBPM results in both higher and lower end of month UKL surface elevations, but the overall trend would be lower due to UKL contributions to augmented Klamath River flows in years where UKL Supply is between 550,000 AF and 950,000 AF. In the simulation, key spawning habitat elevations, (*as mentioned above and in more detail in section 4.4*) absent real-time modification of Project operations (*discussed below*), UKL elevations are maintained above 4,142.00 ft in 33 out of the 39 years simulated, two years less than the No Action Alternative. In those two simulated years (2005 and 2015), UKL surface elevations would still be maintained above 4,142.0 ft for portions of April-May. In real time operations and in the years in which EWA augmentation is triggered, Reclamation would coordinate with the Services to distribute any EWA augmentation volumes and utilize any water from PacifiCorp's reservoirs so that UKL elevations do not fall below 4,1,42.0 in March, April, or May. Table 4-2 lists simulated end of month UKL surface elevation POE's under the Proposed Action Alternative. As shown, end of May UKL surface elevations are simulated to be at or above 4,142.04 ft in 80 percent of simulated years and 4,141.70 ft in 90 percent of simulated years. The KBPM simulation does not include potential water borrowing operations from PacifiCorp reservoirs (*see Section 2.4.1*).

Annual minimum UKL surface elevation levels for the Proposed Action Alternative are also listed by POE in Table 4-2. As shown in Table 4-2, annual minimum UKL surface elevation would not drop below 4,138.00 ft and maintains a surface elevation of 4,138.20 ft at a 90 percent exceedance probability.

Table 4-2. Simulated outcomes for end-of-month Upper Klamath Lake (UKL) surface elevations (feet) for the Proposed Action Alternative. Results are summarized as probability of exceedance (POE), maximum, and minimum UKL elevations by month and annual minimum for the Period of Record. Simulated UKL elevations do not include potential water borrowing operations from downstream PacifiCorp reservoirs.

Month	Max	POE 10%	POE 20%	POE 30%	POE 40%	POE 50%	POE 60%	POE 70%	POE 80%	POE 90%	Min
Oct	4,141.40	4,140.97	4,140.29	4,139.78	4,139.60	4,139.42	4,139.09	4,138.90	4,138.64	4,138.47	4,138.23
Nov	4,141.59	4,141.39	4,140.96	4,140.32	4,140.03	4,139.79	4,139.68	4,139.37	4,139.18	4,139.13	4,138.53
Dec	4,141.79	4,141.79	4,141.69	4,141.16	4,140.97	4,140.72	4,140.54	4,140.25	4,140.15	4,139.82	4,139.66
Jan	4,142.28	4,142.28	4,142.05	4,141.99	4,141.99	4,141.61	4,141.47	4,141.21	4,140.98	4,140.85	4,140.25
Feb	4,142.73	4,142.69	4,142.67	4,142.51	4,142.40	4,142.39	4,142.35	4,142.15	4,141.89	4,141.62	4,140.97
Mar	4,143.09	4,143.09	4,142.98	4,142.81	4,142.79	4,142.79	4,142.79	4,142.74	4,142.50	4,142.36	4,141.42
Apr	4,143.29	4,143.28	4,143.28	4,143.24	4,143.13	4,143.06	4,142.93	4,142.83	4,142.58	4,141.92	4,141.07
May	4,143.30	4,143.26	4,143.21	4,143.11	4,142.97	4,142.63	4,142.41	4,142.36	4,142.04	4,141.70	4,140.65
Jun	4,143.09	4,142.90	4,142.67	4,142.49	4,142.40	4,142.01	4,141.72	4,141.54	4,141.37	4,140.86	4,139.90
Jul	4,142.23	4,141.93	4,141.53	4,141.37	4,141.09	4,140.80	4,140.65	4,140.50	4,140.09	4,139.95	4,139.59
Aug	4,141.38	4,141.05	4,140.46	4,140.27	4,140.06	4,139.64	4,139.50	4,139.35	4,139.04	4,138.85	4,138.75
Sep	4,141.32	4,140.77	4,140.02	4,139.68	4,139.50	4,139.12	4,139.00	4,138.77	4,138.64	4,138.26	4,138.04
Annual min	4,141.12	4,140.68	4,139.88	4,139.59	4,139.46	4,139.03	4,138.90	4,138.69	4,138.53	4,138.20	4,138.00

Differences in simulated UKL surface elevation outcomes between the Proposed Action Alternative and No Action Alternative are listed in Table 4-3.

Table 4-3. Differences in simulated outcomes between alternatives (Proposed Action minus No Action alternatives) for end-of-month and annual minimum Upper Klamath Lake surface elevations (feet).

Month	Max	POE 10%	POE 20%	POE 30%	POE 40%	POE 50%	POE 60%	POE 70%	POE 80%	POE 90%	Min
Oct	0.00	0.00	0.00	-0.07	-0.15	-0.10	-0.14	-0.21	-0.24	-0.14	-0.25
Nov	0.00	0.00	0.00	-0.01	-0.13	-0.18	-0.12	-0.19	-0.28	0.00	-0.34
Dec	0.00	0.00	0.00	-0.06	-0.02	0.00	-0.12	-0.24	-0.09	-0.08	-0.09
Jan	0.00	0.00	-0.02	0.00	0.00	-0.07	0.00	-0.16	-0.17	0.00	-0.10
Feb	0.00	0.00	-0.01	0.01	0.00	0.00	0.00	-0.07	-0.21	-0.09	0.08
Mar	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	-0.03	0.04	0.06	0.09
Apr	0.00	0.00	0.00	-0.03	-0.10	-0.06	-0.16	-0.18	-0.32	-0.17	0.08
May	0.00	0.00	-0.03	-0.06	-0.08	-0.30	-0.37	-0.41	-0.52	-0.26	0.07
Jun	0.00	0.00	-0.06	-0.06	-0.06	-0.35	-0.36	-0.33	-0.32	-0.25	0.05
Jul	0.00	0.00	-0.02	-0.05	-0.13	-0.31	-0.29	-0.15	-0.30	-0.20	0.03
Aug	0.00	0.00	0.00	-0.04	-0.13	-0.42	-0.27	-0.19	-0.36	-0.28	-0.12
Sep	0.00	0.00	0.00	-0.04	-0.12	-0.29	-0.12	-0.23	-0.20	-0.24	-0.24
Annual min	0.00	0.00	0.00	-0.04	-0.10	-0.27	-0.09	-0.23	-0.26	-0.24	-0.26

Figure 4-1 compares No Action Alternative and Proposed Action Alternative UKL surface elevations over five years (2015-2019). The Proposed Action Alternative provides additional water for spring Iron Gate flows (augmentation flows) in four of the five years (2015, 2016, 2018, and 2019). Lowered UKL surface elevation is seen at the end of each of these years as a result. The absolute minimum surface elevation of 4138.00 ft occurs in the Proposed Action Alternative in 2016. While the simulated Iron Gate flow augmentation in 2015 causes the UKL surface elevation to fall below the spawning habitat threshold (4142.00 ft) before the end of May this does not occur in the subsequent 4 years (2016-2019) even though additional Iron Gate flows of 40,000 AF are provided. Additionally, in a WY type like 2015 and in real-time operations, Reclamation would coordinate with the Services and PacifiCorp on the distribution of the 40,000 AF augmented EWA releases, along with utilizing volume within PacifiCorp's Klamath Hydroelectric Project, so that UKL elevations would not fall below 4,142.00 in March, April, or May.

UKL elevation in 2020 is projected to peak in mid-April at an elevation of 4142.02 ft for a few days prior to implementation of a surface flushing flow. After implementation of the surface flushing flow, UKL elevations are projected to drop below 4,142.00 ft in late April and remain below for the rest of the season. The anticipated April 1 UKL Supply is projected to be less than 550,000 AF, which would mean the 40,000 AF EWA augmentation would not be triggered this year and EWA and UKL management would be the same as the No Action Alternative Given that the April 1 UKL Supply is projected to fall below the threshold for EWA augmentation, Reclamation would not attempt to modify EWA releases or borrow water from PacifiCorp to contribute to maintaining UKL elevations above 4,142.0 ft in April and May 2020.

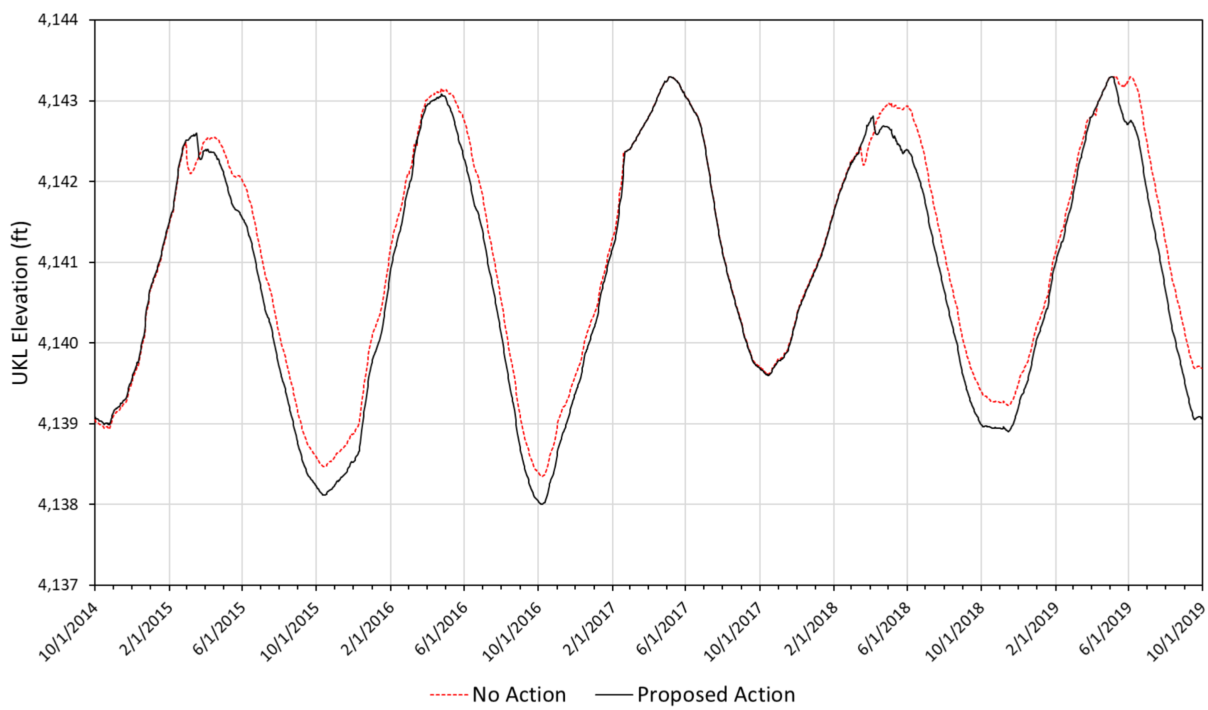

Figure 4-1. Daily time series of Upper Klamath Lake (UKL) surface elevations for a representative period (water years 2015-2019; as they reflect more contemporary water years types experienced in the Period of Record) from simulations for each alternative.

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, the acquisition of Project water, including from Project Supply and/or other sources (LRDC and KSD return flows), for use for fish and wildlife purposes at LKNWR and TLNWR would result in similar UKL surface elevations shown in Table 4-2. Similar UKL elevations to those that are simulated to occur under implementation of the Project Operations component of the Proposed Action Alternative would also be expected to occur as a result of the potential acquisition of Project Supply through the use of short-term water contracts. No additional water from UKL would be needed to fulfill these contracts, as the source of this water would be Project water previously allocated from UKL as Project Supply. Any differences between the simulated UKL elevations under the Proposed Action Alternative as a result of acquiring water for fish and wildlife purposes are anticipated to be short-term and minor. Any discrepancies in UKL elevations would be solely attributable to timing differences between when available water is acquired and delivered for fish and wildlife benefit and when that volume would have otherwise been delivered for irrigation purposes.

4.3.1.2 Klamath River

There is no difference in minimum required Iron Gate flows, or Iron Gate flow ramp rate requirements between the No Action Alternative and the Proposed Action Alternative, targeted in the Iron Gate flow methodology. The only difference is in the provision of EWA augmentation water in the spring. The Proposed Action Alternative provides 40,000 AF of additional EWA water to be released flexibly between the months of March and June in years where the March 1 or April 1 UKL Supply (final EWA augmentation is determined with the April 1 UKL Supply) is between 550,000 AF and 950,000 AF. Furthermore, the May/June augmentation implemented in the No Action Alternative is left intact in the Proposed Action Alternative with a slightly different ramp up and ramp down augmentation versus UKL Supply formulation.

No Action Alternative

Table 4-4 lists the POE for average monthly Iron Gate flows as computed from the No Action Alternative KBPM simulation. It also lists the maximum and minimum average monthly Iron Gate flow found in the simulated POR (1981-2019). During April, May, and June, the 50 percent POE flows are 2,384 cfs, 1,862 cfs, and 1,275 cfs respectively; during that same time period, the 80 percent POE flows are 1,578 cfs, 1,391 cfs and 1,148 cfs respectively.

Table 4-4. Simulated outcomes for releases from Iron Gate Dam (cubic feet per second) for the No Action Alternative. Results are summarized as probability of exceedance (POE), maximum, and minimum releases by month.

Month	Max	POE 10%	POE 20%	POE 30%	POE 40%	POE 50%	POE 60%	POE 70%	POE 80%	POE 90%	Min
Oct	2,374	1,348	1,249	1,193	1,150	1,133	1,122	1,065	1,025	1,000	1,000
Nov	3,813	1,609	1,495	1,231	1,165	1,119	1,111	1,099	1,069	1,000	1,000
Dec	5,825	3,010	1,974	1,473	1,321	1,062	997	974	955	950	950
Jan	9,324	3,711	2,669	1,820	1,558	1,245	1,123	1,071	1,007	977	950
Feb	8,805	5,411	4,138	2,623	2,058	1,587	1,362	1,196	1,048	986	950
Mar	7,576	6,119	5,076	3,821	3,427	3,160	2,511	2,235	2,169	1,481	1,000
Apr	5,794	5,498	4,576	4,067	3,054	2,384	2,168	1,859	1,578	1,396	1,325
May	5,112	4,077	2,981	2,500	2,275	1,862	1,555	1,474	1,391	1,175	1,175
Jun	3,336	2,331	1,797	1,391	1,312	1,275	1,227	1,176	1,148	1,025	1,025
Jul	1,332	1,215	1,153	1,102	1,042	1,026	993	950	931	902	900
Aug	1,224	1,174	1,105	1,067	1,045	1,035	1,034	952	922	902	900
Sep	1,260	1,214	1,161	1,140	1,108	1,040	1,004	1,000	1,000	1,000	1,000

Proposed Action Alternative

<u>Project Operations</u>

Table 4-5 lists the POE for average monthly IGD flows as computed from the Proposed Action Alternative KBPM simulation. It also lists the maximum and minimum average monthly IGD flow found in the simulated POR (1981-2019). For example, the April, May and June 80 percent POE flows are 1,953 cfs, 1,685 cfs and 1,216 cfs respectively. This is 375 cfs, 294 cfs and 68 cfs higher, respectively, than the No Action Alternative in these months at an 80 percent exceedance probability. Table 4-6 reports flow differences for all months between the Proposed Action and No Action alternatives. Reduction of flow in February would be due to reduction in UKL carryover storage from the previous years, and reduction of flows in March is due to either carryover reduction or delaying surface flushing flow implementation until April to better coincide with naturally occurring hydrologic events.

Table 4-5. Simulated outcomes for releases from Iron Gate Dam (cubic feet per second) for the Proposed Action Alternative. Results are summarized as probability of exceedance (POE), maximum, and minimum releases by month and annual minimum for the Period of Record.

Month	Max	POE 10%	POE 20%	POE 30%	POE 40%	POE 50%	POE 60%	POE 70%	POE 80%	POE 90%	Min
Oct	2,373	1,348	1,249	1,193	1,149	1,125	1,101	1,012	1,000	1,000	1,000
Nov	3,813	1,552	1,495	1,186	1,163	1,119	1,111	1,099	1,002	1,000	1,000
Dec	5,825	3,010	1,973	1,412	1,273	1,062	997	970	953	950	950
Jan	9,324	3,710	2,669	1,805	1,467	1,245	1,084	1,066	1,003	977	950
Feb	8,811	5,411	4,138	2,623	1,893	1,484	1,278	1,173	1,048	986	950
Mar	7,576	6,070	5,076	3,822	3,267	3,160	2,478	2,172	1,805	1,243	1,000
Apr	5,794	5,498	4,565	4,066	3,054	2,414	2,377	2,206	1,953	1,792	1,631
May	5,112	4,077	2,983	2,597	2,417	2,278	2,052	1,730	1,685	1,482	1,175
Jun	3,336	2,331	1,797	1,542	1,327	1,283	1,275	1,251	1,216	1,026	1,025
Jul	1,332	1,215	1,154	1,110	1,058	1,026	996	982	920	905	900
Aug	1,224	1,174	1,105	1,073	1,045	1,035	1,034	939	923	907	900
Sep	1,260	1,214	1,161	1,147	1,118	1,074	1,012	1,000	1,000	1,000	1,000

Table 4-6. Differences in simulated outcomes between alternatives (Proposed Action minus No Action alternatives) for releases from Iron Gate Dam (cubic feet per second).

Month	Max	POE 10%	POE 20%	POE 30%	POE 40%	POE 50%	POE 60%	POE 70%	POE 80%	POE 90%	Min
Oct	-1	0	0	0	-1	-8	-21	-52	-25	0	0
Nov	0	-57	0	-45	-3	0	0	0	-66	0	0
Dec	0	0	0	-61	-49	0	0	-4	-2	0	0
Jan	0	0	0	-16	-90	0	-39	-4	-4	0	0
Feb	6	0	0	0	-165	-103	-84	-22	0	0	0
Mar	0	-49	0	1	-160	-1	-33	-63	-364	-238	0
Apr	0	0	-12	-1	0	30	210	347	375	396	306
May	0	0	2	97	142	416	496	256	294	307	0
Jun	0	0	0	152	15	9	48	74	68	1	0
Jul	0	0	0	8	16	0	3	32	-10	3	0
Aug	0	0	0	5	0	1	0	-13	0	5	0
Sep	0	0	0	7	11	34	8	0	0	0	0

Figure 4-2 below shows the No Action and Proposed Action alternatives simulated Iron Gate flows for the years 2015-2019. The simulated surface flushing flow in 2015 is delayed but still occurs in the month of March. The EWA augmentation is used to elevate flows from the end of the surface flushing flow through the end of May. The delay in surface flushing flow in 2018 does change the March timing in the No Action Alternative to April in the Proposed Action Alternative. This allows the EWA augmentation water under the Proposed Action Alternative to avoid steep flow reductions immediately after the surface flushing flow and maintain higher flows through the end of May. Both the No Action and Proposed Action alternatives assume there is flexibility in the timing of the surface flushing flow between March 1 and April 15. The Proposed Action Alternative simulation assumes that, when appropriate, the timing of the surface flushing flow and the augmentation supply would be coordinated to provide maximum benefit to ESA-list coho salmon and SRKW (through Chinook salmon).

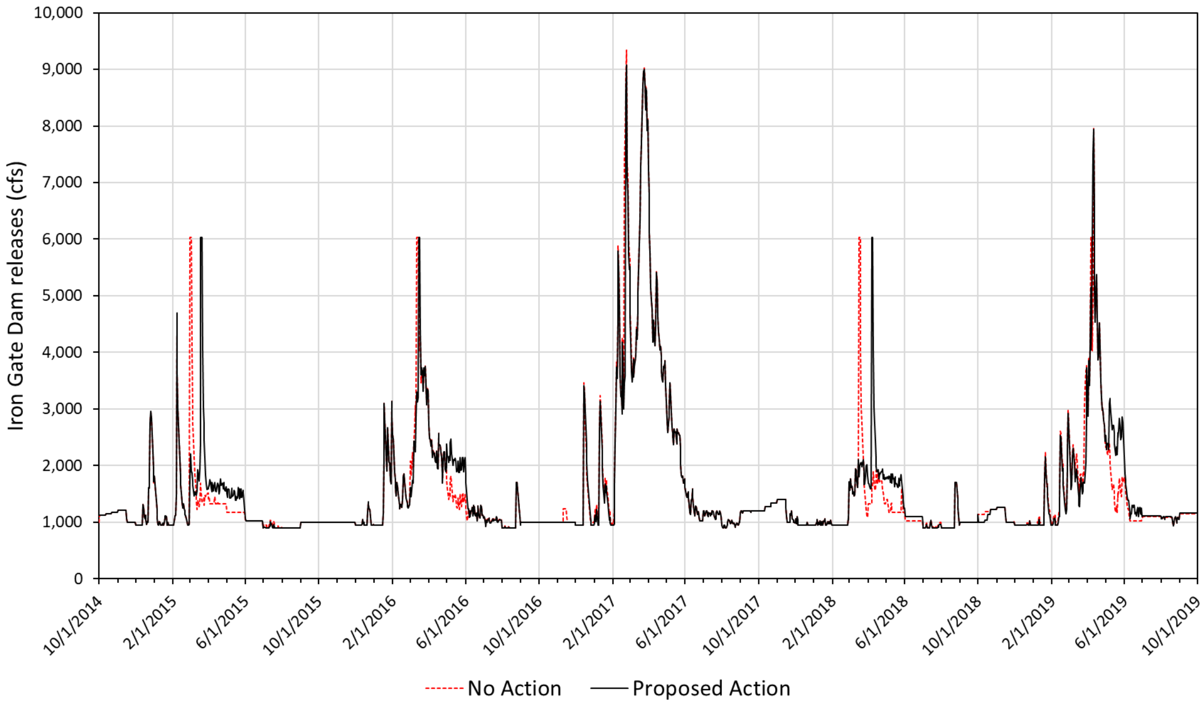

Figure 4-2. Daily time series of Iron Gate Dam releases for a representative period (water years 2015-2019) from simulations for each alternative.

<u>Refuge Water Acquisition</u>
Under the refuge water acquisition component of the Proposed Action Alternative, the acquisition of Project water, from Project Supply and/or other sources (LRDC and KSD return flows), for use for fish and wildlife purposes at LKNWR and TLNWR would result in IGD releases similar to those shown in Table 4-5. Similar IGD releases as those that are simulated to occur under implementation of the *Project Operations* component of the Proposed Action Alternative would also be expected to occur as a result of execution of short-term water contracts. Only Project water available for irrigation purposes would be acquired, which would not change any volumes calculated in the KBPM for EWA or otherwise allocated for IGD releases. Any differences between the simulated IGD releases under the Proposed Action Alternative as a result of acquiring water for fish and wildlife purposes are anticipated to be short-term and minor. Any discrepancies in IGD releases would be solely attributable to timing differences between when available water is acquired and delivered for fish and wildlife benefit and when that volume would have otherwise been delivered for irrigation purposes.

4.3.1.3 Project Supply

No Action Alternative

Under the No Action Alternative, simulated Project Supply ranged from 11,743 AF (1992) to 350,000 AF[25], which would be the maximum Project Supply allowed under either alternative,

[25] As qualified in Section 2.2.6

with a median of 305,984 AF (*Tables 4-7 and 4-9*). Median Project Supply was about 44,000 AF lower than the maximum in the No Action Alternative, whereas the 90 percent POE was about 148,000 AF lower than the maximum. Out of the 39 years in the POR, Project Supply dropped below 200,000 AF in three years (1992, 1994, and 2014), all critically dry WYs (*Table 4-9*).

Table 4-7. Probability of exceedance, maximum, and minimum simulated outcomes for Project Supply (the final determination on June 1) under the No Action Alternative.

Probability of Exceedance (%)	No Action Project Supply (Acre-Feet)
Maximum	350,000
10%	350,000
20%	350,000
30%	350,000
40%	334,829
50%	305,984
60%	298,794
70%	276,543
80%	263,253
90%	202,042
Minimum	11,743

Proposed Action Alternative

<u>Project Operations</u>

Under the Proposed Action Alternative, simulated Project Supply ranged from 18,798 AF (1992) to 350,000 AF, which was the maximum Project Supply allowed under either alternative, with a median of 282,987 AF (*Table 4-8 and 4-9*). Median Project Supply was about 67,000 AF lower than the maximum in the Proposed Action Alternative, whereas the 90 percent POE was about 186,000 AF lower than the maximum. Out of the 39 years in the period-of-record (POR), Project Supply dropped below 200,000 AF in four years (1991, 1992, 1994, and 2014), all critically dry WYs (*Table 4-9*). Projections for Project Supply during WY (2020) are around 130,000 AF for the April allocation. The unusually low allocation is due to a dry fall, low winter snowpack, and dry spring resulting in UKL inflows resembling those in 1992 and 1994 (both critically dry years).

Table 4-8. Probability of exceedance, maximum, and minimum simulated outcomes for Project Supply (the final determination on June 1) under the Proposed Action Alternative.

Probability of Exceedance (%)	**Proposed Action Alternative Project Supply (Acre-Feet)**
Maximum	350,000
10%	350,000
20%	350,000
30%	350,000
40%	334,829
50%	282,987
60%	275,794
70%	254,760
80%	235,118
90%	163,840
Minimum	18,798

<u>Refuge Water Acquisition</u>
Under the refuge water acquisition component of the Proposed Action Alternative, the acquisition of Project water, including from Project Supply, for use for fish and wildlife purposes at LKNWR and TLNWR would not change the calculated Project Supply, resulting in the same volumes shown in Table 4-8. Reclamation may acquire Project Supply for fish and wildlife purposes in 2020 and possibly future years (subject to authority and funding). This action would typically only be taken during drought years. In addition to securing critical water supplies for NWRs, this action could potentially result in non-federal demand management and compensation activities within the Project that may partially offset socioeconomic effects to farmers due to shortages in Project supply, as described in section 4.7.

Alternatives Compared
Relative to the No Action Alternative, the Proposed Action Alternative reduces the Project Supply from UKL in roughly half the years within the POR with an average reduction of about 13,000 AF over the POR (*Table 4-9*). This would also result in a reduction of Project Supply potentially available for acquisition and delivery for fish and wildlife benefit at LKNWR and TLNWR. Years in which EWA augmentation volumes did not occur (which depends on the UKL Supply (*see Section 2*), resulted in similar Project Supply allocations and diversions under each alternative. For example, 1996 through 2000 were relatively wet years in which UKL Supply exceeded 950,000 AF and no EWA augmentation was provided, and as a result the Project Supply did not differ substantially between alternatives. Similarly, 1994 was an exceedingly dry year in which UKL Supply fell below the lower threshold for EWA augmentation of 550,000 AF, resulting in no EWA augmentation and little difference in diversions between alternatives. Differences in Project Supply allocations between the two alternatives occur in years in which precipitation is average to below average (but not critically dry). In some years, differences between alternatives arise because of interannual effects from operations during the prior year. For example, the 7,055 AF increase in Project Supply in a year like 1992 would result because UKL levels coming out of a previous WY like 1991 would be slightly higher under the Proposed Action Alternative. This would slightly increase UKL

Supply, and because EWA would be still at its minimum, Project Supply would increase as well. Years with larger differences usually reflect the combined effects of the different EWA augmentation schemes between the alternatives, as well as the interannual effects from the prior year.

Table 4-9. Differences in simulated outcomes between alternatives (Proposed Action minus No Action alternatives) for Project Supply (the final determination on June 1).

Water year	No Action Project Supply (Acre-Feet)	Proposed Action Alternative Project Supply (Acre-Feet)	Difference (Acre-Feet)
1981	276,543	254,760	-21,783
1982	350,000	350,000	0
1983	350,000	350,000	0
1984	350,000	350,000	0
1985	341,070	341,070	0
1986	350,000	350,000	0
1987	302,780	279,780	-23,000
1988	266,644	243,644	-23,000
1989	350,000	350,000	0
1990	257,751	240,201	-17,549
1991	202,042	163,840	-38,202
1992	11,743	18,798	7,055
1993	350,000	350,000	0
1994	110,957	111,054	97
1995	344,370	344,366	-4
1996	350,000	350,000	0
1997	337,464	337,464	0
1998	350,000	350,000	0
1999	350,000	350,000	0
2000	334,829	334,829	0
2001	263,253	231,398	-31,854
2002	305,590	282,590	-23,000
2003	290,841	265,670	-25,171
2004	291,577	265,887	-25,690
2005	286,069	260,710	-25,359
2006	350,000	350,000	0
2007	303,827	280,827	-23,000
2008	333,197	326,201	-6,996
2009	298,794	275,794	-23,000
2010	256,473	225,328	-31,145
2011	350,000	350,000	0
2012	305,984	282,987	-22,998
2013	263,536	235,118	-28,418
2014	127,707	118,987	-8,719
2015	224,219	203,672	-20,548
2016	310,345	283,780	-26,565
2017	350,000	350,000	0
2018	270,298	241,511	-28,787
2019	329,475	294,058	-35,417

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, to acquire water for fish and wildlife purposes at LKNWR and TLNWR, Reclamation's acquisition of Project water only potentially results in the different place of use within the Project where Project water is applied to beneficial use, there would be no change in total Project Supply as shown in Table 4-9. In drought years, when such a water acquisition program is implemented, and Project Supply is acquired for fish and wildlife purposes, it would reduce the amount Project Supply available for irrigation use. As such, acquiring water for fish and wildlife purposes would have other indirect effects discussed elsewhere in this section (e.g., *see Sections 4.3.3 (groundwater), 4.6 (land use), and 4.7 (socioeconomics)*).

4.3.1.4 Total Spring/Summer Project Diversions

The total spring/summer diversion of surface water consists of the simulated Project diversions through the A Canal and LRDC (Station 48 and Miller Hill Pumping Plant) from March 1 through November 15, and through the Ady and North canals from March through October, plus Project supply from UKL[2]. As such, total spring/summer Project diversions can be denoted by the following equation:

Project Supply[26] diversions (from UKL) + return flow diversions (LRDC and KSD flows) = Total Spring/Summer Project Diversions

No Action Alternative

Under the No Action Alternative, simulated total spring/summer diversions to the Project ranged from 14,420 AF (in years similar to 1992) to 460,932 AF (in years similar to 1999), with a median of 381,496 AF (*Tables 4-10 and 4-12*).

Project diversions from UKL (Project Supply) are summarized for the No Action Alternative in Tables 4-10 and 4-12. Diversions from UKL ranged from 12,299 AF (in years similar to 1992) to 350,663 AF (in years similar to 2006), with a median of 307,065 AF.

Project diversions from KSD and LRDC (return flows) are the non-UKL components of the total spring/summer Project diversions; these diversions are aggregated (diversion of return flow) and summarized for the No Action Alternative in Tables 4-10 and 4-12. Diversion of return flow ranged from 2,121 AF (in years similar to 1992) to 111,150 AF (in years similar to 1999), with a median of 71,206 AF.

Table 4-10 also provides historical spring/summer Project demand over the POR. Additionally, Table 4-10 provides Project demand[27] as a maximum, minimum, and by POE. As can be seen in the table, the median historical project demand (404,799 AF) exceeds the median total project diversion (381,496 AF) by 23,303 AF.

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[26] An estimated 7,436 AF of ungauged diversions that are not explicitly simulated in the KBPM are accounted for operationally by subtracting that volume from Project Supply. KBPM results presented here assume that the ungauged diversions are diverted from Project Supply.

[27]Project demand is defined as Project contractors need for water. For the majority of the POR, Reclamation utilized annual total diversion data to quantify Project demand. However, in other years with involuntary shortages Reclamation estimated Project demand as if the Project was assumed to be unregulated, and also included groundwater use estimates in the following years (2001-2007, 2010, and 2012-2015).

Table 4-10. Probability of exceedance, maximum, and minimum simulated outcomes under the No Action Alternative for total spring/summer (SS) Project diversion of water from Upper Klamath Lake (UKL), from return flows (Lost River Diversion Channel and Klamath Straits Drain), and from all surface water sources combined, relative to historical Project demand [in acre-feet (AF)].

Probability of Exceedance (%)	No Action SS Diversion from UKL (AF)	No Action SS Diversion of Return Flow (AF)	No Action SS Total Project Diversion (AF)	Historical Project Demand (AF)
Maximum	350,663	111,150	460,932	472,665
10%	350,463	104,756	455,419	446,264
20%	349,657	96,012	439,407	424,157
30%	347,862	88,769	420,864	418,665
40%	335,896	77,679	418,527	410,136
50%	307,065	71,206	381,496	404,799
60%	297,575	69,891	372,363	391,615
70%	272,587	62,213	335,160	378,973
80%	264,719	59,946	324,665	373,171
90%	199,671	32,041	231,712	347,028
Minimum	12,299	2,121	14,420	325,000

Figure 4-3 illustrates diversions under the No Action Alternative and Project historical demand over the simulated POR. The stacked bars represent total spring/summer Project diversions divided into diversion from UKL (dark bars) and diversion of return flow (light bars). Each year's historical irrigation demand is represented by the black horizonal line markers. As shown in Figure 4-3, in some years the simulated total spring/summer Project diversions exceed historical demand (i.e., in years similar to 1982-1986). It was assumed in the KBPM simulation that the Project would always utilize all of Project Supply. This was to cover the potential effects (to UKL elevations and IGD releases) of delivering any unused Project Supply to the LKNWR, an action which is included as part of the No Action Alternative.

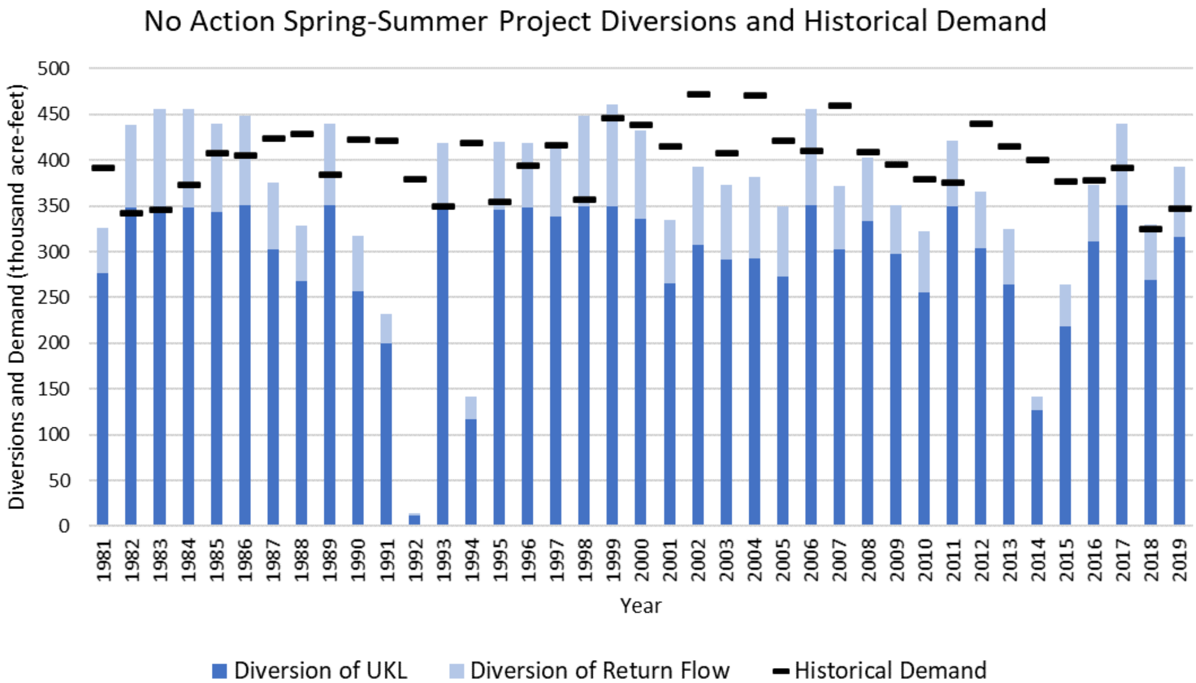

Figure 4-3. Spring-summer Project diversion of surface water from Upper Klamath Lake and return flows (Lost River Diversion Channel and Klamath Straits Drain) under the No Action Alternative, relative to historical Project demand.

Proposed Action Alternative

Under the Proposed Action Alternative, simulated total spring/summer diversions to the Project ranged from 22,476 AF (in years similar to 1992) to 460,928 AF (in years similar to 1999), with a median of 352,377 AF (*Tables 4-11 and 4-12*).

Project diversions from UKL (Project Supply) are summarized for the Proposed Action Alternative in Tables 4-11 and 4-12. Diversions from UKL ranged from 19,206 AF (in years similar to 1992) to 351,658 AF (in years similar to 2017), with a median of 284,697 AF.

Project diversions from KSD and the LRDC are the non-UKL components of the total spring/summer Project diversions; these diversions are aggregated (diversion of return flow) and summarized for the Proposed Action Alternative in Tables 4-11 and 4-12. Diversion of return flow ranged from 3,269 AF (in years similar to 1992) to 111,149 AF (in years similar to 1999), with a median of 70,682 AF.

Table 4-11 also provides historical spring/summer Project demand over the POR. As can be seen in the table, the median historical project demand (404,799 AF) exceeds the median total project diversion (352,377 AF) by 52,422 AF.

Table 4-11. Probability of exceedance, maximum, and minimum simulated outcomes under the Proposed Action Alternative for total spring/summer (SS) Project diversion of water from Upper Klamath Lake (UKL), from return flows (Lost River Diversion Channel and F/FF), and from all surface water sources combined, relative to historical Project demand [in acre-feet (AF)].

Probability of Exceedance (%)	Proposed Action Alternative SS Diversion from UKL (AF)	Proposed Action Alternative SS Diversion of Return Flow (AF)	Proposed Action Alternative SS Total Project Diversion (AF)	Historical Project Demand (AF)
Maximum	351,658	111,149	460,928	472,665
10%	350,548	104,753	455,405	446,264
20%	349,646	96,013	439,377	424,157
30%	347,846	83,022	420,850	418,665
40%	335,898	72,807	417,604	410,136
50%	284,697	70,682	352,377	404,799
60%	275,933	65,354	339,959	391,615
70%	247,188	56,953	302,789	378,973
80%	237,756	53,152	294,901	373,171
90%	162,315	28,859	191,174	347,028
Minimum	19,206	3,269	22,476	325,000

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, the acquisition of Project water, from Project Supply and/or other sources (LRDC and KSD return flows), for use for fish and wildlife purposes in LKNWR and TLNWR would result in the same calculated volumes for total spring/summer Project diversions as those shown in Table 4-11. Reclamation may acquire water for fish and wildlife purposes in 2020 (at LKNWR and TLNWR), and possibly future years (should Congress authorize future funding and authority) from Project Supply and/or other sources including LRDC and KSD return flows. This action would typically only be taken during drought years. In addition to securing critical water supplies for NWRs, this action could potentially result in non-federal demand management and compensation activities within the Project that may partially offset socioeconomic effects to farmers due to shortages of Project water, as described in section 4.7.

Alternatives Compared

Relative to the No Action Alternative, the Proposed Action Alternative reduces total spring/summer Project diversions in most years. Over the POR (1981-2019), the average decrease is simulated to be 14,862 AF for total spring/summer diversions (*Table 4-12*). Of that reduction in diversions, 12,048 AF is the average reduction of UKL diversion, and 2,814 AF is the average reduction of return flow diversions. Similar Project diversions would be made under each alternative during years in which EWA augmentation volumes are simulated to be small or non-existent (*see Section 2*). For example, in years similar to 1996 through 2000 (relatively wet years) UKL Supply would exceed 950,000 AF and no EWA augmentation would be triggered and provided, and as a result, the total spring/summer Project diversions would not differ substantially between alternatives. Similarly, in WYs that mimic 1994 (an exceedingly dry year in which UKL Supply would be below the lower threshold for EWA augmentation of 550,000

AF), the EWA augmentation would not be triggered, causing little difference in diversions between alternatives. In some years, differences between alternatives arise because of interannual effects from operations during the prior year. For example, the 8,056 AF increase in total spring/summer Project diversions in WYs like 1992 would result because UKL elevations at the end of a WY like 1991 would be slightly higher under the Proposed Action Alternative. This would increase UKL Supply slightly, and because EWA would be at its minimum, Project Supply would increase as well. Years with larger differences usually would reflect the combined effects of the different EWA augmentation schemes between the alternatives, as well as, the interannual effects from the prior year.

Table 4-12. Differences in simulated outcomes between alternatives (Proposed Action minus No Action alternatives) for total spring/summer (SS) Project diversions from Upper Klamath Lake (UKL), from return flows (Lost River Diversion Channel and Klamath Straits Drain), and from all surface water sources combined.

Water year	No Action SS Diversion from UKL (Acre-Feet)[28]	Proposed Action SS Diversion from UKL (Acre-Feet)	Difference in Diversion from UKL (Acre-Feet)	No Action Diversion of Return Flow (Acre-Feet)	Proposed Action Diversion of Return Flow (Acre-Feet)	Difference of Return Flows (Acre-Feet)	No Action SS Total Project Diversion (Acre-Feet)	Proposed Action Total Project Diversion (Acre-Feet)	Difference in Total From all Sources (Acre-Feet)
1981	276,118	254,911	-21,207	50,112	45,445	-4,667	326,230	300,356	-25,874
1982	347,862	347,846	-16	91,251	91,249	-2	439,112	439,095	-18
1983	349,751	349,729	-22	105,870	105,864	-6	455,621	455,594	-28
1984	348,486	348,486	0	107,292	107,292	0	455,778	455,778	0
1985	342,924	342,913	-11	96,363	96,360	-3	439,286	439,272	-14
1986	350,568	350,548	-20	98,002	97,997	-5	448,569	448,545	-25
1987	302,630	281,574	-21,056	73,249	68,740	-4,508	375,878	350,314	-25,564
1988	268,212	246,588	-21,624	59,996	56,201	-3,795	328,208	302,789	-25,419
1989	350,638	350,638	0	88,769	88,739	-30	439,407	439,377	-30
1990	256,933	240,253	-16,681	60,065	56,953	-3,113	316,999	297,205	-19,794
1991	199,671	162,315	-37,356	32,041	28,859	-3,182	231,712	191,174	-40,538
1992	12,299	19,206	6,907	2,121	3,269	1,148	14,420	22,476	8,056
1993	348,043	347,950	-93	70,484	70,395	-89	418,527	418,345	-182
1994	116,539	116,625	86	24,958	24,968	10	141,497	141,593	96
1995	345,957	344,409	-1,548	73,591	73,195	-397	419,549	417,604	-1,945
1996	348,059	348,056	-3	70,683	70,682	-1	418,742	418,738	-3
1997	338,303	338,303	0	82,289	82,289	0	420,591	420,591	0
1998	349,796	349,785	-11	98,183	98,180	-3	447,979	447,965	-14
1999	349,782	349,779	-3	111,150	111,149	-1	460,932	460,928	-3
2000	335,896	335,898	3	96,012	96,013	1	431,908	431,911	3
2001	265,269	234,380	-30,889	69,891	62,774	-7,117	335,160	297,154	-38,006
2002	307,065	285,703	-21,362	85,941	80,811	-5,131	393,007	366,514	-26,493
2003	290,900	267,489	-23,411	81,761	72,807	-8,954	372,661	340,296	-32,365
2004	292,450	269,356	-23,095	89,045	83,022	-6,024	381,496	352,377	-29,118
2005	272,587	247,188	-25,399	77,201	70,913	-6,288	349,788	318,101	-31,687
2006	350,663	350,652	-11	104,756	104,753	-3	455,419	455,405	-14
2007	302,407	281,522	-20,885	69,956	65,354	-4,602	372,363	346,876	-25,488
2008	333,573	327,044	-6,529	69,089	67,965	-1,125	402,662	395,008	-7,654
2009	297,575	275,933	-21,642	53,381	48,772	-4,609	350,957	324,706	-26,251
2010	255,708	226,333	-29,375	66,058	59,078	-6,980	321,766	285,411	-36,354
2011	349,657	349,646	-11	71,206	71,204	-3	420,864	420,850	-14

[28] Simulated diversion of Project Supply from UKL

Water year	No Action SS Diversion from UKL (Acre-Feet)[28]	Proposed Action SS Diversion from UKL (Acre-Feet)	Difference in Diversion from UKL (Acre-Feet)	No Action Diversion of Return Flow (Acre-Feet)	Proposed Action Diversion of Return Flow (Acre-Feet)	Difference of Return Flows (Acre-Feet)	No Action SS Total Project Diversion (Acre-Feet)	Proposed Action Total Project Diversion (Acre-Feet)	Difference in Total From all Sources (Acre-Feet)
2012	303,727	282,178	-21,549	62,435	57,781	-4,654	366,162	339,959	-26,203
2013	264,719	237,756	-26,963	59,946	53,152	-6,794	324,665	290,907	-33,757
2014	127,357	118,016	-9,340	13,696	11,058	-2,638	141,053	129,074	-11,978
2015	218,317	197,536	-20,781	45,813	41,290	-4,522	264,129	238,826	-25,303
2016	310,665	284,697	-25,968	62,213	53,661	-8,552	372,878	338,358	-34,520
2017	350,463	351,658	1,195	89,288	89,341	54	439,750	440,999	1,249
2018	268,606	239,485	-29,121	61,709	55,416	-6,293	330,315	294,901	-35,414
2019	315,641	293,570	-22,071	77,679	70,807	-6,872	393,320	364,377	-28,943

Total Project diversions for both the No Action and Proposed Action alternatives are compared to historical demand in Table 4-13 where the difference highlights the shortage. For this analysis, shortage for both alternatives is determined by subtracting total diversions from historical demand. As such, shortage can be denoted by the following equation:

Historical demand – total spring/summer Project diversion = Shortage

There is no shortage when total diversion is greater than historical demand and a 0-AF shortage is reported. The maximum No Action Alternative shortage of 365,210 AF occurs is in 1992. The maximum Proposed Action Alternative shortage of 357,154 AF occurs in the same year. Overall, the average shortage is 13,957 AF higher in the Proposed Action Alternative than the No Action Alternative.

Table 4-13. Project surface water shortages under simulated No Action and Proposed Action alternatives relative to historical Project demand for total spring/summer (SS) Project diversions.

Water year	Historical Project Demand (Acre-Feet)	No Action SS Total Project Diversion (Acre-Feet)	No Action SS Project Shortage (Acre-Feet)	Proposed Action SS Total Project Diversion (Acre-Feet)	Proposed Action SS Project Shortage (Acre-Feet)	Shortage Difference (Acre-Feet)
1981	391,615	326,230	65,385	300,356	91,259	25,874
1982	342,631	439,112	0	439,095	0	0
1983	346,402	455,621	0	455,594	0	0
1984	373,171	455,778	0	455,778	0	0
1985	407,573	439,286	0	439,272	0	0
1986	404,799	448,569	0	448,545	0	0
1987	424,157	375,878	48,279	350,314	73,843	25,564
1988	428,679	328,208	100,471	302,789	125,890	25,419
1989	384,674	439,407	0	439,377	0	0
1990	422,095	316,999	105,096	297,205	124,890	19,794
1991	421,849	231,712	190,137	191,174	230,675	40,538
1992	379,630	14,420	365,210	22,476	357,154	-8,056
1993	350,141	418,527	0	418,345	0	0
1994	418,665	141,497	277,168	141,593	277,072	-96
1995	354,270	419,549	0	417,604	0	0
1996	394,673	418,742	0	418,738	0	0
1997	416,979	420,591	0	420,591	0	0
1998	357,419	447,979	0	447,965	0	0
1999	446,264	460,932	0	460,928	0	0
2000	438,147	431,908	6,239	431,911	6,236	-3
2001	414,817	335,160	79,657	297,154	117,663	38,006
2002	472,665	393,007	79,658	366,514	106,151	26,493
2003	407,224	372,661	34,563	340,296	66,928	32,365
2004	471,008	381,496	89,512	352,377	118,631	29,118
2005	421,869	349,788	72,081	318,101	103,768	31,687
2006	410,136	455,419	0	455,405	0	0
2007	459,057	372,363	86,694	346,876	112,181	25,488
2008	408,776	402,662	6,114	395,008	13,768	7,654
2009	395,947	350,957	44,990	324,706	71,241	26,251
2010	378,973	321,766	57,207	285,411	93,562	36,354
2011	375,186	420,864	0	420,850	0	0
2012	439,748	366,162	73,586	339,959	99,789	26,203
2013	414,710	324,665	90,045	290,907	123,803	33,757
2014	400,885	141,053	259,832	129,074	271,811	11,978
2015	376,400	264,129	112,271	238,826	137,574	25,303
2016	378,555	372,878	5,677	338,358	40,197	34,520

Water year	Historical Project Demand (Acre-Feet)	No Action SS Total Project Diversion (Acre-Feet)	No Action SS Project Shortage (Acre-Feet)	Proposed Action SS Total Project Diversion (Acre-Feet)	Proposed Action SS Project Shortage (Acre-Feet)	Shortage Difference (Acre-Feet)
2017	391,032	439,750	0	440,999	0	0
2018	325,000	330,315	0	294,901	30,099	30,099
2019	347,028	393,320	0	364,377	0	0

Table 4-14. Probability of exceedance, maximum, and minimum simulated outcomes under the No Action and Proposed Action alternatives for shortages from historical Project demand for total spring/summer (SS) Project diversions.

Probability of Exceedance (%)	No Action SS Project Shortage (Acre-Feet)	Proposed Action SS Project Shortage (Acre-Feet)	SS Project Shortage Difference (Acre-Feet)
Maximum	365,210	357,154	-8,056
10%	190,137	230,675	40,538
20%	90,045	123,803	33,757
30%	79,657	106,151	26,494
40%	57,207	91,259	34,052
50%	6,239	40,197	33,958
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Minimum	0	0	0

Figure 4-4 illustrates the Proposed Action Alternative total spring/summer Project diversions, the No Action Alternative total spring/summer Project diversions and Project historical demand over the simulated POR. The stacked bars represent total spring/summer Project diversions under the Proposed Action Alternative divided into diversion from UKL (Project Supply; dark bars) and diversion of return flows (LRDC and KSD return flows; light bars). Each year's historical demand is represented by the black horizonal line markers. The diamond markers show total spring/summer Project diversions under the No Action Alternative. Note that in some years the simulated total diversions exceed historical demand (e.g., WYs similar to 1982-1986). It was assumed in the KBPM simulation that the Project would always utilize all of Project Supply. This covers the possibility of any remaining Project Supply being delivered to LKNWR being delivered to LKNWR prior to the end of November.

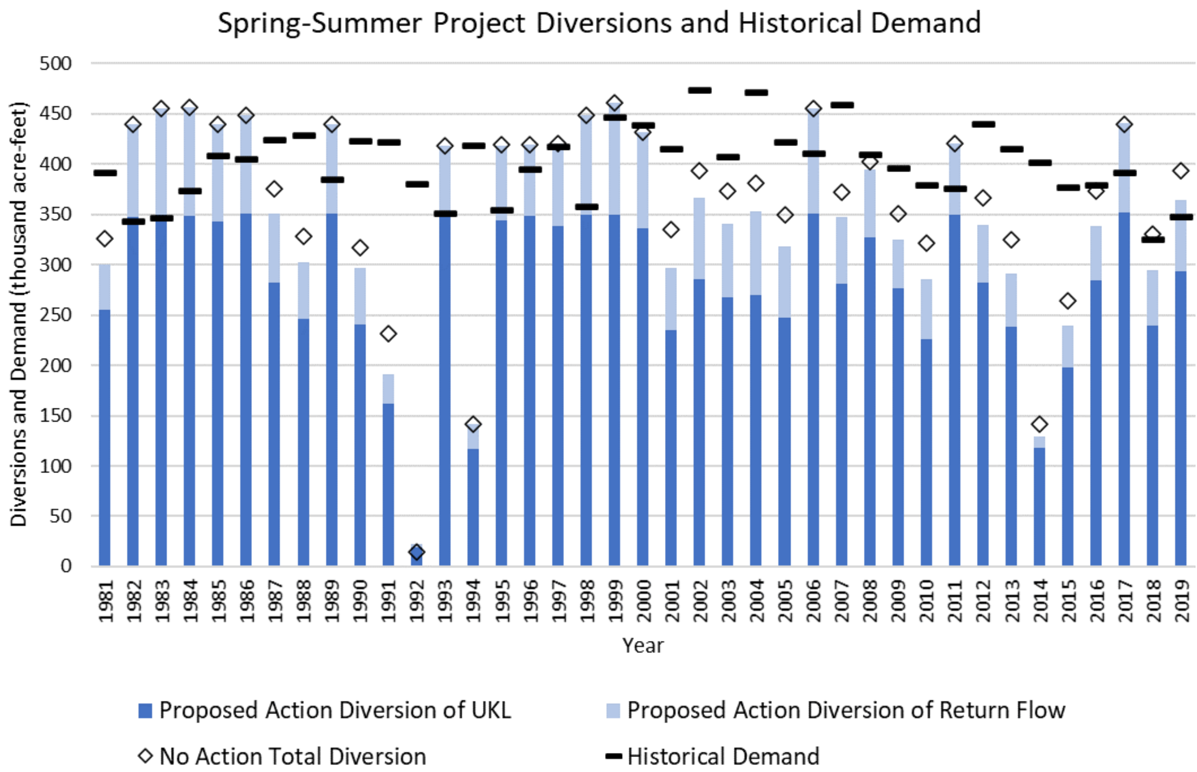

Figure 4-4. Spring-summer Project diversion of surface water from Upper Klamath Lake and return flows (Lost River Diversion Channel and Klamath Straits Drain) under the Proposed Action Alternative, relative to historical Project demand and total spring-summer diversions under the No Action Alternative.

Differences in simulated daily Project diversions during the spring/summer period are shown for a representative period (WYs 2015-2019) in *Figure 4-5*. The seasonal patterns of Project diversions remain intact under each alternative.

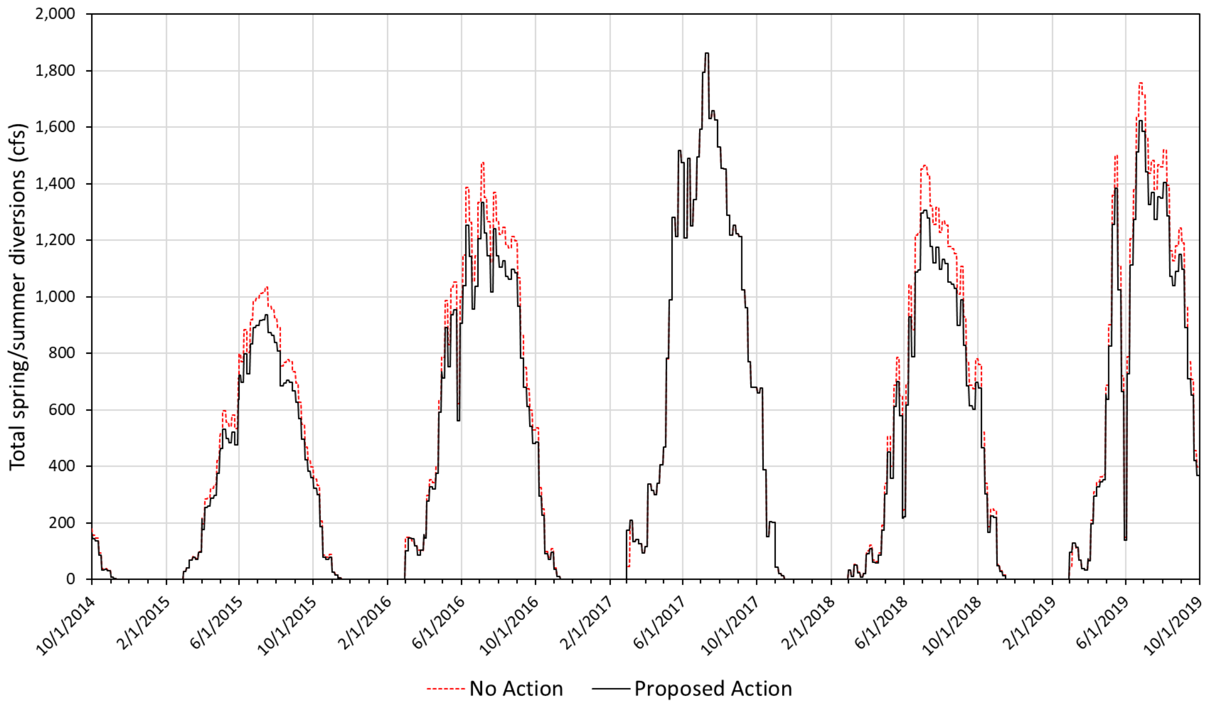

Figure 4-5. Daily time series of total spring/summer Project diversions for a representative period (water years 2015-2019) from simulations for each alternative.

4.3.1.5 Total Fall/Winter Project Diversions

The fall/winter diversion of surface water consists of the simulated diversions from November through February for diversions of UKL water into Area A2. Deliveries are limited to 28,910 AF, which is the maximum amount of diversions under the current water right of record associated with lands in Area A2 for the November through February period. The fall/winter Project diversions discussed here do not include diversions into the LKNWR, which is discussed in *Section 4.3.1.6, Total Annual LKNWR Deliveries from UKL and the Klamath River*. Unlike the spring/summer Project diversions, the fall/winter Project diversions are subject to UKL control, which means that daily diversions can be reduced by up to 80 percent depending on the extent to which UKL elevations are below UKL central tendency elevations (*see Section 2.2.4*).

No Action Alternative

Simulated total fall/winter Project diversion under the No Action Alternative would remain steady at 28,910 AF across about 80 percent of the years similar to those in the POR, with the minimum diversion (in years like 1992) approximately 17,000 AF lower (*Tables 4-15 and 4-17*). Years that are below the 28,910 AF total fall/winter Project diversion amount reflect simulated conditions in which UKL elevations would remain substantially below UKL central tendency for extended periods, thereby reducing daily diversions to the extent that the total is not attained by the end of February.

Table 4-15. Probability of exceedance, maximum, and minimum simulated outcomes for total fall/winter Project diversions under the No Action Alternative.

Probability of Exceedance (%)	No Action Fall/Winter Project Diversion (Acre-Feet)
Maximum	28,910
10%	28,910
20%	28,910
30%	28,910
40%	28,910
50%	28,910
60%	28,910
70%	28,910
80%	28,910
90%	19,921
Minimum	11,749

Proposed Action Alternative

Project Operations

Simulated total fall/winter Project diversions under the Proposed Action Alternative would remain steady at 28,910 AF across about 70 percent of the years in the POR, with the minimum diversion (in years similar to 2016) about 19,000 AF lower (*Table 4-16*) around 10,000 AF. Years that are below the 28,910 AF maximum fall/winter Project diversion amount reflect conditions in which UKL elevations would remain substantially below UKL central tendency for extended periods, reducing daily diversions to the extent that the maximum is not attained by the end of February.

Table 4-16. Probability of exceedance, maximum, and minimum simulated outcomes for total fall/winter Project diversions under the Proposed Action Alternative.

Probability of Exceedance (%)	Proposed Action Fall/Winter Project Diversion (Acre-Feet)
Maximum	28,910
10%	28,910
20%	28,910
30%	28,910
40%	28,910
50%	28,910
60%	28,910
70%	28,910
80%	23,833
90%	19,148
Minimum	10,337

Refuge Water Acquisition

Reclamation does not propose to acquire water that is part of the fall/winter supply as described here. Accordingly, the refuge water acquisition component of the Proposed Action Alternative, to acquire water for fish and wildlife purposes at LKNWR and TLNWR would not impact fall/winter Project diversions, either with respect to the volume of this water or where or how it is used for beneficial purpose.

Alternatives Compared

As mentioned above, some years are below the 28,910 AF maximum fall/winter Project diversion amount as a result of UKL control logic, something that happens more frequently under the Proposed Action Alternative (*Table 4-17*). Typically, this would occur after a dry WY in which UKL elevations are lower than the UKL central tendency elevations. Notably, interannual effects from the previous year can also affect total fall/winter Project diversions. For example, total fall/winter Project diversions under the Proposed Action Alternative would be higher in a WY similar to 1992 than under the No Action Alternative, because UKL levels are simulated to be slightly higher transitioning out of a previous WY like 1991. The incrementally reduced effects of UKL control that resulted under the Proposed Action Alternative allowed for more fall/winter diversion in WY 1992, but still prevented total fall/winter Project diversions from reaching 28,910 AF.

Table 4-17. Differences in simulated outcomes between alternatives (Proposed Action minus No Action alternatives) for total fall/winter Project diversions.

Water year	No Action Fall/Winter Diversion (Acre-Feet)	Proposed Action Fall/Winter Diversion (Acre-Feet)	Difference (Acre-Feet)
1981	28,910	28,910	0
1982	28,910	28,910	0
1983	28,910	28,910	0
1984	28,910	28,910	0
1985	28,910	28,910	0
1986	28,910	28,910	0
1987	28,910	28,910	0
1988	28,910	28,910	0
1989	28,910	28,910	0
1990	28,910	28,910	0
1991	28,910	28,904	-6
1992	11,749	19,148	7,398
1993	19,921	19,751	-170
1994	28,910	28,910	0
1995	17,882	17,846	-36
1996	28,910	28,910	0
1997	28,910	28,910	0
1998	28,910	28,910	0
1999	28,910	28,910	0
2000	28,910	28,910	0
2001	28,910	28,910	0
2002	28,910	28,910	0
2003	21,669	14,805	-6,864
2004	28,910	24,591	-4,319
2005	28,910	28,909	-1
2006	28,910	28,910	0
2007	28,910	28,910	0
2008	28,910	28,910	0
2009	28,910	28,910	0
2010	28,910	28,910	0
2011	28,910	28,910	0
2012	28,910	28,910	0
2013	28,910	28,910	0
2014	22,198	19,522	-2,676
2015	28,910	28,910	0
2016	14,570	10,337	-4,233
2017	28,910	23,833	-5,077
2018	28,910	28,910	0
2019	28,910	20,682	-8,228

Daily simulated fall/winter Project diversions are plotted in Figure 4-6 for a representative sequence of WYs similar to 2015-2019. Here, the effects of UKL control are seen in WYs that resemble 2016, 2017, and 2019. Figure 4-1 shows that in a year similar to 2016, UKL elevations would be 0.36 ft lower at the beginning of the WY under the Proposed Action Alternative (4138.24 versus 4138.60 ft). While both alternatives are simulated to be below UKL central tendency to an extent that produced maximum reductions in diversions over much of the fall/winter period, UKL elevations would improve sufficiently under the No Action Alternative resulting in increased diversions in February, although the increase would not be sufficient to allow for diversion of the full 28,910 AF (*Table 4-17)*. In WYs similar to 2017 and 2019, UKL control logic would constrain diversion rates to a greater extent under the Proposed Action Alternative, preventing diversion of the full amount in those years.

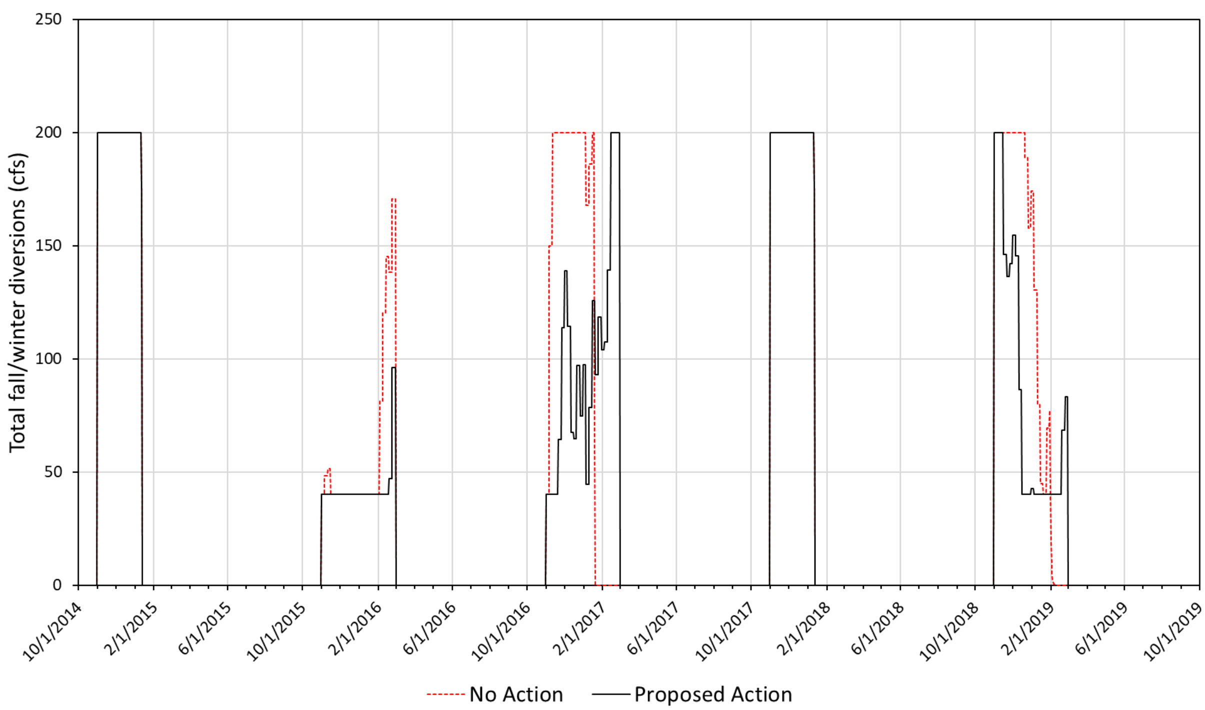

Figure 4-6. Daily time series of total fall/winter Project diversions for a representative period (water years 2015-2019) from simulations for each alternative. There are no differences between simulated fall/winter deliveries between the No Action and Proposed Action alternatives in 2014/2015 and 2017/2018.

4.3.1.6 Total Annual Lower Klamath National Wildlife Refuge Deliveries from Upper Klamath Lake and the Klamath River

The simulated water supply available from the Klamath River and UKL for LKNWR is presented here in terms of total annual deliveries, to reflect how water is currently managed within the refuge (i.e., with extensive reuse of water and little drainage off the refuge over the course of a year). In the simulations, LKNWR deliveries are assumed to be a constant 62 cfs from December through February (about 11,000 AF in total), another 11,000 AF from April through September for the Agency Lake-Barnes Ranch transferred water right, and up to an additional 3,000 AF during June and July under certain hydrologic conditions (*see* section 4.3.2.2.2.2 of the modified 2018 Operations Plan). Daily refuge diversions can be reduced up to 80 percent by UKL control logic during December through February (*see Section 2 and the* *modified 2018 Operations Plan for more detailed information regarding water availability to the LKNWR*).

Simulations within the KBPM result in all of the Project Supply during the spring/summer period being diverted for use within the Project and therefore, unavailable to supplement LKNWR deliveries. In actual operations and under certain hydrologic and meteorological conditions (wet years with full Project Supply and/or reduced Project demand), there frequently is Project Supply available for delivery to LKNWR towards the end of the spring/summer period because it is not needed by water users who otherwise have a contractual right to use such water. Demand for water may be less than available supply for any number of reasons, including precipitation events and low temperatures which can reduce demand. Under both alternatives, Project Supply can and would be delivered to LKNWR to an extent not inconsistent with Reclamation's contractual obligations to other Project water users. Thus, actual deliveries to LKNWR in some years within the POR would be expected to be greater than shown in the KBPM simulated output under both alternatives. Given the potential reduction of 23,000 AF to Project Supply in certain year types under the Proposed Action Alternative (occurring in approximately half the years in the POR), the availability of 'unused' Project Supply is less likely; thus, the No Action Alternative would likely result in greater overall deliveries to the Refuge.

No Action Alternative
Under the No Action Alternative, simulated deliveries to the LKNWR ranged from 13,539 AF (1992) to 25,191 AF (1984), with a median of 22,068 AF (*Tables 4-18 and 4-20*).

Table 4-18. Probability of exceedance, maximum, and minimum simulated outcomes for total diversions to the Lower Klamath National Wildlife Refuge under the No Action Alternative.

Probability of Exceedance (%)	No Action Refuge Diversion (Acre-Feet)
Maximum	25,191
10%	25,068
20%	25,046
30%	22,191
40%	22,068
50%	22,068
60%	22,068
70%	22,068
80%	18,825
90%	15,205
Minimum	13,539

Proposed Action Alternative
<u>Project Operations</u>

Under the Proposed Action Alternative, simulated deliveries to the LKNWR ranged from 13,467 AF (2016) to 25,191 AF (1984), with a median of 22,068 AF (*Tables 4-19 and 4-20*). Note that decreases in diversions accelerate as the years become drier. Unused Project Supply is not expected to be available for delivery to LKNWR in hydrologic years like 2020. This would result in inadequate water supplies for LKNWR absent any water (up to 25,000 AF) that would be acquired by Reclamation under the water acquisition component of the Proposed Action Alternative described in section 2.4.4.

Table 4-19. Probability of exceedance, maximum, and minimum simulated outcomes for total annual diversions to the Lower Klamath National Wildlife Refuge under the Proposed Action Alternative.

Probability of Exceedance (%)	**Proposed Action Refuge Diversion (Acre-Feet)**
Maximum	25,191
10%	25,068
20%	25,046
30%	22,191
40%	22,068
50%	22,068
60%	22,068
70%	20,834
80%	16,806
90%	14,261
Minimum	13,467

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, Reclamation would acquire up to 25,000 AF of Project Supply from UKL and/or other sources (LRDC and KSD return flows), for use for fish and wildlife purposes within LKNWR. This acquisition could increase the volumes delivered to LKNWR shown in Table 4-19. However, the amount of additional water (which could be up to 25,000 AF) that could be delivered as a result of the water acquisition component of the Proposed Action Alternative is currently uncertain in 2020 and future years.

Alternatives Compared

Relative to the No Action Alternative, the Proposed Action Alternative reduces annual deliveries to the LKNWR in many years, with an average reduction of 528 AF over the 1981-2019 POR (*Table 4-20*). Differences between alternatives can arise in some years because of interannual effects from operations during the prior year.

Although the volume and mechanism are uncertain, the component of the Proposed Action Alternative to acquire water for fish and wildlife purposes at LKNWR and TLNWR could increase the volume of water delivered to LKNWR shown in Table 4-17. However, the exact volume of water that could be acquired is uncertain and could be zero in some or all of the years.

Table 4-20. Differences in simulated outcomes between alternatives (Proposed Action minus No Action alternatives) for total diversions to the Lower Klamath National Wildlife Refuge.

Water year	No Action Refuge Diversion (Acre-Feet)	Proposed Action Refuge Diversion (Acre-Feet)	Difference (Acre-Feet)
1981	22,068	22,068	0
1982	25,068	25,068	0
1983	25,068	25,068	0
1984	25,191	25,191	0
1985	22,068	22,068	0
1986	24,629	24,629	0
1987	22,068	22,068	0
1988	22,191	22,191	0
1989	23,994	24,042	48
1990	22,068	22,068	0
1991	19,311	16,616	-2,695
1992	13,539	14,145	606
1993	17,006	16,985	-21
1994	21,610	21,614	4
1995	15,205	15,201	-4
1996	25,046	25,046	0
1997	22,068	22,068	0
1998	25,068	25,068	0
1999	25,068	25,068	0
2000	22,191	22,191	0
2001	22,068	22,068	0
2002	22,068	21,026	-1,042
2003	15,945	14,852	-1,094
2004	19,343	17,016	-2,328
2005	18,825	16,806	-2,018
2006	25,064	25,064	0
2007	22,068	22,068	0
2008	22,191	22,191	0
2009	22,068	22,068	0
2010	22,068	20,834	-1,234
2011	25,068	25,068	0
2012	22,191	22,191	0
2013	22,068	21,555	-513
2014	14,192	13,625	-567
2015	22,068	22,068	0
2016	14,718	13,467	-1,251
2017	24,466	19,962	-4,505
2018	22,068	22,068	0
2019	18,222	14,261	-3,961

Daily simulated LKNWR diversions are plotted in Figure 4-7 for a representative sequence of WYs similar to 2015-2019. The effects of UKL control are seen in the simulated WYs similar to 2016, 2017, and 2019, where deliveries are reduced in the Proposed Action Alternative because UKL elevations are lower when remaining spring/summer Project Supply and/or refuge water acquisition activities are not implemented.

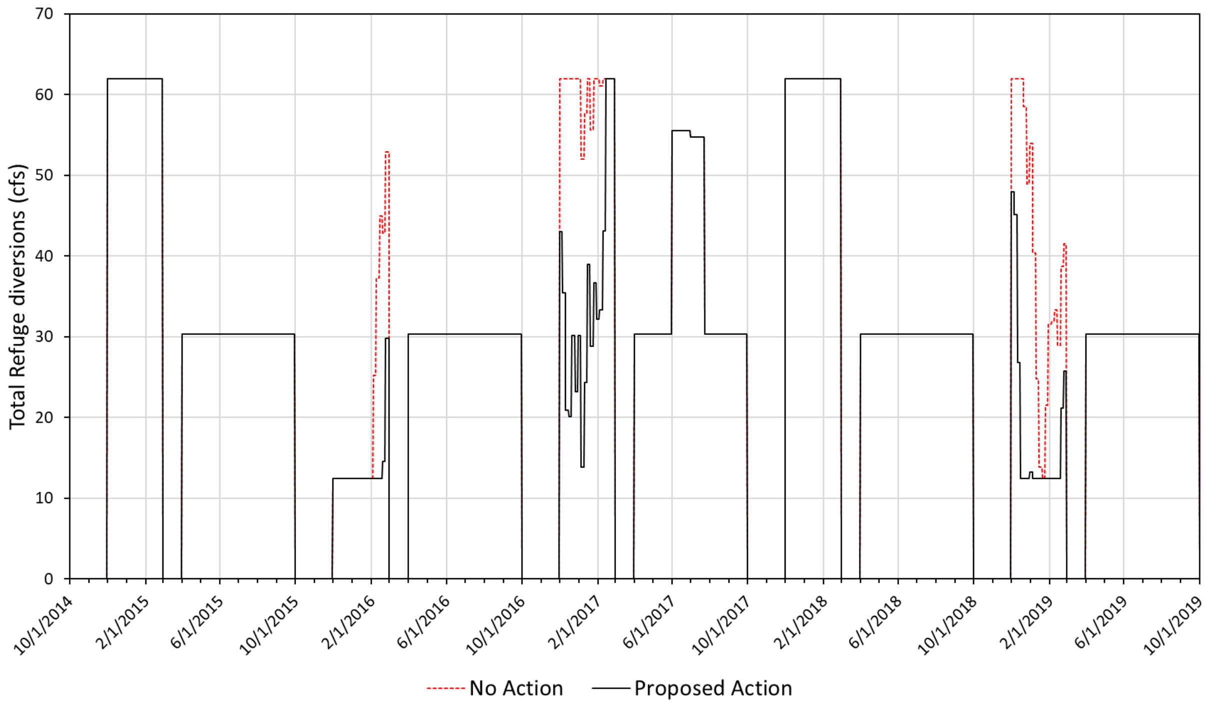

Figure 4-7. Daily time series of total diversions to the Lower Klamath National Wildlife Refuge for a representative period (water years 2015-2019) from simulations for each alternative. There are no differences in simulated Lower Klamath National Wildlife Refuge deliveries in 2015 and 2018 between the No Action and Proposed Action alternatives.

4.3.2 Water Quality

Upper Klamath Basin

The Proposed Action Alternative would likely result in UKL elevations similar to or slightly less than those of the No Action Alternative, so any water quality changes are unlikely between the alternatives. Current peer reviewed literature suggests that there is little or no relationship between water levels in UKL and water quality (Wood et al. 1996; NRC 2004; Morace 2007). Therefore, the Proposed Action Alternative is anticipated to have no impacts to current water quality in the Upper Klamath River or Lost River. The driving force for water quality in the Upper Klamath River is water emanating from UKL. The quality of water entering, within, and leaving the Keno Impoundment is largely due to the export of algal biomass from UKL, and subsequent decomposition within this reach (ODEQ 2018). Because the water quality from UKL is not anticipated to change under the Proposed Action Alternative, water quality in the Upper Klamath River is not anticipated to be impacted by this action.

Lower Klamath Basin

The Proposed Action Alternative would provide an additional 40,000 AF for EWA augmentation in certain WY types (*see Section 2.4*). The Proposed Action Alternative and the additional 40,000 AF of water would likely have only minor effects, either positive or negative, on overall water quality factors such as nutrients or physical parameters (e.g., DO, water temperature) as compared to the No Action Alternative. Water from the source (i.e., UKL) and releases from the down river reservoirs would still be the principal driving factor on Klamath River and these water quality parameters, because the source water is still the same.

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, KSD return flows are available for use within the Project and therefore could be acquired for use within LKNWR. However, the acquisition of water for the refuges would not reduce the volume or timing of KSD return flows under the Proposed Action, just the location of where KSD return flows were re-applied to beneficial use (i.e., private versus public lands).

Modeling studies indicate that water quality from KSD either under current conditions or under improved conditions has only very localized effects on Klamath River water quality (USGS, 2013). Water emanating from UKL is the predominant control on water quality in the Link River to Keno Dam reach of the Klamath River (USGS 2013). The Proposed Action Alternative, including the component of acquiring water for NWRs, is not anticipated to change the rate or volume of KSD return flows that are reused for beneficial use within the Project.

4.3.3 Groundwater

The USGS, in coordination with Reclamation, OWRD and other local entities, has conducted investigations attempting to quantify, through hydrologic models, an appropriate level of groundwater pumping within the Upper Klamath Basin and more specifically the Project (USGS 2012; Wagner and Gannett 2014). The models attempt to suggest the quantity of supplemental groundwater that can be sustainably pumped within the Project depending on the constraints placed on pumping impacts (e.g., acceptable drawdown levels, reductions in groundwater discharge to surface water, or reductions in agricultural return flows).

These investigations and further communication with OWRD (Gall 2018) suggest that supplemental groundwater pumping within the Project of less than 80,000 AF in any given year and that does not exceed an annual average of 30,000 AF over a ten-year period, is consistent with sustainability objectives (herein the 30/80 rule).

Groundwater levels in Oregon are monitored by OWRD through a network of monitoring wells. The purpose of monitoring is to provide information used by OWRD to ensure that groundwater pumping impacts remain within acceptable limits, for example, by issuing drought permits only in areas which have experienced less than 20 ft of drawdown. Although there is no corresponding program in California, TID monitors its own wells and is developing a Groundwater Sustainability Plan under California's SGMA for groundwater sustainability by 2042.

Using monitoring data to correlate groundwater levels with actual pumping volumes would allow a groundwater budget to be developed. A groundwater budget would prescribe allowable pumping volumes to avoid unacceptable drawdown of groundwater levels. Unfortunately, the monitoring network is not dense enough to be used for this purpose; the relationship between actual groundwater levels and pumping volumes is not well understood. Because of this, as well as the lack of coordinated well monitoring and reporting across the state line into California, it is impossible at this time to devise a groundwater pumping budget with any certainty. As such, the 30/80 rule is useful mainly for modeling purposes where the objective is to compare simulated alternatives, but not for management of quantities of groundwater utilized. In real time operations and depending on the year type, the state agencies may allow for more groundwater to be utilized than what is simulated to be provided under the 30/80 rule.

Accordingly, Reclamation is using the 30/80 rule only for the purpose of estimating the socioeconomic impact (*described below in section 4.7*) of the two action alternatives. Recognizing that the nature of surface water shortages can result in highly variable demand for groundwater (e.g., several years of adequate surface water supply requiring no groundwater supplementation followed by severe drought necessitating high levels of groundwater supplementation), Reclamation would continue to rely on the state agencies with jurisdiction over groundwater to ensure that it is used in a sustainable manner.

Table 4-21. Simulated groundwater use over the Period of Record (POR) using the 30/80 Rule. Project demand is historic demand based on the POR and used as a reference for comparison of the two alternatives. Project supply (Supply) [29]under either alternative is the sum of Project Supply and return flows from Klamath Straits Drain and Lost River Diversion Channel. *Note: 2018 demand includes 30 thousand acre-feet (TAF) of assumed demand which was not realized due to activities of the Drought Relief Act.*

Year	Demand (TAF)	Supply Under No Action (TAF)	Shortage Under No Action (TAF)	GW Utilization Under No Action (TAF)	10 Yr Avg GW Under No Action (TAF)	Residual Shortage Under No Action (TAF)	Supply Under Proposed Action (TAF)	Shortage Under Proposed Action (TAF)	GW Utilization Under Proposed Action (TAF)	10 Yr Avg GW Under Proposed Action (TAF)	Residual Shortage Under Proposed Action (TAF)
1981	392	326	-65	65		0	300	-91	80		-11
1982	343	439	0	0		0	439	0	0		0
1983	346	456	0	0		0	456	0	0		0
1984	373	456	0	0		0	456	0	0		0
1985	408	439	0	0		0	439	0	0		0
1986	405	449	0	0		0	449	0	0		0
1987	424	376	-48	48		0	350	-74	74		0
1988	429	328	-100	80		-20	303	-126	80		-46
1989	385	439	0	0		0	439	0	0		0
1990	422	317	-105	80	27.4	-25	297	-125	66	30.0	-59
1991	422	232	-190	80	28.8	-110	191	-231	80	30.0	-151
1992	380	14	-365	12	30.0	-353	22	-357	0	30.0	-357
1993	350	419	0	0	30.0	0	418	0	0	30.0	0
1994	419	141	-277	0	30.0	-277	142	-277	0	30.0	-277
1995	354	420	0	0	30.0	0	418	0	0	30.0	0
1996	395	419	0	0	30.0	0	419	0	0	30.0	0
1997	417	421	0	0	25.2	0	421	0	0	22.6	0
1998	357	448	0	0	17.2	0	448	0	0	14.6	0
1999	446	461	0	0	17.2	0	461	0	0	14.6	0
2000	438	432	-6	6	9.8	0	432	-6	6	8.6	0
2001	415	335	-80	80	9.8	0	297	-118	80	8.6	-38
2002	473	393	-80	80	16.6	0	367	-106	80	16.6	-26
2003	407	373	-35	35	20.0	0	340	-67	67	23.3	0
2004	471	381	-90	80	28.0	-10	352	-119	67	30.0	-52
2005	422	350	-72	20	30.0	-52	318	-104	0	30.0	-104
2006	410	455	0	0	30.0	0	455	0	0	30.0	0
2007	459	372	-87	0	30.0	-87	347	-112	0	30.0	-112
2008	409	403	-6	0	30.0	-6	395	-14	0	30.0	-14
2009	396	351	-45	0	30.0	-45	325	-71	0	30.0	-71
2010	379	322	-57	6	30.0	-51	285	-94	6	30.0	-87
2011	375	421	0	0	22.0	0	421	0	0	22.0	0
2012	440	366	-74	74	21.4	0	340	-100	80	22.0	-20
2013	415	325	-90	80	26.0	-10	291	-124	80	23.3	-44
2014	401	141	-260	80	26.0	-180	129	-272	80	24.6	-192
2015	376	264	-112	60	30.0	-52	239	-138	54	30.0	-84
2016	379	373	-6	0	30.0	-6	338	-40	0	30.0	-40
2017	391	440	0	0	30.0	0	441	0	0	30.0	0
2018	325	330	0	0	30.0	0	295	-30	0	30.0	-30
2019	347	393	0	0	30.0	0	364	0	0	30.0	0
2020	**380**	**168**	**-212**	**6**	**30.0**	**-206**	**145**	**-235**	**6**	**30.0**	**-229**

[29] Reclamation utilized the March 1 NRCS inflow forecast for the Project Supply estimates in this table. The final Environmental Assessment will utilize the April 1 NRCS inflow forecast

No Action Alternative

Under the No Action Alternative, it is likely that groundwater pumping would continue to occur for the purpose of supplementing available Project surface water supplies in years when they are inadequate to meet the full demand[30] of irrigated agriculture. Over the POR, inadequate surface water supplies would occur in 22 of 39 years (56 percent). Sustainable management of groundwater[31] would permit groundwater supplementation in 17 of those 22 water-short years (77 percent) but would fully relieve the surface water shortage in only 7 of those 22 years (32 percent). Total estimated groundwater utilization over the POR using the groundwater management guidelines would total 965,000 AF. Under these assumptions, groundwater utilization under the No Action Alternative simulation would total approximately 6,000 AF of groundwater available in a year like 2020 to keep long-term average groundwater utilization below 30,000 AF. However, it is recognized that due to the large uncertainties surrounding the relationship between groundwater utilization within and near the Project and groundwater impacts, actual pumping in years of Project surface water shortage is likely to exceed this quantity.

Excessive groundwater-level declines have the potential to cause land subsidence. However, there are no known published studies of land subsidence in or near the Project area correlated with groundwater pumping (Reclamation and CDFG 2012).

Proposed Action Alternative

<u>Project Operations</u>

Under the Proposed Action Alternative, it is likely that groundwater pumping would occur for the purpose of supplementing available Project surface water supplies in years when water supplies are inadequate to meet the full demand of irrigated agriculture. Over the POR, inadequate surface water supplies are simulated to occur in 23 of 39 years (59 percent). Groundwater supplementation would occur in 15 of those 23 water-short years (65 percent) but would fully relieve the surface water shortage in only 3 of those 23 years (13 percent). Total groundwater utilization over the POR would total 980,000 AF, an increase in pumping of about 1.6 percent compared to the No Action Alternative. Similar to the No Action Alternative, due to simulated prior years' groundwater utilization, only 6,000 AF of groundwater would be available in WY 2020 if groundwater was being managed according to the 30/80 rule and the simulated groundwater extraction assumed to occur actually occurred in the POR. However, it is recognized that due to the large uncertainties surrounding the relationship between groundwater utilization within and near the Project and groundwater impacts, actual pumping in years of Project surface water shortage is likely to exceed this quantity.

This scenario for groundwater management under either the No Action or Proposed Action Alternative implies that the states of Oregon and California, tasked with groundwater management, take action under their respective state laws to minimize the occurrence and

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[30]Project demand is defined as Project contractors need for water. For the majority of the POR, Reclamation utilized annual total diversion data to quantify Project demand. However, in other years with involuntary shortages Reclamation estimated Project demand as if the Project was assumed to be unregulated, and also included groundwater use estimates in the following years (2001-2007, 2010, and 2012-2015).

[31] As described above, when defining sustainable management, it refers to meeting the objective of pumping groundwater less than 80,000 AF in any given year and not exceeding an annual average of 30,000 AF over a ten-year period.

severity of impacts to groundwater resulting from its legal use. However, in California, where the state's groundwater management mechanism is still being developed and groundwater sustainability is not mandated until 2042, it appears unlikely that such regulation would actually occur, resulting in increases in impacts to groundwater resources within the term of the Proposed Action Alternative in the form of declining groundwater levels. However, surface water impacts from these declining groundwater levels are unlikely during this term (Gannett et al. 2012).

In Oregon, OWRD has the responsibility of managing groundwater extraction in order to ensure long-term sustainable groundwater use. This has been occurring through a moratorium on permits for new wells and through restrictions on issuance of drought permits to avoid areas of excessive use. As a result, groundwater may not be available for some well owners not holding primary or supplemental groundwater rights, particularly in areas experiencing groundwater level declines of concern to OWRD.

Excessive groundwater-level declines have the potential to cause land subsidence. However, there are no known published studies of land subsidence in or near the Project area correlated with groundwater pumping (Reclamation and CDFG 2012).

Alternatives Compared

Comparing the No Action and Proposed Action alternatives, there is only a 1.6 percent difference in simulated groundwater pumping under the 30/80 Rule (965,000 AF versus 980,000 AF). Actual groundwater pumping would likely exceed the quantity estimated to be available under the simulation but would be managed by the respective states. There is no reason to believe that the states will regulate groundwater use any differently under the Proposed Action Alternative as under the No Action Alternative.

<u>Refuge Water Acquisition</u>

The refuge water acquisition component of the Proposed Action Alternative, in which Reclamation would acquire up to 25,000 AF of Project water for fish and wildlife purposes at LKNWR and TLNWR, may result in additional impacts to groundwater. Although Reclamation would not be the entity acquiring groundwater, it is possible that the entity from whom Reclamation would be purchasing Project water would at least partially replace that water with groundwater. However, Oregon water law does not permit groundwater pumping by supplemental or drought permit holders for this purpose (pumping groundwater when surface water is available). Again, the states have the final responsibility for regulating groundwater use to avoid unacceptable impacts.

The level of groundwater pumping that occurs within the Project area is directly related to the surface water supply from the Project. This fact notwithstanding, districts and their representative entities would likely use federal funds obtained from Reclamation's water acquisition program to compensate well owners for the cost of pumping to mitigate involuntary shortages of Project water, which could mitigate to some extent the socioeconomic impacts associated with the Proposed Action Alternative.

4.3.3.1 Groundwater Quality

Because there are no known areas of impaired groundwater quality in the geographic scope of either alternative, any changes in groundwater elevations due to the implementation of either alternative assessed in this effort would not result in impacts to groundwater quality.

4.4 Biological Resources

4.4.1 Upper Klamath River Basin/Upper Klamath Lake Federally Protected Species

No Action Alternative

Lost River and Shortnose Suckers

Under the No Action Alternative, the allocation formulas for Project Supply and EWA, along with other components of the action including the UKL Credit and UKL Control logic, results in UKL elevations during the late summer that would provide deep-water habitat (13 to 20 ft) available for adult suckers in the northern portion of UKL. The late summer elevations would also provide access to refugial habitat in Pelican Bay for adult and juvenile suckers. Based on observed high and consistent adult survival across a wide range of lake elevations, the No Action Alternative is not expected to affect adult sucker survival in UKL.

The No Action Alternative aims to minimize the impacts of implementing components of the water management approach (e.g., flushing flows) on UKL elevations by implementing flows in conjunction with an accretion event and maintaining UKL elevations above 4,142.00 ft as often as possible. This elevation has been identified as important for maintaining adequate depth along the eastern shore of UKL for spawning LRS and subsequent egg development. The No Action Alternative maintains UKL elevations above 4,142.00 ft during the months of March, April, and May in 35 out of the 39-year POR. The four years in which UKL elevations are not maintained above 4,142.00 ft through May are characterized as critically-dry and include WYs 1991, 1992, 1994, and 2014.

The No Action Alternative results in UKL surface elevations on July 15 below 4140.80 ft in 5 of 39 years in the POR. Below this elevation, less than 50 percent of the wetland edge habitat is inundated to a one-foot depth and may impact larval sucker utilization of this habitat. In most years under the No Action Alternative, lake elevations are expected to provide sufficient larval rearing habitat.

Young juvenile suckers (age 0) typically utilize a diversity of lake habitats. Generally, as the lake surface elevations decline, so does the diversity and complexity of habitats available to age 0 suckers. Below 4138.00 ft, hard and rocky substrates are no longer available as nearshore habitat; however, this elevation is not expected to occur under the No Action Alternative.

Older juvenile and adult suckers utilize deeper water areas in the northern part of UKL with a depth preference between 6.6 and 9.9 ft during late summer and fall months. Under the No Action Alternative, the lowest surface elevation in the 39-year POR analyzed was 4138.26 ft. This elevation affords about 9,428 acres in the northern portion of UKL at a depth greater than 6.6 ft and provides 3.8 ft of water depth as access into Pelican Bay for suckers seeking water quality refuge there. Both of these depths reduce the impacts of avian, principally pelican, predation on adult and older juvenile suckers.

Bull Trout

The No Action Alternative would create seasonal fluctuations in surface elevations in UKL and Agency Lake. Agency Lake is identified as a foraging, migration, and overwintering habitat type for bull trout. For much of the year, occupancy of bull trout in Agency Lake is likely water temperature or water quality limited. However, bull trout may migrate through this habitat during winter months. Reclamation anticipates the seasonal lake level fluctuations would have no effect on bull trout that may use Agency Lake as a migration corridor. Seasonal lake elevations in UKL and Agency Lake, characterized by relatively higher elevations in spring to early summer and relatively lower elevations in fall and winter, are not anticipated to affect bull trout migration.

Oregon Spotted Frog

The No Action Alternative would create seasonal fluctuations in surface elevations in UKL and Agency Lake that are characterized as relatively high surface elevations during spring and summer and relatively low surface elevations in fall and winter. Known presence and breeding of OSF north of Agency Lake are at locations with elevations higher than Reclamation's ability to influence lake surface elevations. Reclamation anticipates no impact to OSF. Relatively high surface elevations in Agency Lake could slightly increase river stage in the Wood River leading to inundation of small wetland habitats along the river for short periods of time, particularly in the spring months. A small seasonal increase in this wetland could have beneficial impacts to critical habitat identified as primary constituent elements 1 and 2 (USFWS 2016e) at these locations.

Applegate's Milkvetch

Under the No Action Alternative, Reclamation does not influence water at the sites known to be occupied by Applegate's milkvetch. Reclamation's activities to carry out the storing and delivery of water, such as road maintenance, seasonal mowing, and weed abatement, would not occur at occupied sites or near known plants. The No Action Alternative is anticipated to have no effect on Applegate's milkvetch plants or its designated critical habitat.

Proposed Action Alternative

<u>Project Operations</u>

Lost River and Shortnose Suckers

The Proposed Action Alternative results in both higher and lower end of month UKL surface elevations, but the overall trend is toward lower UKL surface elevations in years that UKL contributes to augmented downstream flows (19 of the 39 years within the POR).

Under the Proposed Action Alternative, the lowest annual simulated minimum UKL surface elevation during the summer and fall months occurs at 4,138.00 ft, in WY 2016. This simulated minimum elevation under the Proposed Action Alternative is lower than the No Action Alternative minimum of 4,138.26 ft (which occurred in 1981 in the simulation). However, maintaining an annual minimum of 4,138.00 ft provides more than a meter of depth at the mouth of Pelican Bay which is sufficient for adult suckers to access Pelican Bay in late summer and early fall (USFWS 2019). This minimum elevation would also provide similar acres of habitat greater than 2 meters depth (USFWS 2019) in late summer and early fall.

A key surface elevation for protecting sucker spawning habitat is maintaining UKL surface elevation above 4,142.00 ft in March, April and May once this elevation (or higher) has been achieved earlier in the spring. The simulated Proposed Action Alternative achieves this elevation in 33 years out of 39 years analyzed in the POR; as previously discussed this simulation does not include potential water borrowing operations from PacifiCorp or redistribution of the 40,000 AF of EWA augmentation. In an additional two years (WYs 2005 and 2015 in the simulation) under the Proposed Action Alternative, simulated UKL surface elevations are achieved and maintained above 4,142.00 ft for portions of the April and May spring spawning period but would drop below this benchmark for multiple consecutive days without the utilization of water from downstream reservoirs and/or modification of EWA releases. Even with implementation of the additional 40,000 AF of EWA augmentation included in the Interim Plan, the modeled output indicates that the frequency at which reduced habitat may concentrate spawning or compel suckers to skip spawning at the shoreline areas is relatively low (i.e., 6 out of 39 years or 15 percent.).

Simulations of the Proposed Action Alternative are useful mainly for modeling purposes where the objective is to compare alternatives and frame potential implications; however, in real-time water operations in the WYs when EWA augmentation is triggered, Reclamation would borrow water from PacifiCorp's downstream reservoirs and/or modify EWA augmentation releases in coordination with others to safeguard against UKL elevations falling below those that have been identified as sufficiently protective of spawning suckers, namely 4,142.00 ft during March, April, and May, once 4,142.0 ft has been achieved. In years where the April 1 UKL Supply is less than 550,000 AF, Reclamation would not attempt to modify EWA releases or borrow water from PacifiCorp such that UKL elevations remain above 4,142.0 ft in March, April and May. There are three years within the POR where the April 1 UKL Supply falls below 550,000 AF.

Given current forecasts, Reclamation anticipates that EWA augmentation would not be triggered under the Proposed Action Alternative in 2020, because the April 1, 2020, UKL Supply is projected to be below 550,000 AF. UKL surface elevations in 2020 are projected to rise above 4,142.00 ft in early April. Current projections indicate that implementation of the annual surface flushing flow would still occur (occurs under both the Proposed Action Alternative as well as the No Action Alternative nearly every year), in mid-April and would reduce UKL elevation below 4,142.00 ft, where it would remain for the rest of the irrigation season. The lowest 2020 UKL surface elevation is anticipated to occur at 4,139.28 ft in late September and early October, which is over a foot higher than the annual minimum elevation of 4,138.00 ft. If the April 1 UKL Supply is at or greater than 550,000 AF in WY 2020, thereby triggering the 40,000 AF EWA augmentation, then Reclamation would likely borrow water from downstream reservoirs and coordinate with others on EWA augmentation releases to such that UKL elevations do not fall below 4,142.00 ft in April and/or May.

In general, the Proposed Action Alternative results in surface elevations protective of both sucker spawning at the shoreline areas in the spring months and adult suckers and their access to refuge habitat in fall although at slightly lower surface elevations than the No Action Alternative. Surface elevations under the Proposed Action Alternative are on average 0.07 ft lower than the No Action Alternative during sucker spawning from the end of February through May (4,142.62 compared to 4,142.69 ft) and 0.15 ft lower in at the end of August and September (4,139.57 versus 4,139.72 ft) which results in minimal reductions of habitat available to adult suckers in late summer at preferred depths in the northern part of UKL.

Bull Trout
Although surface elevations in UKL and Agency Lake are anticipated to be slightly lower under the Proposed Alternative Action than a No Action Alternative, Reclamation anticipates the seasonal lake level fluctuations would have no effect on bull trout that may use Agency Lake as a migration corridor. Seasonal lake elevations in UKL and Agency Lake, are characterized by relatively higher elevations in spring to early summer and relatively lower elevations in fall and winter. As such, minimal differences between the No Action Alternative and the Proposed Action Alternative are expected.

Oregon Spotted Frog
The Proposed Action Alternative is anticipated to have similar effects to OSF as the No Action Alternative. Known presence and breeding of OSF north of Agency Lake are at locations with elevations higher than Reclamation's ability to influence lake surface elevations. Reclamation anticipates no impact to OSF. Relatively high surface elevations in Agency Lake could slightly increase river stage in the Wood River leading to inundation of small wetland habitats along the river for short periods of time. A small seasonal increase in this wetland could have beneficial impacts to their designated critical habitat, primary constituent elements 1 and 2 (USFWS 2016e) at these locations. Overall, minimal differences between the No Action Alternative and the Proposed Action Alternative are expected

Applegate's Milkvetch
The Proposed Action Alternative does not influence water at the sites known to be occupied by Applegate's milkvetch. Reclamation's activities to carry out the storing and delivery of water, such as road maintenance, seasonal mowing, and weed abatement, would not occur at occupied sites or near known plants. The Proposed Action Alternative is anticipated to have no effect on Applegate's milkvetch plants or critical habitat.

Refuge Water Acquisition
Under the refuge water acquisition component of the Proposed Action Alternative, Project water acquired by Reclamation for fish and wildlife purposes for TLNWR and LKNWR may come from Project Supply in UKL and/or KSD and LRDC return flows during the spring/summer period. Acquisition of Project water for fish and wildlife purposes would not increase the volume of water diverted from UKL to fulfill the Project Supply nor would it increase the amount of return flows from KSD and LRDC that would otherwise be used elsewhere within the Project during this time period. Accordingly, no additional effect to Federally-listed species in the Upper Klamath Basin would be expected outside those described for Project Operations. As acquired water may be used on TLNWR where LRS and SNS reside, some level of beneficial effect may occur, though speculative, as it would depend on individual district entity proposals, approval from Reclamation, and subsequent contracts.

Comparison of Alternatives
The Proposed Action Alternative, in comparison to the No Action Alternative, results in slightly lower seasonal UKL surface elevations. Surface elevations under the Proposed Action Alternative are on average 0.07 ft lower than the No Action Alternative during sucker spawning from the end of February through May (4,142.62 ft compared to 4,142.69 ft) and 0.15 ft lower in at the end of August and September (4,139.57 versus 4,139.72 ft) which results in minimal reductions of habitat available to adult suckers in late summer at preferred depths in the northern

part of UKL. However, both alternatives considered are likely to result in conditions that are protective of suckers, bull trout, and their habitat.

Neither the No Action Alternative nor the Proposed Action Alternative directly impact water abundance in areas occupied by OSF or Applegate's milkvetch. For OSF, it is possible that water operations of storing water in UKL and Agency Lake could indirectly influence small wetland areas near the lower one mile of Wood River providing a habitat benefit to OSF in the area. This indirect beneficial impact is largely equal between actions considered. Other activities, such as infrastructure maintenance and weed abatement, required to operate the Klamath Project are also equal between the actions considered and do not occur near occupied OSF or populations of Applegate's milkvetch. Reclamation anticipates no impact to either species or their habitats through either the No Action Alternative or the Proposed Action Alternative. Neither the Proposed Action Alternative nor the No Action Alternative impact areas occupied by OSF or Applegate's milkvetch. Therefore, no impact to either species or their habitats are anticipated with either alternative.

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, Project water acquired by Reclamation for fish and wildlife purposes for TLNWR and LKNWR may come from Project Supply in UKL and/or KSD and LRDC return flows during the spring/summer period. Acquisition of Project water for fish and wildlife purposes would not increase the volume of water diverted from UKL to fulfill the Project Supply, nor would it increase the amount of return flows from KSD and LRDC that would otherwise be used elsewhere within the Project during this time period. Accordingly, no additional effect to Federally-listed species in the Upper Klamath Basin would be expected outside those described for Project Operations. As acquired water may be used on TLNWR where LRS and SNSs reside, some level of beneficial effect may occur, though speculative as it would depend on individual district entity proposals, approval from Reclamation, and subsequent contracts.

4.4.2 Lower Klamath River Basin/Klamath River and Federally Protected Species

As indicated in Section 3.2.2 in this document, both coho and Chinook salmon are currently present in the Klamath River at abundances lower than historical abundances. SONCC coho salmon populations in the Klamath River Evolutionary Significant Unit (ESU) are at high risk of extinction because they are below, or likely below, an abundance threshold that reduces risk of extirpation (NMFS 2016). Wild spring-run Chinook salmon populations are a remnant of their historical abundance and primarily occur in the South Fork Trinity River and Salmon River Basins (NMFS 2011), with recent returns below 1,000 fish. NMFS (2011) indicates fall run Chinook in the last several decades have ranged from below 50,000 to 225,000 fish. Naturally produced (i.e., non-hatchery) smolt production is largely unknown but has also dropped due to the decline in wild adult Chinook salmon runs over the last several decades. As described in the following section, beneficial impacts to coho and Chinook (fall-run and spring-run) are anticipated from additional spring months river flow, as disease mitigation and as increased juvenile salmon habitat, from both the No Action Alternative and the Proposed Action Alternative.

No Action Alternative
<u>Coho and Chinook[32] Salmon</u>

Flows
The No Action Alternative provides surface flushing flows in the Klamath River below IGD during March and April on a nearly annual frequency. The use of surface flushing flows is expected to improve disease conditions related to the *C. shasta* parasite by disrupting annelid (host) habitats thus reducing the prevalence of infection (POI) in juvenile salmonids (coho and Chinook salmon). By reducing POI, salmon survival should improve, thereby triggering increased survival and forage for interconnected species, such as SRKW. Similarly, the No Action Alternative aims to minimize the impacts of implementing a surface flushing flow on UKL elevations by implementing flows in conjunction with accretion (storm) events. As a result, impacts to coho salmon, Chinook salmon, and SRKW are anticipated to remain the same as conditions simulated under the 2019 BiOp.

Habitat
River flow regimes are directly tied to the amount of habitat available for coho and Chinook salmon. Low variability in stream flows can result in reduced habitat complexity, and ultimately, a loss of habitat diversity (Poff et al. 1997). Maintaining a natural level of variability in the flow regime, including high spring discharge events, is critical for conserving the structure and function of a riverine ecosystem (Sanford et al. 2007). Flow in the Klamath River under the No Action Alternative attempts to maintain flow variability and stream processes that support coho and Chinook salmon habitat. It is important to consider four flow categories when assessing habitat and water quality for coho salmon, including subsistence, base, high-flow, and overbank.

Subsistence flow is the minimum flow required to maintain acceptable water-quality conditions and connectivity to tributaries for rearing juvenile coho salmon; for the lower Klamath River it is at least 1,000 cfs (NRC 2005; NMFS and USFWS 2013). Base flow occurs between storm events and is defined as flows between 1,000 and 6,000 cfs (NRC 2005). Under the No Action Alternative during the POR, 18.5 percent of the daily average flows are below 1,000 cfs, indicating that coho and Chinook salmon may have limited access to suitable habitat during these low flows (Table 4-22). However, 78.3 percent of the daily average flows are considered base flows (NRC 2005). Base flow accounts for the majority of all daily average flows and provides sufficient flow and area of habitat for all life stages. High-flow pulses are infrequent events that typically occur after storms and are between 6,000 and 12,000 cfs lasting at least three days (NRC 2005). High-flow pulses can alter available coho and Chinook salmon habitat by mobilizing gravel bars and large wood creating additional habitat for juveniles. In the POR, 3.2 percent of the daily average flows are characterized as high-flow pulses. Lastly, overbank flows are infrequent flow events that breach riverbanks and exceed 12,000 cfs (NRC 2005). Overbank flows support channel and riparian function (Hardy et al. 2006) through mobilization of sediment

[32] Although not listed under the ESA, Chinook salmon are discussed alongside ESA-listed SONCC coho salmon due to their similar habitat needs and interconnectedness to the ESA-listed Southern Resident Killer Whale (discussed further in this section (4.4.2)) which feed on adult Chinook salmon. Furthermore, in addition to the ESA, coho and Chinook salmon are also subject to review under the Federal MSA.

and connecting channel and floodplain habitats (Poff et al. 1997). In the POR, 0.06 percent of average daily flows are characterized as overbank flow.

To analyze the effects of implementation of the action alternatives in this EA, coho and Chinook WUA was modeled for the mainstem Klamath River below IGD (Hardy et al. 2006). For the purpose of this assessment, WUA predictions at R Ranch[33] which is proximal to IGD were reviewed and analyzed. Over the POR, the No Action Alternative results in the lowest coho and Chinook salmon fry and parr habitat availability (at the R Ranch site) from July through October, reaching 40 percent and 60 percent of maximum WUA, respectively. Generally speaking, and based on current available science's reliance upon the 80 percent WUA as a conservation standard, the No Action Alternative is expected to increase percent maximimum WUA gradually from October through May, peaking at approximately 80 percent of maximum for both life stages before declining in the early summer months (Figure 4-9 and Figure 4-11). While additional habitat is available to fry during their peak emergence period in March and May, reduced habitat availability occurs during rearing periods for parr between June and October in the No Action Alternative.

Disease

The No Action Alternative provides for implementation of a surface flushing flow event in 95 percent of years simulated within the POR, which should provide reductions in coho and Chinook salmon disease risk and mortality from *C. shasta*. In the drier years within the POR, under the No Action Alternative, flow variability in the weeks following surface flushing flow implementation can be limited, with the flow variability often resulting from precipitation events. Relatively stable flow periods after surface flushing flow implementation may result in environmental conditions that allow for elevated *C. shasta* spore concentrations to occur (Bartholomew et al. 2019) although the literature also suggests that other factors also influence population-level disease risk, including outmigration timing and water temperature (Som et al. 2016).

Eulachon

The southern DPS Pacific eulachon are only known to occupy the lower Klamath River during the winter and spring for spawning, incubation, and early rearing. Eulachon are documented to spawn in the lower Klamath River reach in association with spring freshets and rearing does occur in the estuarine and near-shore areas at the mouth of the Klamath River. The No Action Alternative, depending on hydrological conditions in a given year, may reduce the cumulative flow in the lower Klamath River from late winter through spring. However, because the winter/springtime flows in the lower 10.7 miles of the Klamath River are largely driven by tributary accretions below IGD, and due to the relatively small upper basin contributions to the overall flow in the lower 20 miles of the Klamath River, any effects to individual eulachon or the habitat elements for the southern DPS Pacific eulachon would be expected to be minor.

[33] R Ranch is above the confluence of the Shasta River near Hornbrook, CA, between river miles 184-185 (rkm 296-298).

Green Sturgeon

Due to the tributary accretions that contribute to flows in the lower Klamath River near the estuary, it is difficult to wholly discern flow contributions from the upper basin (above IGD) to the lower 30 miles of the Klamath River during moderate to low flow periods. The No Action Alternative, depending on hydrological conditions in a given year, may reduce the cumulative flow in the lower 30 miles of the Klamath River during spring and summer when southern DPS green sturgeon are known to occupy the Klamath River estuary. Slight variation of flows near the estuary are not expected to alter, reduce, or change the availability of food resources or modify water temperatures when green sturgeon are anticipated to be present in the estuary or the lower 30 miles of the Klamath River. Due to the relatively small contribution of the upper basin to the overall flow in the lower Klamath River near the estuary, any effects to southern DPS green sturgeon would not be expected to be meaningfully measured.

Southern Resident Killer Whale

Klamath Basin coho and Chinook salmon contribute to the status of SRKWs both as components of the overall, coast-wide prey base, and as a seasonal source of nutrition. Chinook salmon are the preferred prey of SRKW which migrate along the northern California coast principally during spring months. Thus, their potential prey are subadult fall-run Chinook and both subadult and adult spring-run Chinook.

The No Action Alternative provides river flows that provide slightly increased juvenile Chinook habitats but the overall effect for SRKW is likely to be a small improvement in prey availability. Any impact to water temperature as a result of the No Action Alternative is not likely to be meaningful and influence prey availability for SRKW. The No Action Alternative implements recurring surface flushing flows utilizing storage in UKL in conjunction with accretion (storm) events. The surface flushing flows are anticipated to result in reduced actinospore concentrations in the river, POI among fish in the river, and *C. shasta*-related mortality in both coho and Chinook salmon. Modest beneficial effects on survival of coho and Chinook salmon, a seasonal food source for SRKW, as a result of the No Action Alternative is expected to have a beneficial impact on SRKW.

Proposed Action Alternative

<u>Water Operations</u>

Coho and Chinook Salmon

<u>Flow</u>

Under the Proposed Action Alternative, Reclamation would provide an additional EWA augmentation of 40,000 AF during WYs when UKL Supply is between 550,000 AF and 950,000 AF. The 40,000 AF of EWA augmentation included in the Proposed Action Alternative is in addition to an enhanced May/June flows provision in the modified 2018 Operations Plan with slight modifications. Under the Proposed Action Alternative, Reclamation would provide up to a full enhancement volume of 20,000 AF, split evenly between Project Supply and from UKL (the split is even at all enhancement volumes). Reclamation would utilize the May UKL Supply volume to determine whether enhanced May/June flows would occur and the volume available for flow enhancement.

As described in Reclamation's modified 2018 Operations Plan, Reclamation would maintain a flexible approach when utilizing the proposed 40,000 AF of EWA augmentation and enhanced May/June flows. Reclamation would allow for flexibility in the timing and distribution of augmentation volumes, with the exception that EWA augmentation water and enhanced May/June flows would be utilized within the March through June timeframe. The existing FASTA process would be utilized to provide real-time operational input into water use. This would potentially provide ecological benefits to coho salmon including improving habitat conditions, minimizing disease risk, or both, while simultaneously maintaining UKL elevations and conditions protective of LRS and SNS. Furthermore, Reclamation has coordinated with PacifiCorp to borrow water during springtime operations to ensure EWA augmentation volumes can be used to address disease and habitat concerns for coho salmon. Specifically, PacifiCorp would provide augmented river flows so that UKL elevations do not fall below levels that are required to protect spawning suckers.

Habitat

Subsistence, base, high, and overbank flows and their importance to coho salmon habitat availability are defined above in the No Action Alternative coho and Chinook salmon habitat section. Under the Proposed Action Alternative, during the POR, 18.6 percent of the daily flows fall below subsistence and 78.2 percent are considered base flows (*Table 4-22*).

Table 4-22. Summary of average daily flows at Iron Gate Dam for No Action and Proposed Action alternatives during the Period of Record (1981 - 2019).

Criteria	Proposed Action	No Action	Difference
			Total Daily Flows
Count	14,305	14,305	0
Average Daily Flow (cfs)	1822	1805	17
Percent of Proposed Action	100	99.1	0.9
			Less than 1,000 cfs
Count	2,663	2,640	23
Percent of Total Count	18.6	18.5	0.2
Average Daily Flow (cfs)	938	937	0.7
			Greater than or equal to 1,000 cfs but less than 6,000 cfs
Count	11,185	11,198	-13
Percent of Total Count	78.2	78.3	-0.1
Average Daily Flow (cfs)	1,798	1,770	27.46
			Greater than or equal to 6,000 cfs but less than 12,000 cfs
Count	448	458	-10
Percent of Total Count	3.1	3.2	-0.1
Average Daily Flow (cfs)	7,415	7,397	17.4
			Greater than or equal to 12,000 cfs
Count	9	9	0
Percent of Total Count	0.06	0.06	0.0
Average Daily Flow (cfs)	14,549	14,549	0

During the times when flows are less than subsistence flow requirements, the amount and accessibility of available habitat would be limited for juvenile coho and Chinook salmon. Base flow accounts for the majority of all daily average flows and provides sufficient flow and area of habitat for all life stages. High flow and overbank flows account for 3.1 percent and 0.06 percent of daily average flows over the POR, respectively.

Based on the currently available science utilizing 80 percent WUA as a conservation standard, increased flows as a result of the proposed 40,000 AF of EWA augmentation and enhanced May/June provision would likely improve simulated achievement of the 80 percent WUA. The augmentation volumes produce a simulated increase in the amount of suitable habitat for juvenile salmonids and, therefore, increase the simulated frequency of meeting the 80 percent WUA habitat conservation standard. Outside of the simulated conditions, real-world operators have an ability to manage augmentation volumes (timing and distribution) to allow for the volume used to coincide with the peak outmigration timing for coho and Chinook salmon. While increases in aquatic habitat are likely to occur along the mainstem of the Klamath River with the additional 40,000 AF of EWA, questions remain about the use of the 80 percent WUA as a means for appropriately identifying critical needs for threatened coho salmon in the Klamath River basin.

Disease

The Proposed Action Alternative provides for implementation of surface flushing flow events in 95 percent of years simulated within the POR, which should provide reductions in coho and Chinook salmon disease risk and mortality from *C. shasta*. The Proposed Action Alternative allows for flexibility in the use of 40,000 AF between the months of March through June. In the simulated Proposed Action Alternative, all 40,000 AF were distributed between March 23 and May 18. Maintaining higher flows during this period (April – June), which coincides with smolt outmigration, may dilute *C. shasta* spore concentrations and reduce water temperatures, thereby potentially reducing the POI and mortality for coho and Chinook salmon (Hillemeier et al. 2017), although population-level benefits from managed dilution-type flow events have not been clearly demonstrated (Som and Hetrick 2019).

<u>*Comparison of Alternatives*</u>

Flow

Average daily IGD flow is estimated to be similar between the Proposed Action and the No Action alternatives (*Figure 4-8*).

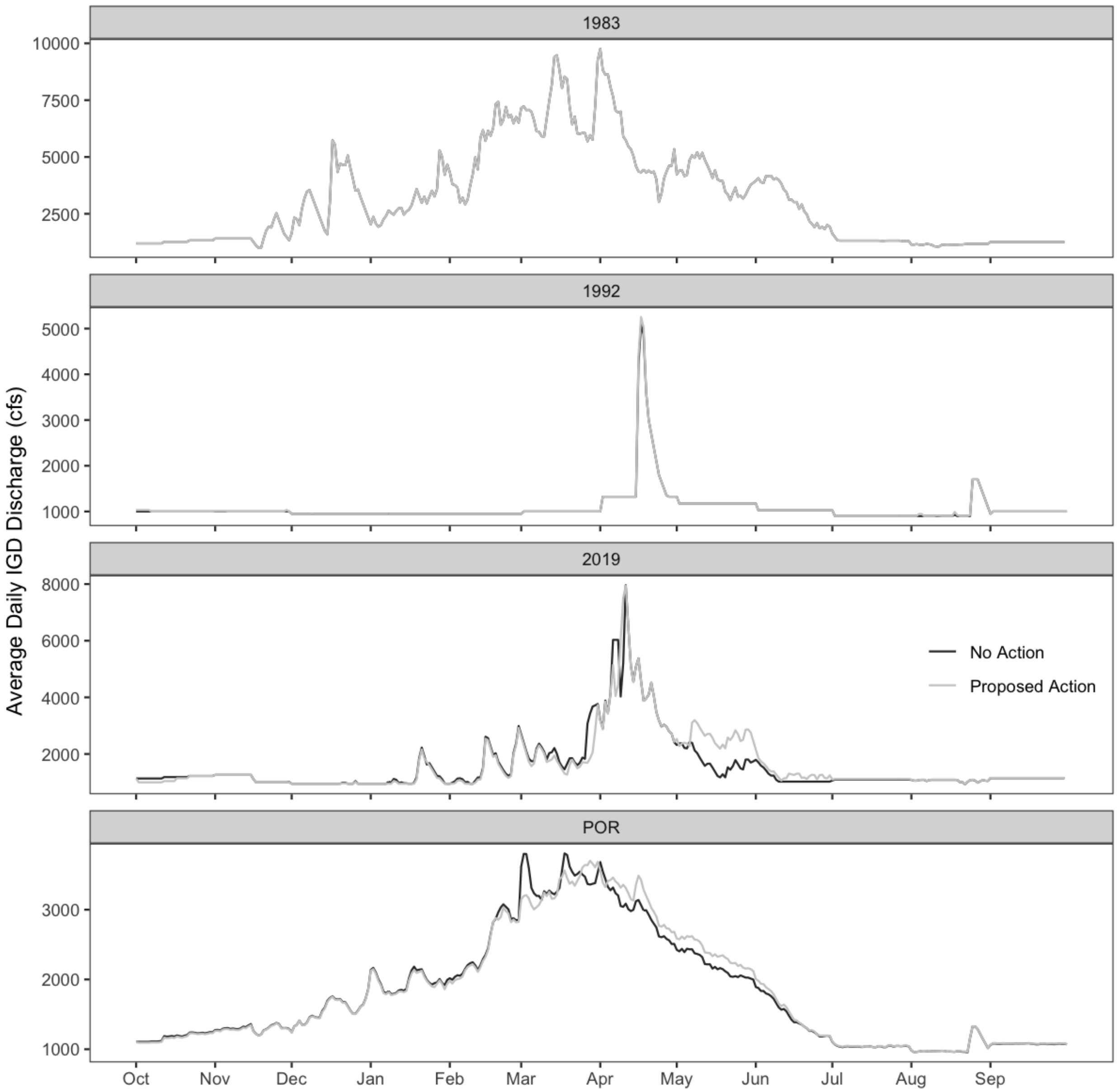

Figure 4-8. Simulated average daily discharge at Iron Gate Dam for a wet (1983), dry (1992), and average (2019) water year, and for the Period of Record (1981 – 2019) for the No Action (black line) and the Proposed Action (grey line) alternatives.

Due to EWA augmentation not occurring in WYs when the April UKL Supply is less than 550,000 AF or greater than 950,000 AF, there are no differences in flow during a wet year (similar to 1983) or critically dry WY (similar to 1992). However, during an average (2019) WY, due to simulated use of the 40,000 AF of EWA augmentation, spring (April and May) flows are higher under the Proposed Action Alternative. For the POR, the flows under the Proposed Action Alternative are predicted to be slightly lower in March and slightly higher during April through June relative to the No Action Alternative. Monthly exceedance[34] flows under the Proposed Action Alternative may be slightly lower October through March compared to the No Action Alternative. Conversely, exceedance flows are slightly higher April through September under the Proposed Action Alternative with the largest simulated difference occurring in April and May (28-33 percent higher) (*Figure 4-23*).

Table 4-23. Percent change (Proposed Action minus No Action) between Proposed Action and No Action Alternative daily average Iron Gate Dam exceedance flows for the Period of Record (1981 – 2019).

Exceedance	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
0.95	0.00	0.00	0.00	0.00	0.00	0.00	8.72	0.00	0.00	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	-5.69	23.32	22.13	0.00	0.00	0.00	0.00
0.85	0.00	0.00	0.00	0.00	0.00	-4.60	28.28	33.49	0.00	0.00	0.00	0.00
0.80	-1.26	0.00	0.00	0.00	0.00	-2.67	28.04	23.72	0.00	0.00	0.00	0.00
0.75	-4.20	0.00	0.00	0.00	-2.13	-1.27	19.16	23.09	5.73	1.01	0.00	0.00
0.70	-7.56	0.00	0.00	0.00	-2.10	-2.53	14.06	20.69	4.81	0.95	0.00	0.00
0.65	-5.48	0.00	0.00	-1.14	-4.29	-4.58	14.38	19.89	2.25	0.78	0.00	0.00
0.60	-2.43	-1.82	0.00	-1.28	-3.97	-7.67	9.82	20.36	3.43	0.72	0.00	0.00
0.55	-2.33	-4.49	0.00	-1.95	-3.34	-5.94	8.28	15.69	3.27	0.62	0.70	0.00
0.50	-0.69	-4.05	-0.42	-2.53	-8.22	-5.27	4.53	15.45	3.68	0.01	0.97	4.23
0.45	-1.12	-0.95	-1.06	-3.44	-7.50	-3.91	3.15	10.80	4.17	0.64	0.97	1.67
0.40	-0.45	-0.02	-0.84	-2.73	-1.50	-4.76	1.92	9.04	7.19	0.21	0.39	1.47
0.35	-0.38	-0.10	-1.70	-2.35	-0.14	-4.82	3.68	6.35	8.31	-0.24	0.30	0.17
0.30	-0.17	0.02	-0.81	-1.70	-0.43	-1.01	4.14	3.91	4.08	0.73	0.51	0.86
0.25	-0.14	0.04	-1.42	-0.73	-2.20	-5.32	1.88	2.84	2.11	0.04	0.03	0.08
0.20	-0.03	-0.46	-0.86	-2.10	-1.16	-3.70	1.29	2.26	3.51	0.03	-0.02	0.03
0.15	0.00	0.01	-0.79	-0.67	-0.66	0.00	2.50	0.78	6.64	0.04	-0.04	-0.03
0.10	-0.01	0.01	0.54	0.28	-0.77	0.10	0.89	0.01	1.66	0.03	0.03	0.02
0.05	0.03	-3.17	0.01	-1.51	-1.11	-0.03	0.21	0.02	-0.33	-0.02	0.00	-0.01

[34] The probability that flows equal or exceed a given value.

Habitat

Relative to coho salmon the percent maximum WUA is directly related to flow (*Figure 4-9*).

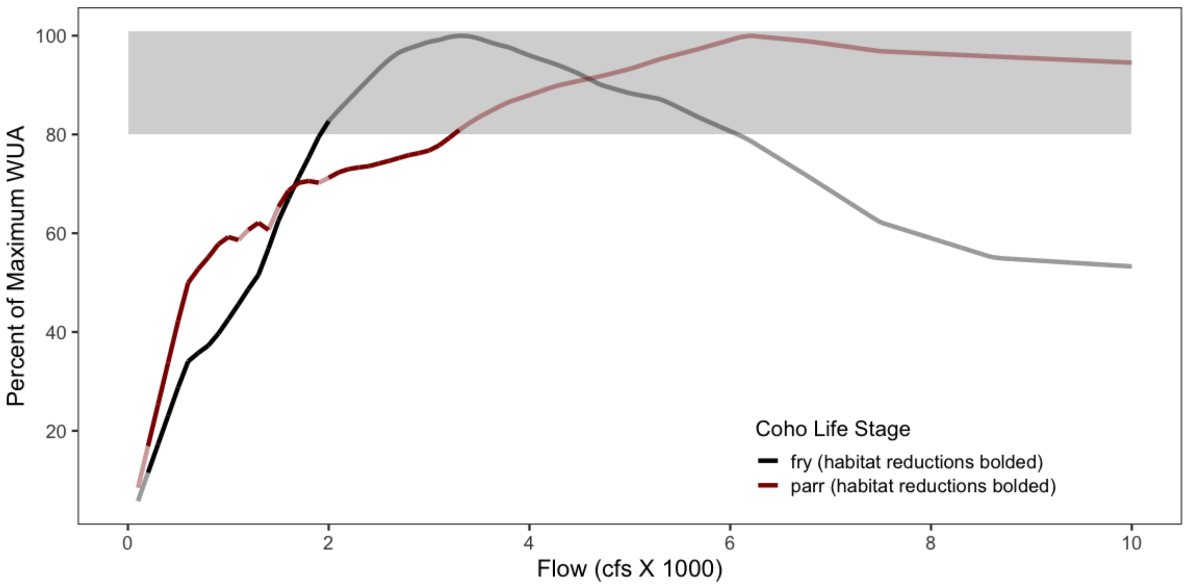

Figure 4-9. Coho Salmon fry and parr habitat availability relative to mainstem flows at R Ranch. Flows account for tributary accretions and were estimated for each habitat unit when calculating Weighted Usable Area (WUA). Gray horizontal bands indicate WUA values ≥ 80 percent of maximum. Potential habitat reductions due to the Proposed Action Alternative are bolded.

As a result, the difference in habitat predicted under the Proposed Action and the No Action alternatives follows a similar pattern to the difference in predicted flows. Because the 40,000 AF EWA augmentation is not triggered in wet or critically dry years, there is no discernable difference in predicted WUA for coho and Chinook salmon and fry and parr at the R Ranch site for wet (similar to 1983) and critically-dry (similar to 1992) WYs between alternatives (*Figure 4-10, Figure 4-12*).

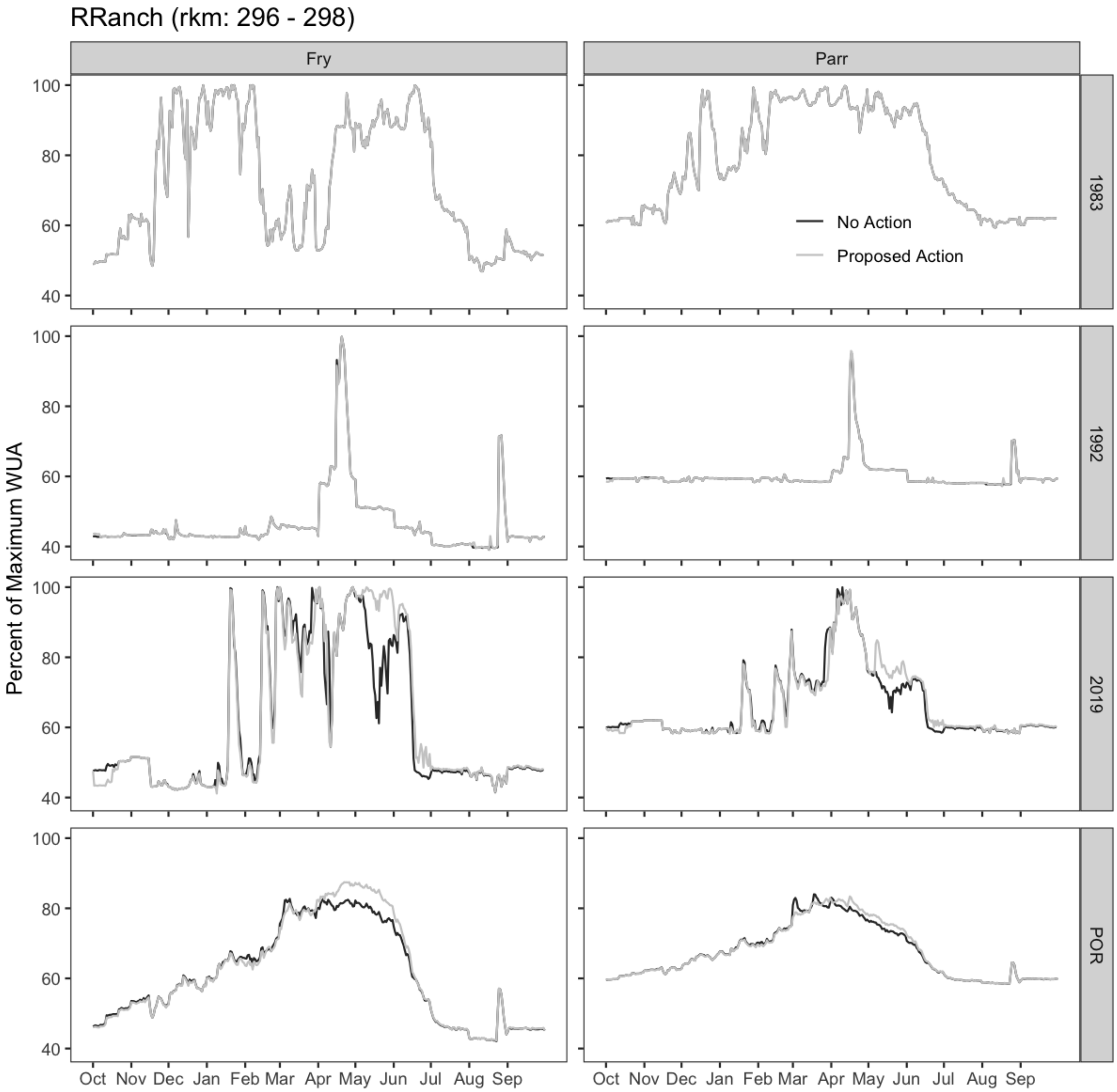

Figure 4-10. Percent of maximum Weighted Usable Area (WUA) at the R Ranch Site on the Klamath River, in 1983, 1992, 2019, and the Period of Record (1981 – 2019) for coho salmon fry and parr for the Proposed Action (grey line) and No Action (black line) Alternative flow predictions.

The same is true for Chinook salmon, the amount of WUA is directly related to flow (*Figure 4-11*).

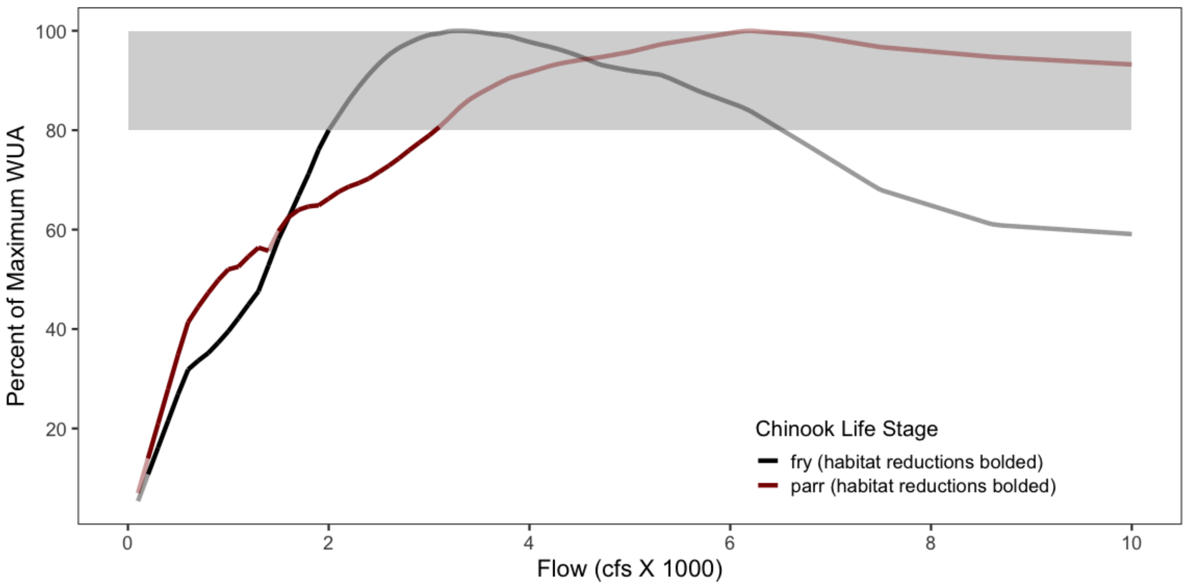

Figure 4-11. Chinook Salmon fry and parr habitat availability relative to mainstem flows at R Ranch. Flows account for tributary accretions and were estimated for each habitat unit when calculating Weighted Usable Area (WUA). Gray horizontal bands indicate WUA values ≥ 80 percent of maximum. Potential habitat reductions are bolded.

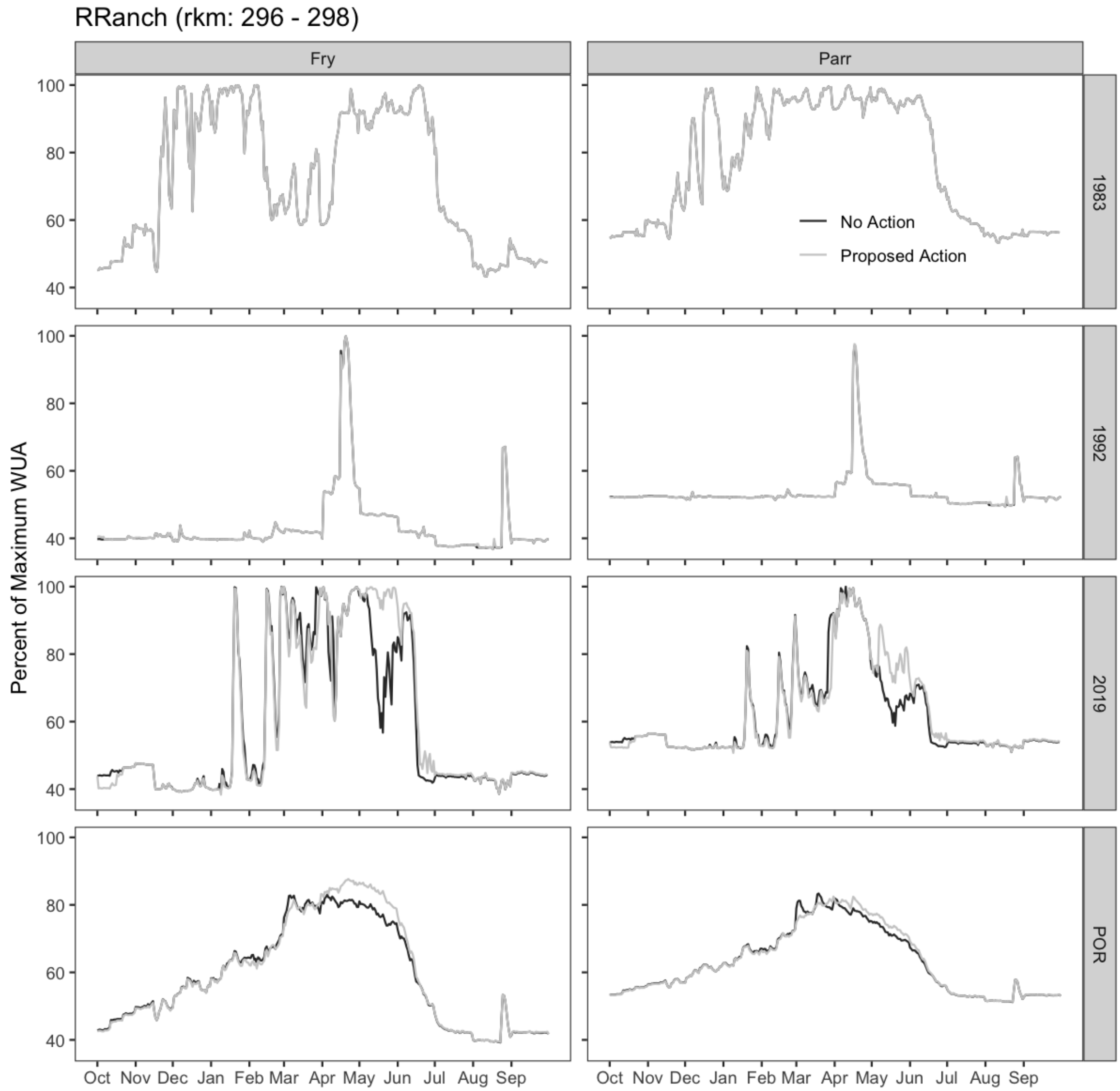

Figure 4-12. Percent of maximum Weighted Usable Area (WUA) at The R Ranch Site on the Klamath River for water years 1983, 1992, 2019, and the Period of Record for Chinook Salmon fry and parr for the Proposed Action (grey line) and No Action (black line) Alternatives flow predictions.

During an average WY (similar to 2019), WUA for coho and Chinook fry and parr is predicted to be slightly higher from May through June under the Proposed Action Alternative. Similarly, WUA is predicted to be slightly higher for juvenile coho and Chinook salmon from April through June under the Proposed Action Alternative for the POR (*Figure 4-10 and Figure 4-12*).

Based on current available science utilizing 80 percent WUA as a conservation standard, increased flows as a result of the implementation of the 40,000 AF of EWA augmentation under the Proposed Action Alternative paired with the enhanced May/June provision included in the 2018 modified Operation Plan would likely improve rearing and outmigration conditions for juvenile coho and Chinook salmon (in year types when the May UKL Supply is between 625,000 AF and 950,000 AF) . The augmentation volumes would likely increase the amount of suitable habitat for juvenile salmonids and the amount of time the habitat conservation standard is met.

When considering the POR, the frequency of subsistence, base, high, and overbank flows is similar between alternatives (Table 4-22).

For example, under the Proposed Action Alternative there is a 0.2 percent increase in the number of days where flows falls below subsistence. As a result, there is no considerable change in tributary connectivity for rearing juveniles. Similarly, under the Proposed Action Alternative there is a 0.1 percent decrease in the number of days where flows are at base flow or high flow levels, relative to the No Action Alternative. This indicates that there would be little to no difference in channel complexity or recruitment of large wood under the two flow alternatives. Additionally, there would be no discernable difference in sediment transport or connectivity between the main channel and the floodplain, since there is no predicted difference in the frequency of overbank flows between the Proposed Action and No Action alternatives.

Disease

Surface flushing flows are high flow events shown to reduce (up to 90 percent) densities of *M. speciosa*, an intermediate annelid host of the *C. shasta* parasite (Reclamation 2018). Under both the Proposed Action and No Action alternatives, surface flushing events occur in 95 percent of years. Surface flushing events in the Proposed Action Alternative occur either at the same time or slightly later in the year compared to the No Action Alternative. The timing of these flows relative to the release of salmon-infecting *C. shasta* spores (actinospores) and smolt outmigration in the spring may increase the efficacy that these flows have on minimizing POI and mortality in salmonids. For example, under the Proposed Action Alternative, surface flushing flows would be shifted later in the season (although still occurring between March 1 – April 15) in some years (e.g. 2002 and 2010) compared to the No Action Alternative. Conversely, the Proposed Action Alternative generally provides higher flows during the spring smolt outmigration, which may effectively dilute *C. shasta* concentrations and reduce disease risk for coho and Chinook salmon, although the effectiveness of elevated flows (concurrent with outmigration) at reducing disease risk for juvenile salmon has not been clearly demonstrated (Som and Hetrick 2019).

Furthermore, the additional volume of EWA augmentation included under the Proposed Action Alternative could potentially reduce water temperatures (depending on timing). Overall, the Proposed Action Alternative is expected to increase habitat availability, reduce water temperatures, and reduce actinospore concentrations when compared to the No Action Alternative which is likely to result in benefits to coho and Chinook salmon and designated critical habitat as well as EFH, for coho and Chinook salmon on the mainstem of the Klamath River.

Eulachon

The Proposed Action Alternative includes a potential increase in river flows depending on hydrological conditions in a given year, which may improve the cumulative flow in the lower Klamath River from late winter through spring. However, because the winter/springtime flows in the lower 10.7 miles of the Klamath River are largely driven by tributary accretions below IGD, resulting flow from the Proposed Action Alternative in this reach of the lower Klamath

River is not expected to differ from the No Action Alternative. Any effect resulting from the Proposed Action Alternative, that in approximately half the years would increase river flows, is expected to slightly improve conditions and habitats for eulachon.

Green Sturgeon

The Proposed Action Alternative includes a potential increase in river flows depending on hydrological conditions in a given year, which may improve the cumulative flow in the lower Klamath River estuary during spring and summer when southern DPS green sturgeon are known to occupy the estuary. Slight variation of flows near the estuary are not expected to alter, reduce, or change the availability of food resources or modify water temperatures when green sturgeon are anticipated to be present, and therefore, the variation is not expected to differ from the No Action Alternative. Any effect resulting from the Proposed Action Alternative, that in some years can increase river flows, is expected to slightly improve conditions and habitats for green sturgeon.

Southern Resident Killer Whale

Under the Proposed Action Alternative, the additional volume of EWA augmentation has the potential to reduce Klamath River spring water temperatures, increase habitat availability and further reduce POI, in salmonids, increasing survival and thereby triggering increased survival and forage for interconnected species, such as SRKW. As a result, impacts to coho salmon, Chinook salmon, and therefore SRKW, are anticipated to result in increased prey availability and improved overall conditions, as compared to those simulated under the No Action Alternative.

Klamath Basin coho and Chinook salmon contribute to the status of SRKWs both as components of the overall, coast-wide prey base, and as a seasonal source of nutrition. Chinook salmon are the preferred prey of SRKW which migrate along the northern California coast principally during spring months. Thus, their potential prey are subadult fall-run Chinook and both subadult and adult spring-run Chinook.

The Proposed Action Alternative provides river flows that increase juvenile Chinook habitats, but the overall effect for SRKW is likely to be a small improvement in prey availability. Any reduced water temperatures as a result of the Proposed Action Alternative could beneficially influence prey availability for SRKW, although temperature influences of the Proposed Action Alternative are anticipated to be small. The Proposed Action Alternative implements nearly annual surface flushing flows and increased spring river flows. The surface flushing flows, and to some degree the increased river flows, are anticipated to reduce actinospore concentrations in the river, POI among fish in the river, and *C. shasta*-related mortality in both coho and Chinook salmon. Modest beneficial impacts on survival of coho and Chinook salmon (a seasonal food source for SRKW), as a result the Proposed Action Alternative is expected to have a beneficial impact on SRKW.

Refuge Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, Reclamation's acquisition of Project water, including from Project Supply or other sources, for use for fish and wildlife purposes in TLNWR and/or LKNWR, would result in the same Klamath River flows as simulated under the No Action Alternative. No additional water from UKL that is allocated for Klamath River flows (EWA) would be needed to fulfill the short-term water acquisition contracts, but rather only water already allocated under Project Supply and available from other sources (i.e., return flows from LRDC and KSD for irrigation purposes). As a result, no impacts to Lower Klamath River Basin ESA-listed species would occur.

4.4.3 Other Fish and Wildlife Species (Non-Endangered Species Act Listed)

No Action Alternative
Aquatic Species

Upper Basin
Under the No Action Alternative, the calculated volume of Project Supply would result in UKL water surface elevations, as shown in Table 4-1. These water surface elevations would generally support the aquatic species listed in Appendix B, including but not limited to: redband trout (*Oncorhynchus mykiss*), yellow perch (*Perca flavescens*), kokanee (*Oncorhynchus nerka*), pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ameiurus nebulosus*), tui chub (*Siphateles bicolor*) and blue chub (*Gila coerulea*) and a small remnant population of artificially introduced white sturgeon (*Acipenser transmontanus*).

The amount of water allocated to the Klamath River under the EWA (*as described in Section 2.3*) inclusive of annual surface flushing flows and associated ramping rates in the Klamath River below Link River Dam and Keno Dam under the No Action Alternative would increase the frequency of large flow events beyond those experienced in the POR. Reptiles and amphibians also inhabiting UKL and the Tule Lake sumps would experience no difference under the No Action Alternative in the food and habitat availability that is currently afforded by these waterbodies.

Lower Basin
Similar to coho and Chinook salmon, individuals of and habitat for other anadromous and resident species, such as steelhead and resident rainbow trout, dace, river suckers, and sculpin, benefit from variability in river flow regimes. Flow variability, including high spring discharge events, conserves the structure and function of a riverine ecosystem (Sanford et al. 2007). The No Action Alternative attempts to maintain flow variability and stream processes that support anadromous and resident fish habitats. Generally, relatively high spring flows help resident fish and steelhead access spawning areas and keep spawning gravels clean. Subsistence flows in the summer allow for the persistence of habitats and food items for resident fish. The No Action Alternative, dependent on hydrologic conditions for the year, appear to achieve high flow pulses, elevated spring flows, and subsistence flows in the summer months in most years. There are likely minor effects to resident and other anadromous fish species from the No Action Alternative that vary by hydrologic condition. Resident fishes during drier years, through reductions to food resources and the availability and accessibility of habitat whereas access to or the amount of habitat and food resources, under wetter conditions, resident fishes may experience minimal effects. Given that the effects would be temporal based on hydrologic conditions, any effect would be anticipated to be intermittent and minor.

Terrestrial Species

Upper and Lower Basins

Similar to aquatic species under the No Action Alternative, terrestrial species would maintain their current status as there would be similar conditions to the current environment. Species around and dependent on surface waters and agricultural, upland, forested areas, wetland, and other riparian areas would experience similar conditions at present and would likely migrate to areas that fulfill their biological needs. The need for movement to areas of more suitable habitat would likely be less than a few miles.

Though removed from protection under the ESA, bald (and golden) eagles continue to be protected under the Bald and Golden Eagle Protection Action (16 U.S.C. 668-668c). No measurable change in impacts is anticipated for these species under the No Action Alternative as compared to current conditions.

Proposed Action Alternative

Project Operations

Aquatic Species

Upper Basin

Under the Proposed Action Alternative reduced UKL elevations could result in greater levels of avian predation on fish or reduced amounts of preferred nearshore habitats. However, within the Proposed Action Alternative minimum surface elevations would be likely to continue to support native and non-native fish species in UKL, such as native chub species, non-native bass and sunfish, and yellow perch.

Lower Basin

Under the Proposed Action Alternative, the augmentation of 40,000 AF of EWA is anticipated to contribute to negligible (though likely beneficial) impacts to non-Federally-listed species including, but not limited to, steelhead trout, resident rainbow trout, dace, and sculpin.

Terrestrial Species

Upper and Lower Basin

Reducing UKL elevations under the Proposed Action Alternative, to support the proposed EWA augmentation may increase the survivorship or fitness of many species such as waterfowl (American white pelicans, double-crested cormorants, California gull, terns, and other piscivorous avian predators) that prey upon LRS eggs that are abundant at UKL's east side springs during the sucker-spawning season.

However, in general and similar to the No Action Alternative's water management approach, terrestrial species in the Upper and Lower basins dependent on surface waters and agricultural, upland, forested area, wetlands, and riparian areas would likely continue to experience similar conditions as compared to the No Action Alternative. In the event the hydrologic changes prescribed in the Proposed Action Alternative result in some difference to food or habitat availability, terrestrial species would likely migrate to areas that fulfill their biological needs. The need for movement to areas of more suitable habitat would likely be less than a few miles.

Though removed from protection under the ESA, bald (and golden) eagles continue to be protected under the Bald and Golden Eagle Protection Action (16 U.S.C. 668-668c). No measurable change in impacts is anticipated for these species under the Proposed Action Alternative.

4.4.4 Wetland and Riparian Areas

No Action Alternative

Under the No Action Alternative, water levels in UKL and TLS1A and irrigation deliveries to the Project, including irrigated lands within LKNWR and TLNWR, would be maintained consistent with the modified 2018 Operations Plan, as described herein.

Upper Klamath Lake and Upper Klamath National Wildlife Refuge

As noted previously, UKNWR contains some of the last remnant wetland areas around UKL, and emergent wetland areas in UKNWR are typically inundated when water levels in UKL are above 4,139.50 ft in elevation (USFWS 2016a). Under the No Action Alternative, water levels in UKL would be frequently below 4,139.50 for extended periods of time, particularly in drier years (e.g., similar to 1991, 1992, and 1994) (*see Table 4-1*). With respect to the end of September, UKL elevations are projected to be at or above 4,139.50, in approximately 40 percent of all years (*Table 4-1*).

When UKL elevation is below 4,139.50 ft, surrounding wetland areas, including within UKNWR, would largely be without standing surface water (spring and tributary fed waterways would still continue to exist). In terms of scope, the Hanks Marsh and Upper Klamath Marsh units of UKNWR (comprising approximately 15,000 acres) are most directly affected when water levels in UKL are below 4,139.50 ft. Wet meadow habitat within the Agency-Barnes Unit (9,796 acres) is less dependent on water levels in UKL, being generally surrounded by dikes and is wetted due to the effect of sub-irrigation. A reduction of inundated wetlands could have negative effects on aquatic species (i.e., fish, waterfowl, and mammals) that utilize wetland and open water edge habitats for foraging.

Link and Klamath Rivers and Hydroelectric Reach

There are limited amounts of wetland habitat downstream of Link River Dam. Most of these wetlands are associated with the riverbank shoreline and areas of impounded water near reservoirs. The largest amount of wetland habitat in the river reach below Link River Dam is between the Link River and Keno Dam (i.e., Keno Impoundment). The No Action Alternative river stage would be variable, although the variation is anticipated to be minor. Under the No Action Alternative, PacifiCorp's normal operation of surface elevations between 4,085.50 and 4,085.70 ft in Keno Impoundment is not expected to change. Reclamation anticipates little to no impact to the amount of wetlands from the Link River Dam to IGD as a result of the No Action Alternative.

Lower Klamath National Wildlife Refuge

Under the No Action Alternative total annual water deliveries to LKNWR from UKL and the Klamath River average approximately 22,100 AF and range from 13,500 AF to 25,100 AF. (*see Table 4-18*).

Under the No Action Alternative, overall deliveries to LKNWR from UKL and the Klamath River are relatively consistent, with at least 13,500 AF in every year and only three years with deliveries less than 15,000 AF. The precise extent of the impact under the No Action Alternative, in terms of acres of wetlands without standing surface water, would necessarily depend on other conditions, particularly recent precipitation and water deliveries to LKNWR during immediately preceding years, including from Pumping Plant D.

While the water supply for LKNWR under the No Action Alternative may be more reliable than past management scenarios, the annual average volume of water for LKNWR under the No Action Alternative (22,100 AF) is still inadequate to meet refuge needs in some years. The constraints on the average annual volume of water available for LKNWR limits USFWS' ability to manage the various units within the refuge to provide a variety of vegetative communities, particularly for wetland-dependent species. Overall, less habitat can be maintained as wetland areas at any given time. In severely dry years, particularly if successive, the lack of water may result in LKNWR being completely dry (i.e., no wetland areas) due to evaporation and seepage consuming the small volumes of water that are anticipated to be available and associated impacts to migratory birds (*see Section 4.4.5 below*). However, any impacts to wetland areas are not a result of operation of the Project under the No Action Alternative, but rather due to the lack of an established allocation for LKNWR of a portion of the Project Supply.

Tule Lake National Wildlife Refuge (Tule Lake Sumps 1A and 1B)
Under the No Action Alternative, minimum water levels in TLS1A would be 4,034.00 ft year-round. For the 13,240 acres of permanently flooded wetlands within TLNWR (TLS1A and 1B), this minimum elevations for TLS1A under the No Action Alternative provide sufficient water levels to maintain the emergent and submergent vegetation, and associated invertebrates, fish, and amphibians, that characterize these wetland areas.

Proposed Action Alternative
Project Operations

Upper Klamath Lake and Upper Klamath National Wildlife Refuge
The Proposed Action Alternative results in lower water surface levels in UKL, especially in drier years when compared to the No Action Alternative. Under the Proposed Action Alternative, water levels in UKL are also frequently below 4,139.50 ft for extended periods of time, particularly in drier years similar to hydrologic conditions experienced in 1991, 1992, and 1994) (see Table 4-2). Under both the No Action and Proposed Action alternatives, water levels in UKL are below 4,139.50 ft for generally the same period, although the Proposed Action Alternative would likely result in elevations slightly lower and of longer duration than the No Action Alternative (Tables 4-1 and 4-2). With respect to the end of September elevation, UKL elevations are projected to be at or above 4,139.50 ft in 40 percent of all years (Tables 4-1 and 4-2). As noted above, water levels in UKL are similar under both the Proposed Action and No Action alternatives, including extended periods of time above 4,139.50 ft, when fringe wetland areas, including UKNWR, are inundated. These water levels support emergent and submergent wetland vegetation, and invertebrates, fish, and amphibians that occupy this habitat. Wetland areas provide food and habitat for other wetland-dependent wildlife, including waterfowl and other migratory birds.

Although the differences are not clearly discernable with respect to wetland and riparian areas, the Proposed Action Alternative does result in water surface levels in UKL being slightly lower at certain times in comparison to the No Action Alternative (Table 4-3). This change is generally evident with respect to water surface elevations at or below 4,139.50 ft. Specifically, the simulated annual minimum water elevations are approximately 0.25 ft lower under the Proposed Action Alternative compared to the No Action Alternative.

Both the No Action and the Proposed Action alternatives would result in similar periods of time when wetlands around UKL, including within UKNWR, lack standing surface water. Standing surface water supports emergent and submergent wetland vegetation, and invertebrates, fish, and amphibians that occupy this habitat. Wetland areas provide food and habitat for other wetland-dependent wildlife, including waterfowl and other migratory birds.

Accordingly, the Proposed Action Alternative should not result in any long-term, permanent changes to the wetland and riparian areas compared to the No Action Alternative due to its short duration (three-year period) and it is expected to result in similar water surface levels in UKL.

Link and Klamath Rivers and the Hydroelectric Reach

As described in the No Action Alternative, there are limited amounts of wetland habitat downstream of Link River Dam. Most of these wetlands are associated with the riverbank shoreline and areas of impounded water near reservoirs with the largest amount of wetland habitat in the river reach known as Keno Impoundment. The Proposed Action Alternative would result in seasonally variable river stage in this reach, although the variability is likely to be minor. Under the Proposed Action Alternative, PacifiCorp's normal operation of surface elevations between 4,085.50 and 4,085.70 ft in Keno Impoundment is not expected to change. Reclamation anticipates no discernable difference to wetlands from the Link River Dam to below IGD as a result of the Proposed Action Alternative.

Lower Klamath National Wildlife Refuge

Under the Proposed Action Alternative total annual water deliveries to LKNWR from UKL and the Klamath River average approximately 22,100 AF and range from 13,500 AF to 25,100 AF, similar to the No Action Alternative. Accordingly, the Proposed Action Alternative is not expected to result in a discernable change in wetland and riparian areas within LKNWR compared to the No Action Alternative.

Like the No Action Alternative, overall deliveries to LKNWR from UKL and the Klamath River under the Proposed Action Alternative are relatively consistent, with at least 13,500 AF in every year; however, under the Proposed Action Alternative, five years with deliveries less than 15,000 AF occur. Additionally, the Proposed Action Alternative does not include extended periods (i.e., more than twelve months) with no deliveries to LKNWR which should create conditions that reduce the frequency and duration of periods when all wetlands, both permanent and temporary, (i.e., approximately 24,000 acres) in LKNWR lack standing surface water. The precise extent of the impact, in terms acres of wetlands without standing surface water, would necessarily depend on other conditions, particularly recent precipitation and water deliveries to LKNWR during immediately preceding years, including from Pumping Plant D.

Although deliveries to LKNWR are similar under both alternatives, the average volume of water for LKNWR the alternatives is still inadequate to meet refuge needs in every year. The constraints on the average annual volume of water available for LKNWR limits USFWS' ability to manage the various units within the refuge to provide a variety of vegetative communities, particularly for wetland-dependent species. Overall, less habitat can be maintained as wetland areas at any given time. In severely dry years, the lack of water may result in LKNWR being completely dry (i.e., no wetland areas) due to evaporation and seepage consuming the small volumes of water that are anticipated to be available. However, any impacts to wetland areas and resulting impacts to wetland-dependent species, including waterfowl (see Section 4.4.5 below), are not a result of operation of the Project under the Proposed Action Alternative, but rather due to the lack of an established allocation for LKNWR of a portion of the Project Supply.

Tule Lake National Wildlife Refuge (Tule Lake Sumps 1A and 1B)
Under the Proposed Action Alternative, minimum water levels in TLS1A would be 4,034.00 ft year-round. Therefore, minimum elevations under the Proposed Action Alternative would be the same under both the No Action Alternative and the Proposed Action Alternative. As such, for the 13,240 acres of permanently flooded wetlands within TLNWR (TLS1A and 1B), this minimum elevation for TLS1A under the Proposed Action Alternative provides sufficient water levels to maintain the emergent and submergent vegetation, and associated invertebrates, fish, and amphibians, that characterize these wetland areas.

<u>Refuge Water Acquisition</u>
Under the refuge water acquisition component of the Proposed Action Alternative, the acquisition of Project water, including potentially Project Supply from UKL and LRDC and KSD return flows, for use for fish and wildlife purposes could increase available wetland and riparian areas within TLNWR and LKNWR. Although the amount of additional water that could be delivered as a result of the water acquisition component of the Proposed Action Alternative is currently uncertain in 2020, the amount of water acquired could be up to 25,000 AF for the spring/summer period (March – November). This action would be expected to increase deliveries to LKNWR and/or TLNWR, particularly during drier years when refuge water supply would likely be deficient, which would be expected to increase wetland and riparian areas beyond those that would be expected if water was not to be acquired. However, the exact amount of water to be acquired under short-term contracts is uncertain at this time and, as such, any precise estimation of amount of increased wetland and riparian areas would be speculative. Between two and three AF are required to maintain an acre of wetland habitat in TLNWR and LKNWR, meaning that 25,000 AF could maintain up to approximately 10,000 to 12,000 acres of wetlands between the two refuges, however, the place of use of the acquired water is yet to be determined.

4.4.5 Migratory Birds

No Action Alternative and Proposed Action Alternative
<u>Project Operations</u>
The diversity of habitats, from mountain forests to wetlands, attract many migratory birds to the Klamath Basin. Both the No Action Alternative and the Proposed Action Alternative are likely to only impact a few of these diverse habitats, principally open water, cropland, and wetland habitats. Possible reduction in open water and wetland habitats may concentrate migratory birds

that utilize these areas for feeding and nesting or encourage the birds to move to other areas than the Klamath Basin. The reduction of irrigated cropland may also concentrate birds in the remaining croplands or encourage birds to leave the basin. Seasonal reduction in water depth at shallow bodies of water may attract fish-eating birds.

The No Action and Proposed Action alternatives would result in similar patterns and overall UKL elevations through the POR (average monthly differences less than 0.2 ft) as shown in Table 4-3. These water surface elevations would generally maintain the existing wetland and aquatic habitat in the lake, which supports high levels of migratory birds, particularly waterfowl.

As noted above, wetland areas in UKNWR are generally inundated when the water surface elevation of UKL is at or above 4,139.50 ft. Under both alternatives, UKL is below this elevation at the end of September in half of all years, resulting, to some extent, in the loss of food resources and habitat of these wetlands for fall migrating waterfowl. In these cases, open water areas within UKL would still provide food and habitat for waterfowl, particularly diving ducks such as canvasback, redheads, and ringnecks; however, wetland-dependent waterfowl, such as mallards, pintail, widgeon, and Canada geese, may lose access to inundated wetland habitat. Non-inundated wetlands may still provide food resources and habitat for migratory waterfowl, particularly geese and ducks.

Although deliveries to LKNWR from UKL and the Klamath River are the same under both alternatives, the average volume of water annually delivered (22,100 AF) still may not meet all refuge needs, which would necessarily limit USFWS' overall ability to maintain wetland areas within LKNWR on a year to year basis (USFWS 2016). Limited water supplies for wetland areas would result in a reduction in the historical level of food resources and habitat in the Klamath Basin for wetland-dependent migratory birds, including waterfowl, shorebirds, gulls, terns, cranes, rails, herons, grebes, egrets, songbirds, and raptors. Similarly, low water levels in LKNWR would exacerbate waterfowl disease conditions, particularly avian botulism.

Refuge Water Acquisition

It is anticipated that under the refuge water acquisition component of the Proposed Action Alternative, potential negative impacts to fish and wildlife resources in LKNWR and TLNWR may be reduced in 2020 and future similar dry years, due to Reclamation acquiring water from district entities willing to make limited water supplies available in exchange for federal drought relief assistance. As this action would be expected to increase deliveries to LKNWR and/or TLNWR, particularly during drier years when the refuge's water supply would likely be deficient, the refuge water acquisition component of the Proposed Action Alternative would be expected to increase food and habitat resources for migratory birds beyond those that would be expected if water was not to be acquired.

4.5 Recreation

Impacts to recreation on the Klamath River under each alternative would be minor and temporary (specifically in the spring/early summer period) as a result of fluctuations in river operations to implement surface flushing flows downstream of IGD, to minimize the incidence of salmon disease and increase available habitat. These flows are short in duration (7-10 days) and would only temporarily affect river activities (e.g., fishing), but may assist in providing whitewater rafting activities as well as benefits to species and thus recreational fishing opportunities. Ramping rates in the Klamath River below IGD are largely consistent with what would be observed under natural conditions and are unlikely to impact recreational fishing; however, ramp rates below LRD and Keno Dam may impact recreational fishing opportunities. Overall, recreational fishing and boating in the Lower Klamath Basin are anticipated to remain largely consistent with existing conditions under both alternatives.

For the Upper Klamath Basin, recreation (e.g., boating) associated with open water bodies like UKL, would remain unchanged between both alternatives, and would remain consistent with historical recreation opportunities. Boat access to adjacent wetland areas, including in UKNWR, would also be similar under both alternatives. Channels and open water areas within marshes adjacent to UKL generally are accessible by boat, including canoes and kayaks, when water levels are at or above 4,140.00 ft in elevation. Under either alternative, UKL water surface levels for the start of the spring/summer recreation season (March 1) are in excess of 4,140 in all years, and conversely less than this elevation at the start of the fall recreation season (September 30) in about 80 percent of (Tables 4-1 and 4-2) years. In other words, wetland areas surrounding UKL, including within UKNWR, are generally expected to be accessible at the start of the spring (March) and inaccessible at the start of the fall (October) in moderately wet to dry years under both alternatives. This accessibility to wetland areas around the lake allows for recreational use of the areas during the summer and early fall, when this access is generally in demand. UKL elevations descending below 4,140 ft tend to happen earlier and last longer under the Proposed Action Alternative, although the differences are minimal (Tables 4-1 and 4-2).

Portions of LKNWR are open to and accessible for hunting (waterfowl and ring-necked pheasant), boating, wildlife observation, and photography. Hunting opportunities vary between walk-in areas, boat-in marshes, agricultural fields, and established pit blinds. As such, although waterfowl hunting use is primarily focused around flooded, wetland areas, there are still hunting opportunities when wetlands lack standing water. The annual numbers of waterfowl hunters that visit LKNWR varies between approximately 1,500 and 2,600, including years with severely reduced water deliveries. Wildlife observation and photography are also aided by the presence of water, but not dependent upon it, and can be assumed to continue at the same general level under both alternatives. Boating, however, does require open water areas, and thus water deliveries to LKNWR to support these conditions would be impacted under both alternatives, but slightly more so under the Proposed Action Alternative.

Recreation opportunities within TLNWR, which are primarily focused around wildlife observation, boating, waterfowl hunting, and interpretation, are anticipated to continue at historic levels under both alternatives.

Refuge Water Acquisition
Under the refuge water acquisition component of the Proposed Action Alternative, where Reclamation would acquire water for fish and wildlife purposes at LKNWR and TLNWR, it is anticipated that additional inundated wetland areas within LKNWR and TLNWR would occur as compared to the No Action Alternative. These inundated areas would provide more hunting, boating and wildlife viewing opportunities compared to the No Action Alternative.

4.6 Land Use

The scope of the analysis in this EA for both alternatives is the five-county area discussed in Section 3.4. Neither alternative is anticipated to impact land use outside the Project. The alternatives are also not anticipated to change established land management practices within the Klamath Basin Refuge Complex, as identified in USFWS' CCP. Further discussion below is therefore limited to privately owned lands within Klamath, Modoc, and Siskiyou counties.

As simulated over the POR for analysis of socioeconomic impacts, there will be shortages in the supply of Project surface water during the spring/summer season under both the No Action and Proposed Action alternatives. The shortages would be larger and more frequent under the Proposed Action Alternative as shown in (Table 4-13). Shortages that cannot be mitigated by groundwater supplementation may result in involuntary land idling.

No Action Alternative
In socioeconomic impact simulations of the No Action Alternative (Section 4.7), involuntary land idling occurred in 11 years of the 39-year POR (28 percent of years). Fallowed acreage averaged 12,400 acres over the POR, or 43,900 acres per occurrence of years of short water supplies. Short-term impacts due to involuntary land idling may include weed growth and dust mobilization if cover crops are not planted (see Section 4.7). However, long-term land use patterns would not be expected to change.

Proposed Action Alternative
Project Operations
In socioeconomic impact simulations of the Proposed Action Alternative (Section 4.7), involuntary land idling occurred in 20 years of the 39-year POR (51 percent of years). Fallowed acreage averaged 18,200 acres over the POR, or 35,500 acres per occurrence of years of short water supplies. Short-term impacts due to involuntary land idling may include weed growth and dust mobilization if cover crops are not planted (see Section 4.7). However, long-term land use patterns would not be expected to change.

The principal difference between the No Action and Proposed Action alternatives with respect to land use is the increased frequency of years of involuntary land idling likely caused by the inability of groundwater utilization (due to sustainable management objectives and guidelines) to mitigate increasing shortages of Project water supply (Figure 4-13). Although the acreage of involuntary land idling in each year of shortage is actually lower under the Proposed Action Alternative in comparison to the No Action Alternative (35,500 acres vs. 43,900 acres), the frequency of such occurrences is 82 percent higher (20 years vs. 11 years).

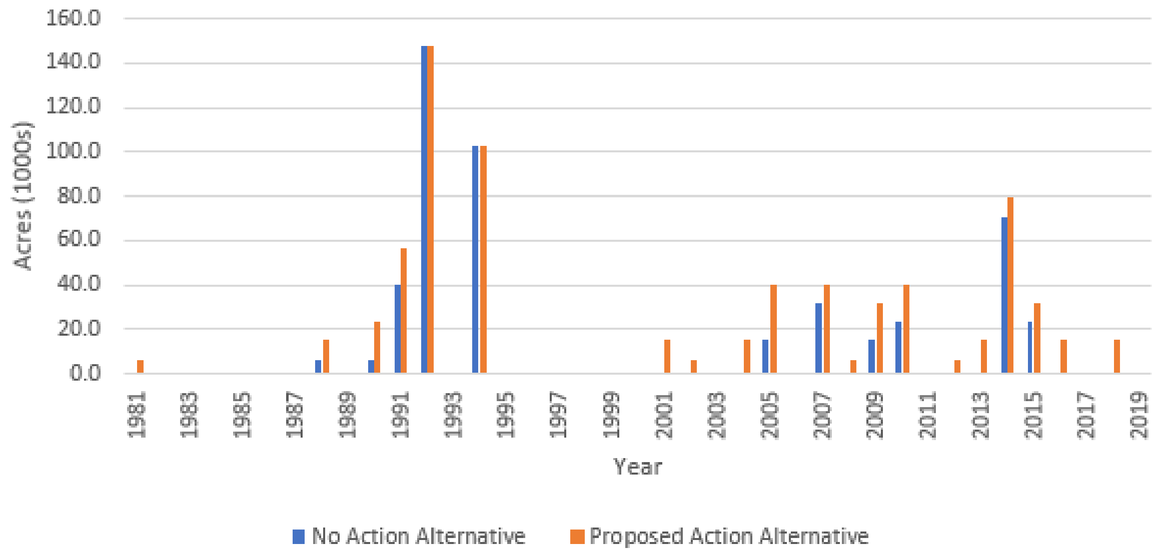

Figure 4-13. Comparison of No Action and Proposed Action alternatives with respect to involuntary land idling expected to result from shortages of irrigation water supply (Project surface water and groundwater[35]).

Refuge Water Acquisition

The refuge water acquisition component of the Proposed Action Alternative where Reclamation acquires up to 25,000 AF of water for fish and wildlife purposes within LKNWR and TLNWR may result in voluntary idling of land. This acreage would be comprised of 1) land which would have received Project water but which is being idled in order to make the water available elsewhere (either the refuges or through transfer to land which would not have received water), and 2) land which would not have received irrigation water and would have been involuntarily idled. Districts and individuals are anticipated to make water available for refuge acquisition from sources and at times that minimize the impact of water shortages on farm activity.

The acquisition of water by Reclamation may result in delayed or reduced irrigation practices to some extent (again unquantifiable as individual water acquisition proposals have not yet been determined), but not in additional land idling beyond what would already be expected to occur were Reclamation to not acquire water; the primary effect of water acquisition would be to replace involuntary land idling with voluntary land idling. This action would only be taken in drought years so even though the acreage of land participating in voluntary land idling is uncertain, the same short-term impacts could be expected as for involuntary land idling.

The socioeconomic effect of such water acquisition would therefore be to partially offset the immediate economic impact of water shortages through funding provided under this drought relief program.

[35] This information presented correlates with the analysis conducted in Section 4.7. which accounts for the socioeconomic impacts of shortages if each alternative is implemented for years similar to those in the POR. The number of acres idled for both alternatives compares available Project spring/summer supplies plus some assumed amount of groundwater pumped to historical demand during the POR.

4.7 Socioeconomic Resources

Project Irrigated Agriculture

The modeling approach used for estimating socioeconomic impacts is presented in Appendix D; the results of the socioeconomic analysis are derived from a simulation of the impact of the No Action and Proposed Action alternatives over the POR.

The availability of Project water under the two alternatives is superimposed on historic demand over the POR. In the simulation, when shortages of Project water occur in a given year under either alternative, sustainably managed groundwater (30/80 rule, *see Section 4.3.3*) is used to fill the gap between available water supply and demand to the extent possible. The cost of individual and private groundwater supplementation is estimated based on the cost of pumping (cost of power and average well efficiency) (Figure 4-14). If managing under the 30/80 rule, groundwater may not be available to fill the gap between Project water supply and agricultural demand if the gap exceeds 80,000 AF or if groundwater has been utilized in previous years such that the ten-year average withdrawal exceeds 30,000 AF (See also appendix D for information on how model assumptions specific to groundwater utilization are used to estimate socioeconomic impact). If a water supply shortage remains after groundwater supplementation, the resultant reduction in irrigated land due to involuntary land idling is used to estimate lost farm revenue. The model (as described in Appendix D) takes into account and estimates, for both alternatives, the average cropping patterns, the market value of various crops, priority of access to Project water supply consistent with Reclamation's contractual obligations and he extended effects of lost farm revenue on the regional economy (Figure 4-15).

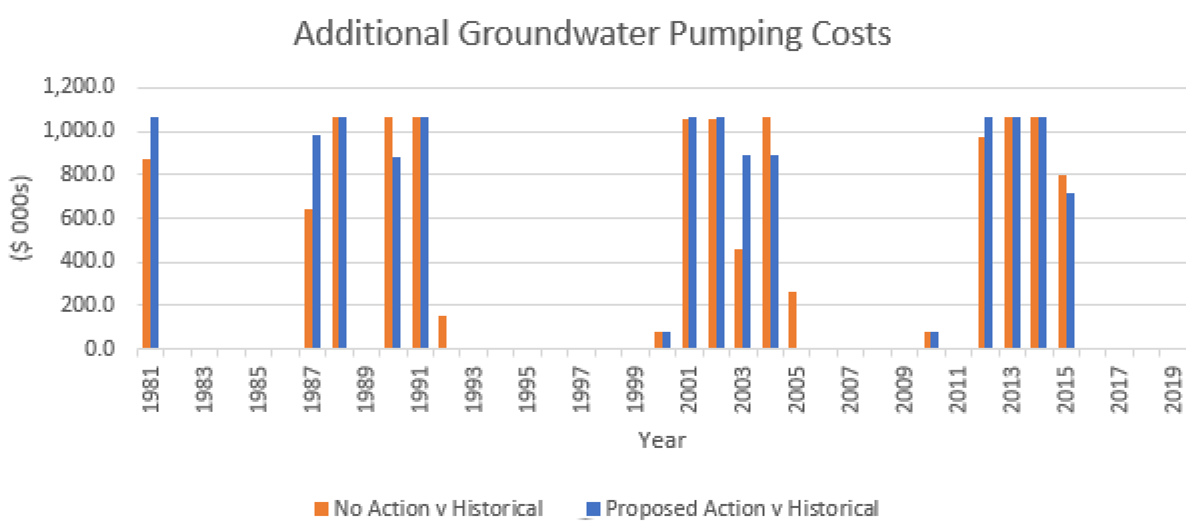

Figure 4-14. Simulated groundwater pumping costs due to shortages of Project water.

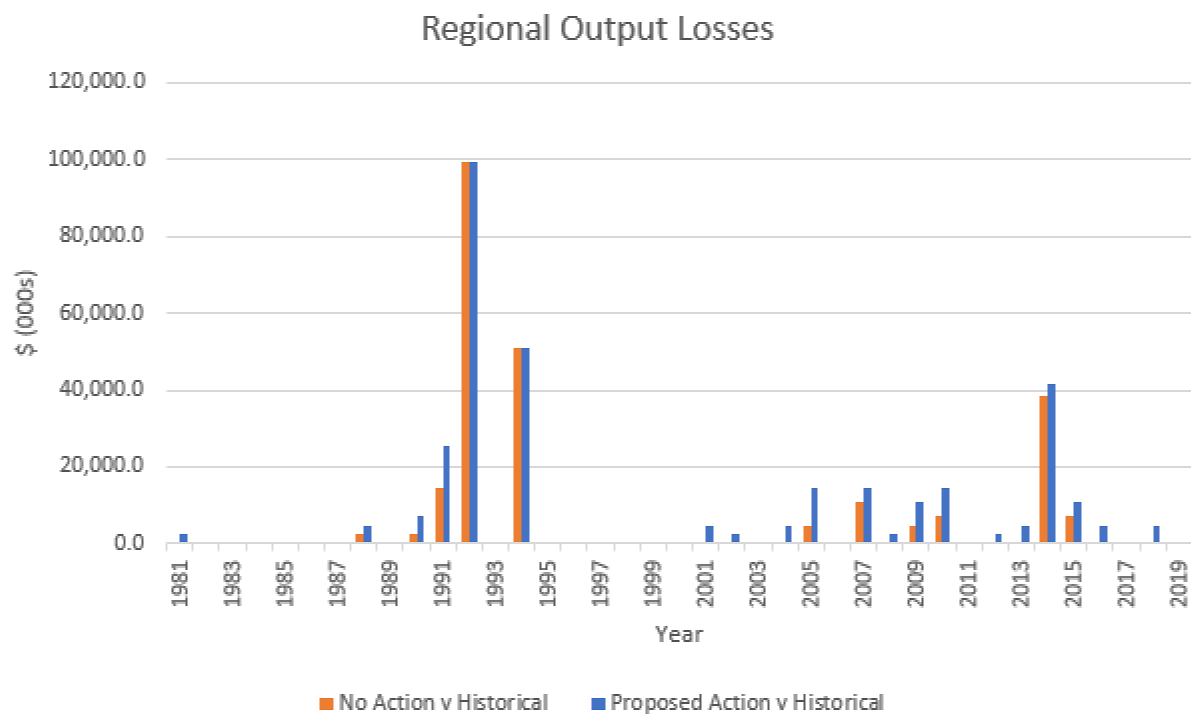

Figure 4-15. Simulated regional economic losses occurring due to unmitigable shortages of irrigation water under implementation of the No Action and Proposed Action alternatives. Values include gross on-farm revenue losses.

No Action Alternative

Under the No Action Alternative, shortages in Project surface water supply are estimated to occur in 56 percent of years (22 of 39 years in the POR). Sustainable use of groundwater mitigates the shortage in 17 of the 22 years, and offsets it completely in 7 years. The average annual cost of groundwater pumping in years in which pumping occurs is $754,000. The annual maximum groundwater pumping cost is $1,062,100 (Appendix D).

After groundwater mitigation, the frequency of unmitigated shortages in irrigation water (Project surface water plus private groundwater) is reduced from 22 to 15 years (38 percent of years in the POR). In four of those 15 years, the magnitude of the unmitigated shortage is less than or equal to 2.5 percent of acreage that would be involuntarily idled and therefore is below the threshold of impacts considered in the socioeconomic impact modeling. Estimated annual regional output losses in the remaining 11 years average $22.1 million (14 percent below estimated full output of $163.2 million) per occurrence, or $6.3 million per year when averaged over the POR. The highest economic impact of a short WY is $99.5 million, or a loss of 61 percent of regional economic activity attributable to agriculture in that year (see further detail in Appendix D).

Under the No Action Alternative, annual regional modeled job losses within the geographic scope of analysis in this EA average 164.3 jobs in each year of unmitigated short water supplies, with an annual maximum of 737.5 jobs lost in any one year (see further detail in Appendix D).

Indian Tribal Communities

This analysis focuses on fishing opportunities, related cultural and social practices, standard of living, and health for four federally recognized tribes in the Klamath Basin (The Klamath Tribes, Karuk Tribe, Yurok Tribe, and Hoopa Valley Tribe) that may have qualitative impacts on the overall socioeconomic status of the Tribes.

Upper Klamath Basin

Under the No Action Alternative, Reclamation anticipates that due to that status of ESA-listed suckers, fishing opportunities for the Klamath Tribes, relative to ceremonial use, subsistence, and commercial needs would still not occur. It is also anticipated that UKL management relative to operation of the Project under the No Action Alternative would not impact The Klamath Tribes' access or availability to other Tribally important resources such as wocus or yellow pond lily (*Nuphar luteum ssp. Polysepalum*; found in areas including the Klamath Marsh and UKNWR)[36].

Lower Klamath Basin

Reclamation anticipates that implementation of the No Action Alternative would maintain the current level of mitigation measures for disease risk to coho and Chinook salmon and increased available habitat in the Klamath River as was experienced in WY 2019 under the modified 2018 Operations plan. In turn, the current levels of salmonid fitness and reduced vulnerability would continue. Under the No Action Alternative, there would be decreased potential for adverse impacts to tribal fisheries-related socioeconomic resources than in years prior to 2019, potentially resulting in increases in Tribal subsistence and commercial fishing and associated cultural practices for the Klamath River Tribes. Due to the integral nature of fish to the worldview, status, and health of the Tribes, any improvements to the health and availability of fish and the Klamath River could contribute to improved standard of living and health for the Tribes. However, standard of living and health improvements would likely occur over the long term which would exceed the three-year period of implementing the No Action Alternative.

Commercial Fishing-Lower Klamath Basin

The No Action Alternative is expected to maintain current riverine conditions for commercially fished species including coho and Chinook salmon relative to conditions prior to 2019. However, because: 1) the long-term benefit has not been quantified, 2) the duration of this Proposed Action Alternative is relatively short (three years), and 3) salmon populations are currently depressed, improvement adequate to sustain commercially harvestable populations is unlikely to occur within the term of the No Action Alternative. Therefore, implementation of the No Action Alternative, though an improvement from prior years, is unlikely to result in long-term effects either positive or negative related to commercial fishing opportunities and resultant economic activity.

[36] The Wocus *(yellow pond lily), is a historical food of the Klamath Tribe and* is indigenous to the Upper Klamath Basin (The Klamath Tribes, 2020).

Recreation
Socioeconomic impacts related to recreation include refuge recreation in the Klamath Basin NWRs associated with water from the Project, and water-based recreation on the Klamath River and along the southern Oregon and northern California coastline.

As refuge recreation largely remains consistent under varying refuge conditions, refuge recreation is unlikely to be substantially impacted by implementation of the No Action Alternative. Therefore, socioeconomics related to NWR recreational use are unlikely to be impacted (though years in which hydrologic conditions are dry/extremely dry may reduce the level of economic stimulus created by recreationalists like hunters). Likewise, as noted for commercial fishing above, water-based recreation centered on recreational fishing is unlikely to change from previous years, though economic stimulus may be impacted by hydrologic conditions impacting fisheries resources outside the control of Reclamation's operation of the Project.

Proposed Action Alternative
Under the Proposed Action Alternative, shortages in Project surface water supply are estimated to occur in about 59 percent of years (23 of 39 years). Sustainable use of groundwater is able to mitigate the shortage in 15 of the 23 years, completely so in 3 years. The average annual cost of groundwater pumping in years in which pumping occurs is $867,000. The annual maximum groundwater pumping cost is $1,062,100 (see further detail in Appendix D).

After groundwater mitigation, the frequency of unmitigated shortages in irrigation water (Project surface water plus private groundwater) is reduced from 23 to 20 years (51 percent of years in the POR). Estimated annual regional output losses in the remaining 20 years average $16.4 million (10 percent below estimated full output of $163.2 million) per occurrence, or $8.4 million per year when averaged over the POR. Based on the socioeconomic modeling conducted for this EA, the highest economic impact of a short WY is $99.5 million, or a loss of 61 percent of regional economic activity attributable to agriculture in that year (*See Appendix D for further detail*).

Under the Proposed Action Alternative, annual regional modeled job losses within the geographic scope of analysis in this EA average 121.6 jobs in each year of unmitigated short water supplies, with an annual maximum of 737.5 jobs lost in any one year.

Comparing the Proposed Action Alternative to the No Action Alternative, groundwater pumping would occur slightly less often due to greater utilization of groundwater in years of Project surface water shortage, making groundwater less available in later years. Total groundwater pumped would increase slightly from 965,000 AF to 980,000 AF. Total pumping costs over the POR would rise by 1.5 percent. Losses to the Project's $163.2 million regional output would be expected to occur in 82 percent of years when groundwater pumping is insufficient to mitigate the Project water shortage, and while the annual loss is projected to be 27.5 percent less severe each time they occurred ($16.4 million vs. $22.2 million), the increased frequency would cause the average losses over the POR to increase 33 percent from $6.3 million to $8.4 million (*Figure 4-15*). The long-term impact of more frequent, albeit smaller, losses on the sustainability of Klamath Basin agriculture is unknown.

Implementation of the Proposed Action Alternative would result in more frequent regional job losses. Compared to the No Action Alternative, the Proposed Action Alternative would result in an 82 percent increase in the frequency of years with job losses which, while not as deep as those under the No Action Alternative (164.3 jobs vs. 121.6 jobs), may create chronic impacts to employment.

Indian Tribal Communities
Under the Proposed Action Alternative, Reclamation anticipates that there would be no change to fishing opportunities for the Klamath Tribes relative to the No Action Alternative.

Reclamation anticipates a reduced disease risk to coho and Chinook salmon and increased available habitat in the Klamath River which is likely to result in increased fitness and decreased vulnerability, relative to the No Action Alternative. In turn, there may be less potential for adverse effects to tribal fisheries-related socioeconomic resources which may increase fish harvest for subsistence and commercial fishing and associated cultural and associated practices for the Klamath River Tribes. Due to the integral nature of fish to the worldview, status, and health of the Tribes, any improvements to the health and availability of fish and the Klamath River could contribute to improved standard of living and health for the Tribes. However, standard of living and health improvements would likely occur over the long term which would exceed the three-year period of the Proposed Action Alternative.

Commercial Fishing-Lower Klamath Basin
The Proposed Action Alternative is expected to improve riverine conditions for commercially fished species including coho and Chinook salmon relative to the No Action Alternative. However, because 1) the long-term benefit has not been quantified, 2) the duration of this Proposed Action Alternative is relatively short (three years), and 3) salmon populations are currently depressed, improvement adequate to sustain commercially harvestable populations is unlikely within the term of the Proposed Action Alternative. Therefore, implementation of the Proposed Action Alternative is unlikely to impact commercial fishing opportunities and resultant economic activity in a manner that can be measured as compared to the No Action Alternative.

Recreation
Because water supplies to the LKNWR average 22,100 AF for both alternatives over the POR, refuge recreation is unlikely to be measurably impacted by implementation of the Proposed Action Alternative except in critically dry hydrologic years. Likewise, as noted for commercial fishing above, water-based recreation centered on recreational fishing is unlikely to change in comparison with the No Action Alternative.

Refuge Water Acquisition
Under the refuge water acquisition component of the Proposed Action Alternative, Reclamation’s acquisition of water for fish and wildlife purposes in LKNWR and TLNWR in 2020, and possibly future years, would offset at least part of the economic impacts to agriculture by providing federal funds that can be used (if districts so choose) to compensate landowners for the cost of pumping supplemental groundwater or voluntary or involuntary curtailments resulting in fallowed lands. This benefit may partially mitigate the negative impacts of reduced water supply discussed above.

4.8 Air Quality

No Action Alternative

Under the No Action Alternative, the air quality condition is anticipated to remain the same as currently being experienced in Del Norte and Humboldt, California counties. Reclamation's water operations under both alternatives are centered on managing Klamath River flows in these counties and would not create any direct/indirect increases/decreases of emissions like $PM_{2.5}$.

Under the No Action Alternative there is a likelihood that agricultural lands within the Project boundaries (Klamath, Modoc, and Siskiyou counties) would be fallowed as a result of individual farming practices or due to reductions in available Federal water supplies. Details of this land fallowing are presented in Section 4.6. Dust emissions ($PM_{2.5}$) within the Project boundaries would likely occur as a result of fallowed land due to limited Project water supplies under certain hydrologic conditions. Dust mitigation practices such as cover crops and stubble management may be employed but are speculative and not able to be measured accurately as they would occur on an individual basis but would be likely be short-term, temporary, and limited to drought years.

Proposed Action Alternative

<u>Project Operations</u>

Under the Proposed Action Alternative there is a likelihood that agricultural lands within the Project boundaries would be fallowed as a result of individual farming practices or due to reductions in available Federal water supplies. Details of this land fallowing, which would likely exceed in extent and frequency the acreage fallowed under the No Action Alternative, are presented in Section 4.6. Similar to the No Action Alternative, dust emissions ($PM_{2.5}$) within the Project boundaries would likely occur as a result of fallowed land due to limited Project water supplies under certain hydrologic conditions. Dust mitigation practices such as cover crops and stubble management may be employed but are speculative and not able to be measured accurately as they would occur at the farm level but would likely be short-term, temporary and limited to drought years.

<u>Refuge Water Acquisition</u>

Under the refuge water acquisition component of the Proposed Action Alternative Reclamation's acquisition of water for fish and wildlife purposes in LKNWR and TLNWR in 2020, and possibly future years, may impact air quality, by providing federal funds that can be used (if districts or their representatives so choose) to compensate landowners for voluntarily fallowing agricultural farmland. Details of this land fallowing, which would occur in addition to lands fallowed as a result of Project Operations, are presented in Section 4.6. Similar to the No Action Alternative, dust emissions ($PM_{2.5}$) within the Project boundaries would likely occur as a result of fallowed land and which could experience incremental increases in years where the 40,000 AF augmentation of the EWA occurs. Dust mitigation practices such as cover crops and stubble management may be employed but are speculative and not able to be measured accurately as they would occur on a farm level and would likely be short-term, temporary and limited to drought years.

4.9 Indian Trust Resources

No Action Alternative

Under the No Action Alternative, management of UKL would result in the elevations outlined in the modified 2018 Operations Plan. In most years, the No Action Alternative would likely provide sufficient habitat for adult suckers that have led to relatively consistent and high survival rates, with juvenile suckers experiencing continued low survival and very limited recruitment into the adult sucker populations. The Klamath Tribes' (located in the Upper Klamath Basin) current levels of ceremonial use would continue and fishing for ESA-listed suckers for subsistence and commercial needs would still not occur. As such, there would be no change relative to current conditions.

The No Action Alternative would be implemented consistent with federal law, Oregon water law, and the stipulated agreement between the U.S., The Klamath Tribes, and Project water users that provides that the tribal water right for minimum water surface levels in UKL would not be exercised against any water rights prior to August 9, 1908. The stipulated agreement is valid until the judicial review of the Klamath Basin General Stream Adjudication is complete. The ACFFOD is subject to ongoing judicial review but is currently enforceable under Oregon law. The Klamath Tribes, with the concurrence of the Bureau of Indian Affairs, have made a call to enforce some or all of the water rights for instream flows in tributaries to UKL, at varying levels, every year since issuance of the ACFFOD in 2013. This would likely continue to occur under the No Action Alternative (The Klamath Tribes did make a call for the 2020 irrigation season). As such, there would be no change relative to The Klamath Tribes' federal reserved water rights under the No Acton Alternative.

Implementation of the No Action Alternative includes a preventative measure for minimizing disease in the form of a forced surface flushing flow that would be provided with certainty in nearly every year. The No Action Alternative provides a 20,000 AF augmentation to the EWA in certain year types for May and June which can be can either used for habitat flows or disease mitigation purposes at the recommendation of the FASTA Team to meet fisheries needs. Tribal trust fisheries in the Klamath River would likely experience increased fitness and decreased vulnerability, allowing for harvest of salmon for subsistence, ceremonial, and commercial needs.

Additionally, under the No Action Alternative, 7,000 AF of water for the Yurok Tribe's Ceremonial Boat Dance would continue to be supported in even years (e,g, 2020). Ceremonial events dependent on water resources for the Hoopa Valley Tribe would not be impacted by implementation of the No Action Alternative as Klamath River flows for those purposes are supported by releases from the Trinity River in odd years (e.g, 2021).

Proposed Action Alternative

<u>Project Operations</u>

Under the Proposed Action Alternative, management of UKL would result in both higher and lower end of month UKL surface elevations, but the overall trend would be lower under the Proposed Action Alternative due to UKL contributions to the additional augmented flows in years where UKL Supply is between 550,000 AF and 950,000 AF. However, as described in section 2.4.2 under the Proposed Action Alternative UKL surface elevations would be maintained above 4,142.00 ft in March, April, and May in the years in which EWA augmentation is triggered, and UKL elevations would always be maintained above 4,138.0 ft (regardless of whether EWA augmentation occurs). Overall though there is an average decrease of 0.07 ft during sucker spawning from February to May and an average decrease of 0.15 ft for August and September. Under the Proposed Action Alternative, sufficient habitat for adult suckers would continue and lead to relatively consistent outcomes as under the No Action Alternative (e.g., high survival rates, with juvenile suckers experiencing continued low survival and very limited recruitment into the adult sucker populations). Therefore, it is expected that there would be no impact to The Klamath Tribes' trust resources as current levels of ceremonial use of ESA-listed suckers would continue and fishing for subsistence and commercial needs would still not occur, similar to the No Action Alternative.

Like the No Action Alternative, the Proposed Action Alternative would be implemented consistent with federal law, Oregon water law, and the stipulated agreement between the U.S., The Klamath Tribes, and Project water users that provides that the water right for minimum water surface levels in UKL would not be exercised against any water rights with a priority date before August 9, 1908. The stipulated agreement would remain valid until the judicial review of the Klamath Basin General Stream Adjudication is complete and there would be no change to The Klamath Tribes' federal reserved water rights as compared to the No Acton Alternative.

Similar to the No Action Alternative, implementation of forced surface flushing flows would continue and 20,000 AF of EWA in May and June in certain years would be utilized under the Proposed Action Alternative. With an additional 40,000 AF for EWA augmentation under certain hydrologic conditions, the Tribal trust fishery in the Klamath River, under the Proposed Action Alternative would likely experience an increase in salmonid fitness and decreased vulnerability, allowing for potentially increased opportunities for harvest of salmon for subsistence, ceremonial, and commercial needs.

The Proposed Action Alternative would not alter Klamath River water availability for the Yurok Tribe's Ceremonial Boat Dance as compared to the No Action Alternative. Nor would any ceremonial events conducted by the Hoopa Valley Tribe be impacted by the Proposed Action Alternative, as Klamath River flows for those purposes are supported by releases from the Trinity River in odd years (e.g., 2021).

Water Acquisition

Under the refuge water acquisition component of the Proposed Action Alternative, Reclamation's acquisition of water for fish and wildlife purposes for LKNWR and TLNWR under the Proposed Action Alternative would not impact Indian trust resources as the proposed acquisition is solely to acquire water for NWRs that are likely to receive limited water supplies in dry hydrologic years. As the acquired water is to originate from Project Supply or other sources (LRDC and KSD return flows) no impacts to UKL or suckers (trust resource for the Klamath Tribe) is anticipated. Similarly, no additional water allocated for the EWA or Klamath River flows would be impacted through this proposed water acquisition, resulting in no impact to downriver tribal trust resources.

4.10 Environmental Justice

Regarding environmental justice implications consistent with Executive Order 12898 "*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*," under both alternatives some involuntary land fallowing of productive irrigable land within the Proposed Action Alternative area would occur leading to an increased risk to local rural agricultural communities. However, both alternatives would maintain current patterns of agricultural production and related employment opportunities through the use of supplemental water supplies (e.g., groundwater), changes in agricultural practices (e.g., conservation/crop rotation), application of on-farm crop insurance program, use of NRCS programs, and other potential state and federal programs and activities, thereby reducing risks to populations within Klamath, Modoc, and portions of Siskiyou counties. However, use of these mitigation measures is uncertain and would be conducted on an individual level. Regional job losses in the agricultural community (*Section 4.7*) may disproportionately impact minority and low-income populations. However, socioeconomic modeling suggests that in years in which job losses occur due to shortages of Project water, although more frequent, would not be as severe.

Increasing the amount of water used to meet ESA-listed species requirements under the Proposed Action Alternative would not adversely affect the likelihood of dependent Tribal communities (i.e., Karuk, Yurok, Hoopa Valley Tribes (Lower Basin Tribes), and The Klamath Tribes (Upper Basin Tribe) to continue utilizing fisheries as a community economic and cultural resource relative to the No Action Alternative. Under the Proposed Action Alternative, it is anticipated that the tribal fishery in the Klamath River would experience increased fitness and decreased vulnerability, allowing for a potential increase in coho and Chinook salmon availability as an economic and resource when compared to the No Action Alternative. For suckers there would be no change from existing levels related to use as an economic and cultural resource for the Klamath Tribe. In turn, the overall risk to the tribal fisheries and the associated environmental justice would be reduced for Lower Klamath Basin Tribes and maintained for The Klamath Tribes.

Overall, under both alternatives the impacts on minority and low-income populations throughout the action area are expected to be minor due to the short term of the action. Therefore, ethnic minority and/or low-income sectors of the population are not expected to be disproportionately affected by adverse environmental impacts associated with the either alternative.

<u>Refuge Water Acquisition</u>

Under the refuge water acquisition component of the Proposed Action Alternative, Reclamation's acquisition of 25,000 AF of Project water for fish and wildlife purposes in LKNWR and TLNWR could lessen the economic hardships on local low income rural agricultural communities in Klamath, Modoc, and portions of Siskiyou counties during years of dry hydrologic conditions like WY 2020, by providing a source of funding for non-federal voluntary demand management activities including land idling and groundwater pumping, etc. (*see Appendix E*). No environmental justice impacts are anticipated for the Klamath Tribal communities mentioned above as this component of the Proposed Action Alternative is solely focused on water management of available Project water supplies within the Project.

4.11 Cumulative Impacts

According to the Council on Environmental Quality regulations for implementing the procedural provisions of NEPA, a cumulative impact is defined as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR § 1508.7) Reclamation considers only future actions which have completed planning and any required compliance activities to be reasonably foreseeable and those that will have effects within the three-year period of analysis for this action. The necessity of these considerations is based on the likelihood of an action occurring and any associated effects being experienced within the term of analysis covered in this EA (2020-2023).

<u>Water Resources</u>
No reasonably foreseeable actions are known to Reclamation that would affect water resources beyond the past and present actions (included in the affected environment discussion) and the impacts of the Proposed Action Alternative. As a result, for the three-year period of the Proposed Action Alternative, there are no anticipated substantial cumulative impacts on Klamath River Basin water resources.

<u>Biological Resources</u>
Past and present actions, as presented in the affected environment discussion, have modified the biological resources in the Klamath Basin over the last century. Reasonably foreseeable future actions that could affect biological resources include implementation of USFWS' *Sucker Recovery Program* and PacifiCorp's *Coho Enhancement Fund* required under their Habitat Conservation Plan (PacifiCorp 2011,2012; USFWS 2019). During the three-year period of the Proposed Action Alternative, the cumulative impacts are likely to be minor, as sucker recovery, coho enhancement, and changes to the biological resources would require a much longer time frame to be implemented and their effects are speculative beyond the period of analysis.

<u>Recreation</u>
Reclamation has identified no reasonably foreseeable actions that would add to a cumulative impact upon recreation resources in the action area during the three-year period of the Proposed Action Alternative. No cumulative impacts beyond the effects of the Proposed Action Alternative are anticipated.

<u>Land Use</u>
Implementation of the Proposed Action Alternative is largely a water management action taking place within aquatic habitat. Reclamation has identified no reasonably foreseeable actions that would add to a cumulative impact upon land use in the action area during the three-year period of the Proposed Action Alternative. Past and present actions are included in the affected environment discussion of land use (*Section 3.4*). No cumulative impacts beyond the effects of the Proposed Action Alternative are anticipated.

Socioeconomic Resources

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative impact upon socioeconomic resources in the action area during the three-year period of the Proposed Action Alternative. No cumulative effects beyond those specific to the Proposed Action Alternative are anticipated.

Air Quality

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative effect upon air quality in the action area during the three-year period of the Proposed Action Alternative. No cumulative impacts beyond those specific to the Proposed Action Alternative are anticipated.

Indian Trust Resources

Reasonably foreseeable future actions that could affect Indian Trust Resources include implementation of USFWS Sucker Recovery Plan and implementation of PacifiCorp's Coho Enhancement Fund actions. During the three-year period of the Proposed Action Alternative, the cumulative impacts in comparison to the No Action Alternative are likely to be minor, as sucker recovery and changes to the biological resources would require a much longer time frame to be implemented and their effects are speculative beyond the period of analysis.

Environmental Justice

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative impact upon socioeconomic resources in the action area during the three-year period of the Proposed Action Alternative when compared to the No Action Alternative. Cumulative impacts of future activities beyond the three-year period of the Proposed Action Alternative on minority and low-income populations are speculative. The net cumulative impacts are anticipated to be minor due to the likely (if somewhat uncertain, because decisions by individuals are speculative) use of supplemental water supplies, changes in agricultural practices, and/or application of on-farm crop insurance program that might be implemented in response to shortages, thereby minimizing the impacts to populations within Klamath, Modoc, and portions of Siskiyou counties.

Section 5 Consultation and Coordination

5.1 Agencies and Groups Consulted

Reclamation coordinated with the Services regarding compliance with the ESA and the MSA as well as OWRD regarding groundwater resources in the preparation of this EA.

Comments received from the public review of the draft will be used to develop the Final EA and FONSI or to determine if a NOI to prepare an Environmental Impact Statement is warranted.

5.2 Endangered Species Act

Section 7 of the ESA requires Federal agencies in consultation with the Departments of the Interior and/or Commerce, to ensure that the agency's action does not jeopardize the continued existence of ESA-listed species or result in adverse modification of the species critical habitat (50 CFR § 402.10). Development of the Proposed Action Alternative was highly coordinated with the Services to ensure compatibility with the effects on the species in which each agency has jurisdiction.

Reclamation analyzed the Proposed Action Alternative's potential effects on identified ESA-listed species and their designated critical habitat that may be impacted by implementation of the Proposed Action Alternative. Utilizing the KBPM, the hydrologic modeling tool utilized in the 2019 consultation efforts (*described in Sections 1 and 2.2.1 of this EA and Sections 3.4 and 4.2.1 of the modified 2018 Operations Plan*), Reclamation prepared final model output, and a technical description of 40,000 AF of EWA augmentation and the enhanced May/June provisions to evaluate the Proposed Action Alternative's potential effects to Federally-listed species (specifically SONCC coho salmon, LRS and SNS, and SRKW).

Through this evaluation, Reclamation has determined the Proposed Action Alternative is expected to provide additional habitat availability for SONCC coho salmon which would contribute toward meeting the habitat conservation standard and potentially reduce disease risk for this species. As such, Reclamation believes that implementation of the Proposed Action Alternative would result in reduced effects from those previously analyzed in NMFS' 2019 BiOp and therefore be consistent with NMFS' 2019 determinations that Project operations are not likely to jeopardize the continued existence of SONCC coho salmon or destroy or adversely modify their designated critical habitat.

Additionally, the Proposed Action Alternative may reduce UKL elevations at certain times of the year when the 40,000 AF of EWA augmentation is triggered. However, when the 40,000 AF of EWA augmentation is triggered, Reclamation would operate such that UKL elevation will not drop below 4,142.00 ft during the months of March, April or May in that WY (once that elevation has been achieved). Further, while implementation of the 40,000 AF of EWA augmentation could cause UKL minimum surface elevation to be reduced below elevation 4,138.26 (elevations previously identified in the USFWS 2019 BiOp) to an elevation of 4138.00, (expected to be an infrequent occurrence), this elevation would still be expected to provide sufficient depth for suckers to access refugial habitat within Pelican Bay.

In general, the differences would result in an average decrease of 0.07 ft during sucker spawning from February to May and an average decrease of 0.15 ft for August and September that results in minimal reductions of habitat available to adult suckers in late summer in the preferred depths in the northern part of UKL. In addition, Reclamation believes that the ability to borrow water from PacifiCorp reservoirs provides additional safeguards such that the Proposed Action Alternative would be protective of suckers in UKL at critical life stages and associated UKL elevations (4,142.0 ft in April and May and 4,138.0 ft as an annual minimum) that avoid jeopardizing the continued existence of LRS and SNS and do not destroy or adversely modify their designated critical habitat.

Reclamation believes this proposed Interim Plan meets Reclamation’s ESA responsibility to not jeopardize Federally-listed species or destroy or cause adverse modification of their designated critical habitat.

Reclamation’s evaluation, determination on effects to ESA-listed species, and request confirmation of Reclamation’s findings was transmitted to the Services on March 27, 2020, and is included in Appendix F.

Through coordination with the Services, Reclamation anticipates receiving responses from both Services in early April, concluding ESA coordination and consultation on the Proposed Action Alternative. The Services’ responses will be reviewed and incorporated into this NEPA analysis prior to finalization of the EA and issuance of either a FONSI or NOI.

5.3 Essential Fish Habitat

EFH is designated for commercially fished species under the MSA. The MSA requires federal fishery management plans, developed by NMFS and the Pacific Southwest Fisheries Management Council, to describe the habitat essential to the fish being managed and to describe threats to that habitat from both fishing and non-fishing activities. Pursuant to section 305(b) of the MSA (16 U.S.C. 1855(b)), federal agencies are required to consult with NMFS on actions that may adversely affect EFH for species managed under the Pacific Coast Salmon Fishery Management Plan. This section also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

Reclamation’s EFH analysis covered Chinook salmon (a food source of and therefore interrelated to the endangered SRKW) and SONCC coho salmon was submitted to NMFS on March 8, 2019. On March 29, 2019, NMFS concluded that Reclamation’s modified 2018 Operations Plan would adversely affect coho salmon and Chinook salmon EFH. The following is a list of EFH conservation recommendations that NMFS states would protect, by avoiding or minimizing the adverse effects described above, the mainstem Klamath River and tributaries designated as EFH for Pacific Coast salmon.

- Reclamation should maximize the benefits of opportunistic high flow releases to create habitat conditions conducive to salmonid fitness, and detrimental to the disease pathogen *C. shasta*. For example, to the extent practicable, Reclamation should implement deep flushing flow events described as Measure 2 in Hillemeier et al. (2017) Implementation of Guidance Measure 2 will also help reduce adverse effects of the Proposed Action Alternative to water quality.

- Reclamation should ensure that habitat restoration projects funded through the Program are designed and implemented consistent with techniques and minimization measures presented in California Department of Fish and Wildlife's California Salmonid Stream Habitat Restoration Manual, Fourth Edition, Volume II (Part IX: Fish Passage Evaluation at Stream Crossings, Part XI: Riparian Habitat Restoration, and Part XII: Fish Passage Design and Implementation; referred to as the Restoration Manual) (Flosi et al. 2010). This will help ensure that any short-term adverse effects to the streambed and associated benthic organisms EFH are minimized.

Reclamation believes that the effects of the Proposed Action Alternative are within the effects analyzed and submitted to NMFS in its March 8, 2019 EFH Assessment. Through coordination with NMFS, their response letter described above in Section 5.2, is anticipated to address EFH and any revisions to the NMFS' conservations recommendations listed above and in their March 2019 EFH Assessment. Consistent with the MSA, Reclamation will provide a detailed written response to NMFS's EFH conservation recommendations within 30 days of receipt of the recommendations (50 CFR S 600.920(k)(l)).

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Section 7 Appendices

Appendix A Maps of the Klamath River Basin, Klamath Project, and National Wildlife Refuges within the Geographic Scope of both Alternatives.

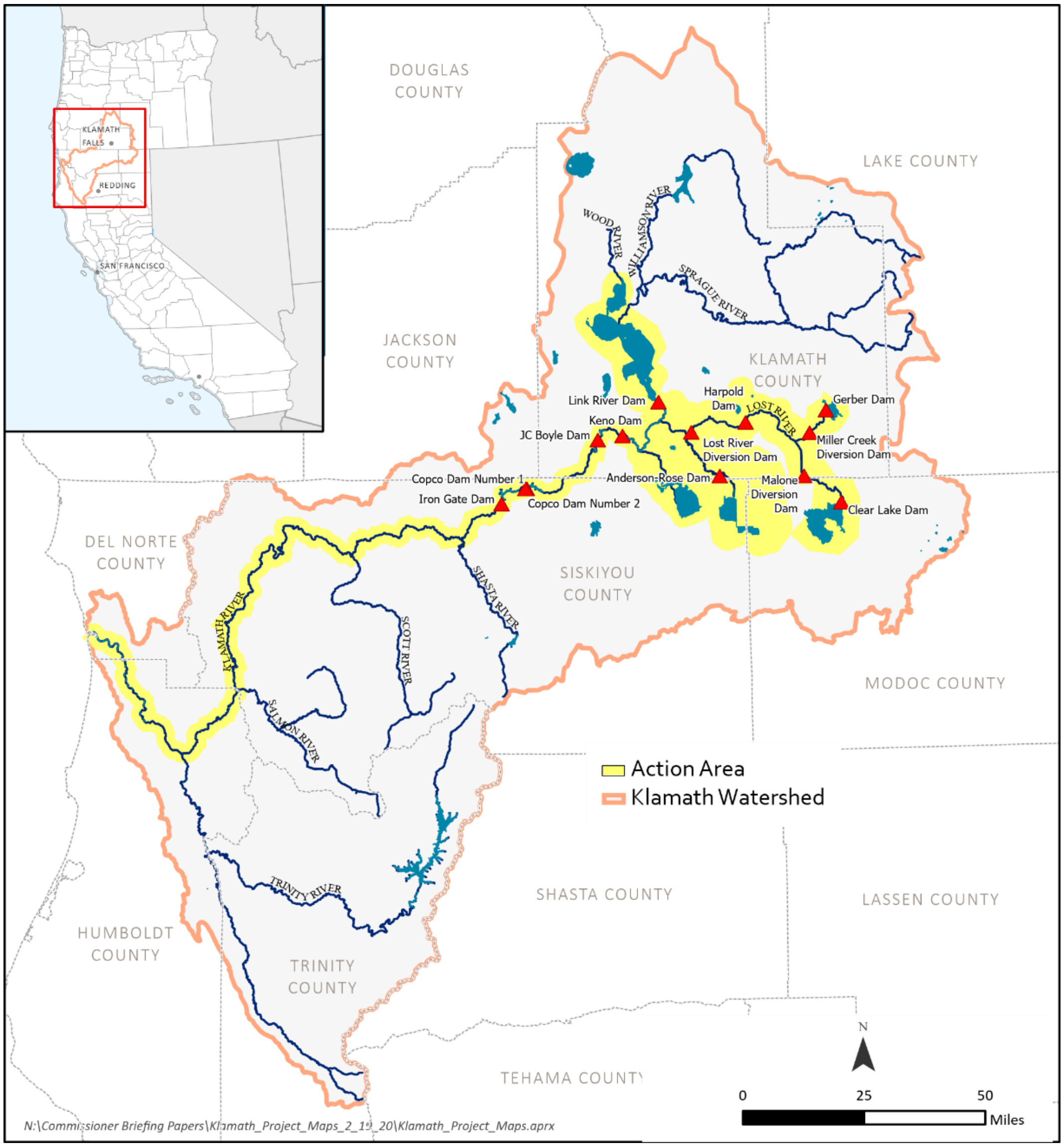

Figure 7-1. Geographic scope of the No Action and Proposed Action alternatives, Klamath River Basin. Source: Bureau of Reclamation, 2020

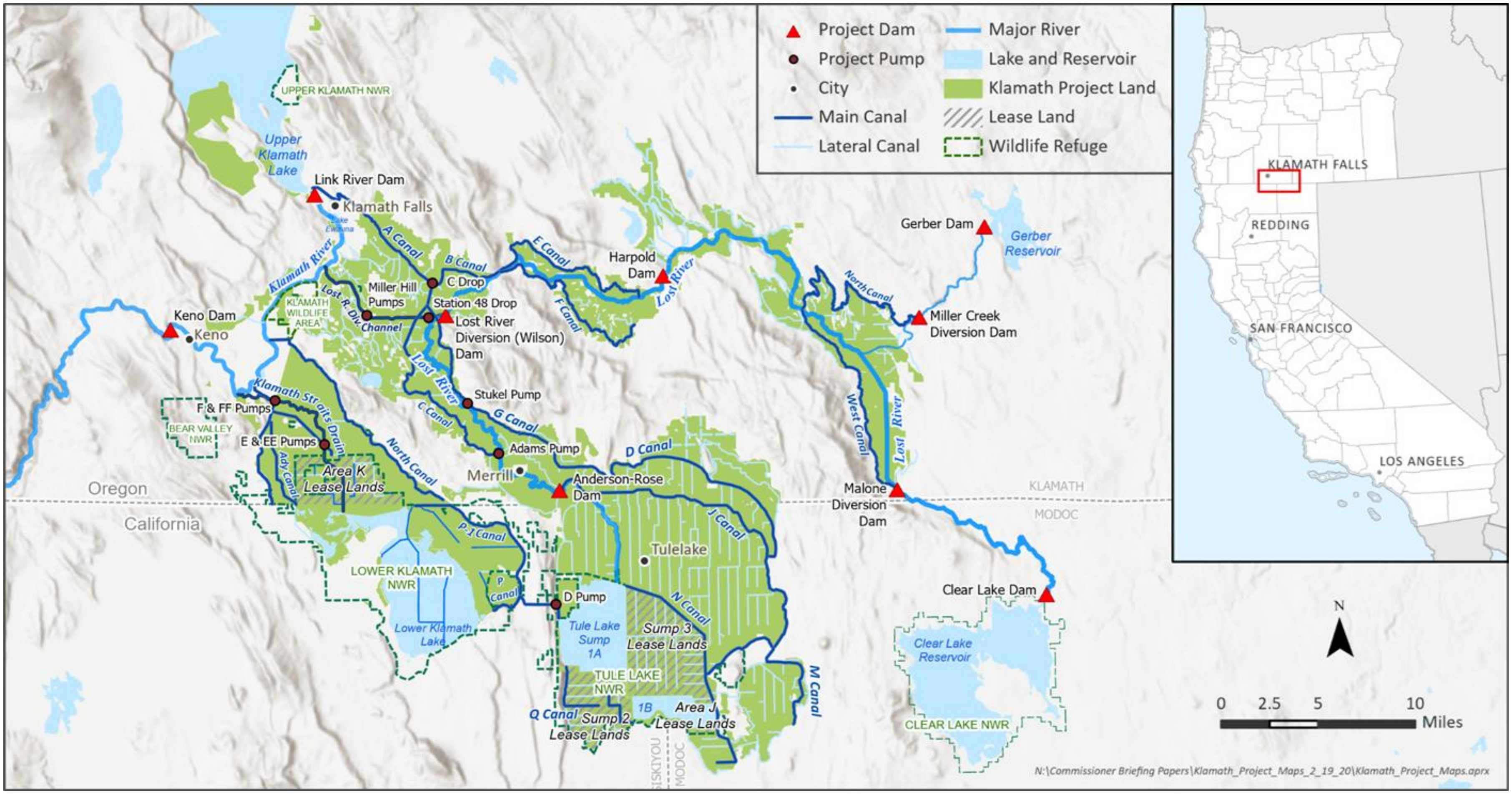

Figure 7-2. Map of the Upper Klamath Basin

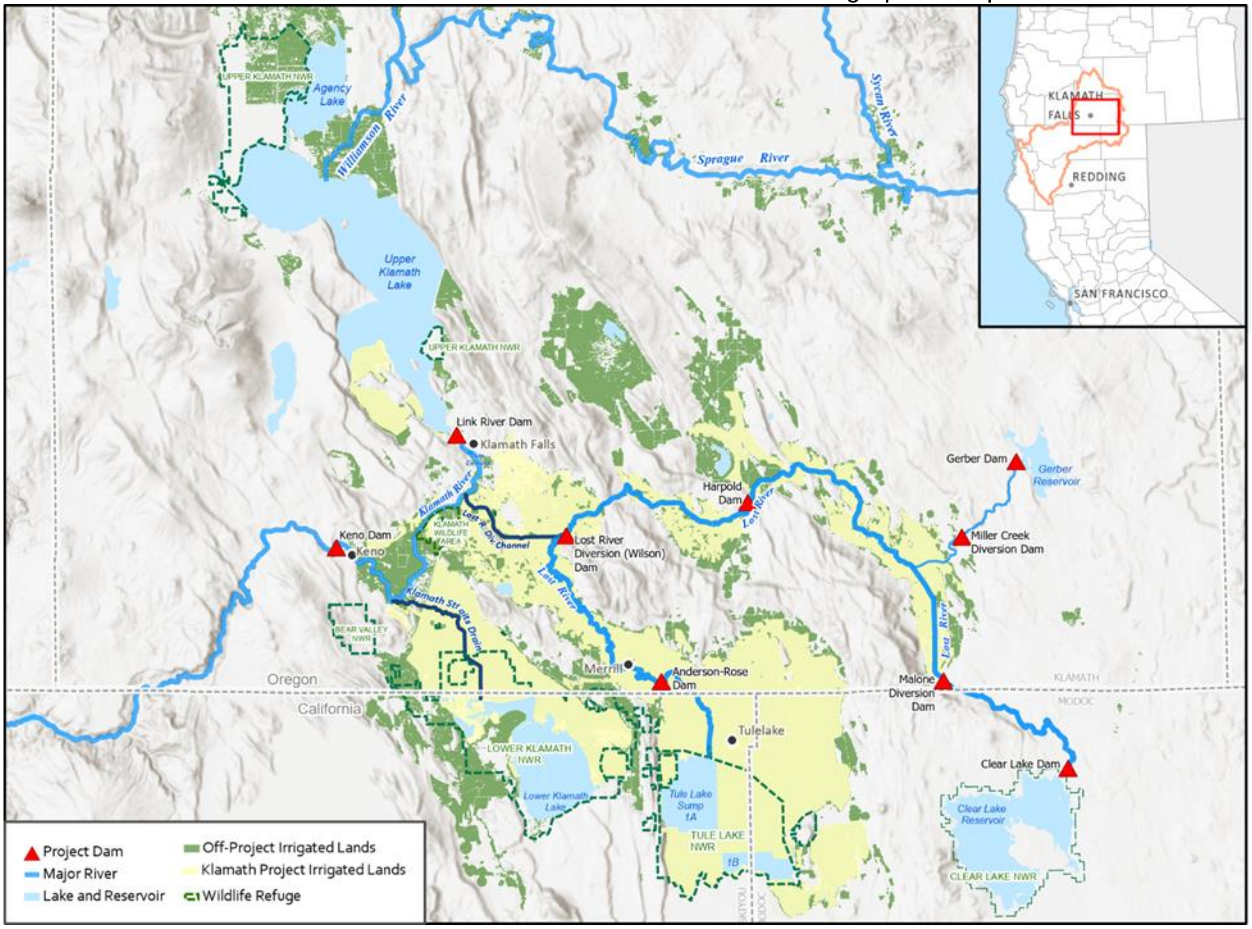

Figure 7-3. Map of the Upper Klamath Basin. Source: Reclamation 2020.

Appendix B Other Wildlife Species

Other species that may be present within the geographic scope of the EA.

Reptiles

Reptile species diversity and relative abundance is considered high (PacifiCorp 2004). The western fence lizard (*Sceloporus occidentalis*) is a highly abundant reptile species found in a variety of habitats in the area. Other reptile species include gopher snake (*Pituophis catenifer catenifer*), northern sagebrush lizard (*Sceloporus graciosus graciosus*), western rattlesnake (*Crotalus viridis*), southern alligator lizard (*Elgaria multicarinata*), western yellow-bellied racer (*Coluber constrictor mormon*), common garter snake (*Thamnophis sirtalis*), western terrestrial garter snake (*Thamnophis elegans*), western pond turtle (*Actinemys marmorata*), common king snake (*Lampropeltis getula*), striped whipsnake (*Masticophis taeniatus*), sharptail snake (*Contia tenuis*), ringneck snake (*Diadophis punctatus*), western skink (*Eumeces skiltonianus*), rubber boa (*Charina bottae*), and California mountain king snake (*Lampropeltis zonata*) (PacifiCorp 2004).

Mammals

In addition, many common mammals are found throughout the area, including black-tailed jackrabbit (*Lepus californicus*), mule deer (*Odocoileus hemionus*), and California ground squirrel (*Otospermophilus beecheyi*). Small mammals in the area include deer mouse (*Peromyscus*), bushy-tailed woodrat (*Neotoma cinerea*), least chipmunk (*Neotamias minimus*), several species of bats, and montane vole (*Microtus montanus*). Medium-sized mammals in the area include bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), yellow-bellied marmot (*Marmota flaviventris*), and coyote (*Canis latrans*). Large mammals such as deer (*Cervidae*), elk (*Cervus canadensis*), mountain lion (*Puma concolor*), and black bear (*Ursus americanus*) are also present. Five aquatic or riparian-associated fur-bearing mammals are present, including raccoon (*Procyon lotor*), beaver (*Castor*), muskrat (*Ondatra zibethicus*), mink (*Neovison vison*), and river otter (*Lontra canadensis*) (PacifiCorp 2004).

Birds

The Project area is along the Pacific Flyway, which supports the largest concentration of migratory waterfowl in North America, with many thousands of migratory birds during fall migration and about half that number in spring (Jarvis 2002). Waterfowl fall migration peaks in September and October, and spring migration peaks in March and April. After the final agricultural harvest of the season while fields remain unfarmed, they may be flooded to benefit waterfowl. These fields offer vital nesting habitat and feeding grounds for migrating waterfowl (USFWS 2013b). Large numbers of water-related birds also use the area for breeding (Shuford et al. 2004). The wetlands support large breeding colonies of American white pelicans (*Pelecanus erythrorhynchos*); double-crested cormorants (*Phalacrocorax auritus*); eared, Western, and Clark's grebes (*Phalacrocorax auritus*, *Aechmophorus occidentalis*, and *Aechmophorus clarkii*); great egret (*Ardea alba*); white-faced ibis (*Plegadis chihi*); ring-billed gull (*Larus delawarensis*); California gull (*Larus californicus*); and Caspian, Forster's, and black terns (*Hydroprogne caspia, Sterna forsteri,* and *Chlidonias niger*) (Reclamation and CDFG 2012).

In addition, the area supports the largest wintering population of bald eagles (*Haliaeetus leucocephalus*) in the contiguous U.S.USGS (Shuford et al. 2004). Eagles typically nest mid-January to mid-August (Reclamation and CDFG 2012). Riparian and wetland habitats support other migratory birds such as western wood pewee (*Contopus sordidulus*), song sparrow (*Melospiza melodia*), Brewer's blackbird (*Euphagus cyanocephalus*), yellow warbler (*Setophaga petechia*) (a California species of special concern), brown-headed cowbird (*Molothrus ater*), black-headed grosbeak (*Pheucticus melanocephalus*), and mourning dove (*Zenaida macroura*) (PacifiCorp 2004). Most nesting by migratory birds occurs between March 1 and August 31 (Reclamation and CDFG 2012)

Special-Status Terrestrial Species

Although numerous special-status species have the potential to occur in the project area because they have been sighted at similar habitats in the Lost River Subbasin, most the species listed below have been reported in the project area (USFWS 2013; California Natural Diversity Database 2014; Oregon Biodiversity Information Center 2014):

- American white pelican – common in suitable habitat spring through fall; uncommon in winter.
- Bald eagle – abundant fall through spring; common in summer. The closest bald eagle nest is more than 6 miles from the nearest construction site.
- Bank swallow (*Riparia riparia*) – uncommon in summer; rare in spring and fall; not present in winter.
- Golden eagle (*Aquila chrysaetos*) – uncommon year-round.
- Gray wolf (*Canis lupus*) – infrequent; confirmed at LKNWR in 2012.
- Greater sandhill crane (*Grus canadensis tabida*) – common in spring and fall; uncommon in summer and winter.
- Purple martin (*Progne subis*) – very rare; breeds April through August.
- Swainson's hawk (*Buteo swainsoni*) – uncommon spring through fall; not present in winter.
- Western snowy plover (*Charadrius alexandrinus nivosus*) – very rare; breeds March through September.

Aquatic Species

Resident fish (both native and nonnative) in the project area include Klamath largescale sucker (*Catostomus snyderi*), bullhead, chubs, sunfish, perch, trout, and bass. Redband trout (*Oncorhynchus mykiss gairdnerii*) are present in UKL and the Klamath River. Pacific lamprey (*Lampetra tridentata*) are present in the Klamath River downstream of IGD.

Amphibian Species

Amphibian species most likely to occur in the project area include long-toed salamander (*Ambystoma macrodactylum*), bullfrog (*Lithobates catesbeianus*), Pacific chorus frog (*Pseudacris regilla*), and western toad (*Anaxyrus boreas*). These species are generally restricted to ponds or other still-water habitats, except the western toad, which can breed in streams and standing water (Reclamation and CDFG 2012).

Appendix C Cultural Resources

CULTURAL RESOURCES COMPLIANCE
Division of Environmental Affairs
Cultural Resources Branch (MP-153)

MP-153 Tracking Number: 20-KBAO-111

Project Name: Implementation of Klamath Project Operating Procedures 2020-2022

NEPA Document: CGB-EA-2020-018

NEPA Contact: Amanda Babcock, Natural Resource Specialist

MP 153 Cultural Resources Reviewer: Scott Williams, Archaeologist

Date: March 13, 2020

Reclamation has developed and is proposing to implement Klamath Project Operating Procedures for 2020-2022, consistent with its contractual and/or water right delivery obligations and applicable Federal laws. This is the type of undertaking that does not have the potential to cause effects to historic properties, should such properties be present, pursuant to the Title 54 U.S.C. § 306108, commonly known as Section 106 of the National Historic Preservation Act (NHPA) regulations codified at 36 CFR § 800.3(a)(1). Reclamation has no further obligations under NHPA Section 106, pursuant to 36 CFR § 800.3(a)(1).

Reclamation is proposing to implement a modified water management approach for Klamath Project (Project) operations that would ensure water supply reliability for irrigators while addressing Endangered Species Act requirements for listed species and/or designated critical habitat. The Proposed Action defines how Project operations would be conducted, consistent with Reclamation's responsibilities and obligations, with an April 1 determination of available Project Supply. Implementation of the Proposed Action also defines how Reclamation would manage Upper Klamath Lake elevations and Klamath River flows below Iron Gate Dam. Though the Proposed Action includes operation and maintenance tasks (e.g., inspections and repair/replacement of gates, pumps, canals, etc.), the Proposed Action would not produce any ground disturbances, would not result in the construction of new facilities or the modification of existing facilities, and would not result in land use changes. Any operation and maintenance (O&M) of Klamath Project facilities (e.g., maintenance, repair, and replacement of gates, conduits, pumps, trash racks, water measurement gages, boat ramps, canals, pipes, fish screens, etc.) needed to operate the Project will be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA and the National Historic Preservation Act is required prior to the activity(ies) being implemented.

This document is intended to convey the completion of the NHPA Section 106 process for this undertaking. This action would not have significant impacts on properties listed, or eligible for listing, on the National Register of Historic Places as determined by Reclamation (LND 02-01) (43 CFR 46.215 (g). Please retain a copy in the administrative record for this action. Should changes be made to this project, additional NHPA Section 106 review, possibly including consultation with the State Historic Preservation Officer, may be necessary. Thank you for providing the opportunity to comment.

Appendix D Analysis of Socioeconomic Impacts

D.1 Models

Two models were used to estimate potential impacts. The first is a farm budget application called KB_HEM, developed by Reclamation, to measure net farm income for the No Action and Proposed Action alternatives. For a complete description of KB_HEM see Reclamation 2011. The second modeling package used to assess the regional economic impacts resulting from the potential change in the on-farm gross crop revenue was IMPLAN (IMpact analysis for PLANning). IMPLAN estimates the regional economic impacts measured in terms of output, jobs and labor income supported by the Project. IMPLAN is a commonly used, industry accepted economic input-output modeling system that estimates the effects of economic changes in a defined analysis area. MIG, Inc., developed the IMPLAN modeling system. This analysis leverages the analysis that was prepared for the 2011 Secretarial Determination (SD) of the KBRA, thereby increasing the efficiency and lowering the costs of the analysis without significant impact to the results. The SD used 2009 IMPLAN data for the counties which encompass the Study Area.

D.2 On-Farm Model Inputs

D.2.1 Irrigation Supplies

The impact of the Proposed Action Alternative on the agricultural economy is calculated by comparing the available irrigation supply from the Proposed Action Alternative and the No Action Alternative to a historical baseline. The historical baseline estimates crop water demand over the 1981 – 2019 POR.

Estimation of the impact begins with calculation of the difference between irrigation supplies under the two alternatives and historic demand:

1) Shortages in estimated irrigation water supply (Project surface water diversions plus supplemental groundwater pumping) under the No Action Alternative compared to historical diversions (*Figure 1*) and
2) Shortages in estimated irrigation water supply (Project surface water diversions plus supplemental groundwater pumping) under the Proposed Action Alternative compared to historical diversions (*Figure 2*).

Historic Project demand estimates the supply of irrigation water necessary to meet all agricultural demands. The water supply restrictions imposed by the No Action Alternative and Proposed Action Alternative reduce the available surface supply. The model assumes groundwater will be used to make up for shortages in surface water supplies, subject to two sustainability constraints. First, annual groundwater pumping volume does not exceed 80,000 AF and second, the ten-year rolling average of extraction volume does not exceed 30,000 AF (Gall 2018).

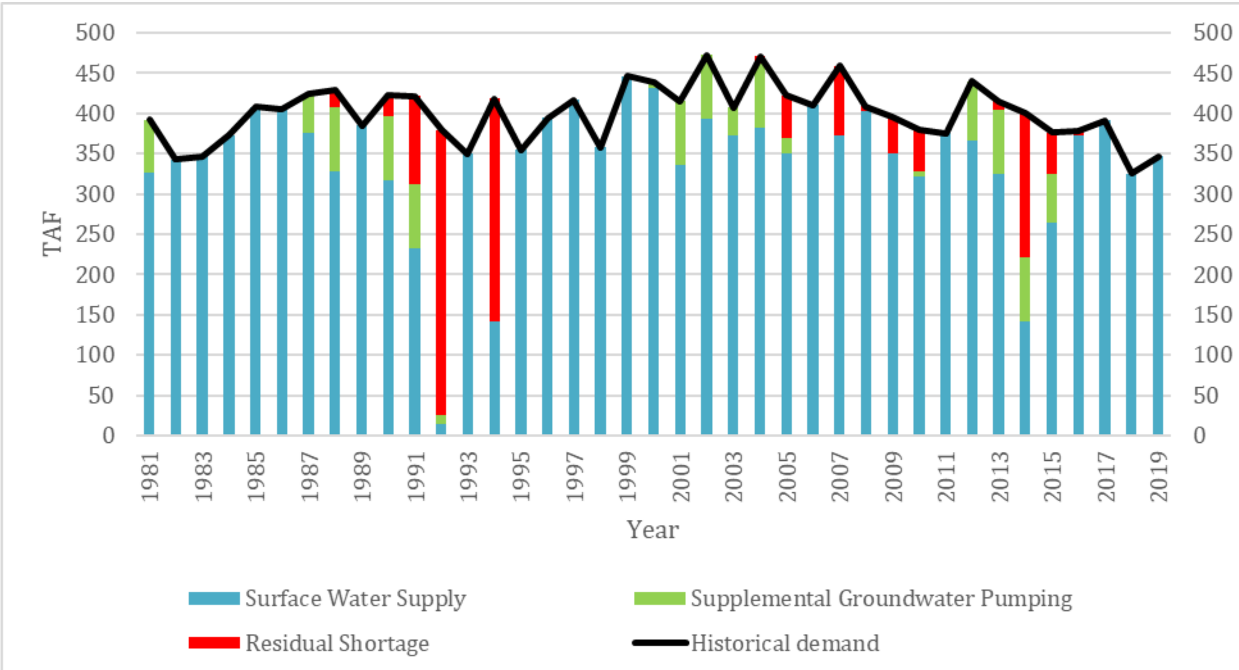

Figure 7-4. Source of irrigation water supplies, No Action Alternative. Source: Reclamation 2020.

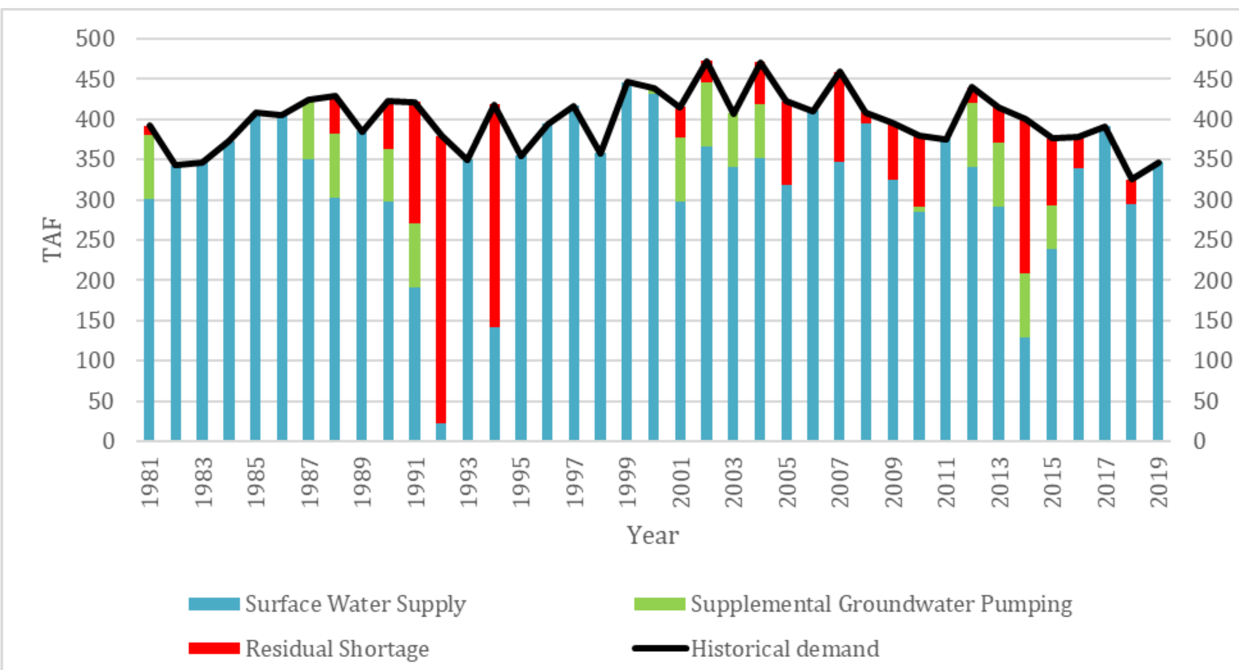

Figure 7-5. Source of irrigation water supplies, Proposed Action Alternative. Source: Reclamation 2020.

For example, in 1990, estimated unconstrained irrigation water supply under the historical conditions is 422,000 AF (*Figure 1*). Under the No Action Alternative, the available surface water diversion is 317,000 AF, a 105,000 shortage in surface water compared to historical baseline. Groundwater pumping mitigates the shortage by 80,000 AF, leaving a net shortage of irrigation supply of 25,000 AF.

Under the Proposed Action Alternative, the available surface water diversions in 1990 are 297,000 AF, shorting the Project by 125,000 AF (*Figure 2*). Groundwater pumping of 66,000 AF mitigates the shortage, leaving a net shortage of irrigation supply of 59,000 AF.

D.2.2 Water Allocation

Surface water on the Project is allocated according to the relative priority of each user's water delivery contract. Contracts are categorized as either A, B or C priority, where A-contracts are senior to B-contracts, which are senior to C-contracts. Under the A/B/C water type allocation, C-users are the first to experience a reduction in diversions. B-users are next in line to experience a reduction in diversions but only after all diversions to C-users have completely ceased. A-users are the last users to experience a reduction in diversions, and only after all diversions to B-users have ceased. Under the A/B/C allocation, A-contract holders receive 100 percent of historical irrigation supplies when project-wide irrigation supplies are estimated to be above 60 percent of historical irrigation supplies (*Figure 3*). B-contract holders experience a reduction in irrigation supplies when project-wide supplies are between 95 percent and 65 percent of historical deliveries. Below 65 percent of project-wide historical deliveries B-contract users receive no irrigation diversions. C-contract holders, because there are so few of them, lose all their irrigation supplies under even minimal project-wide shortages.

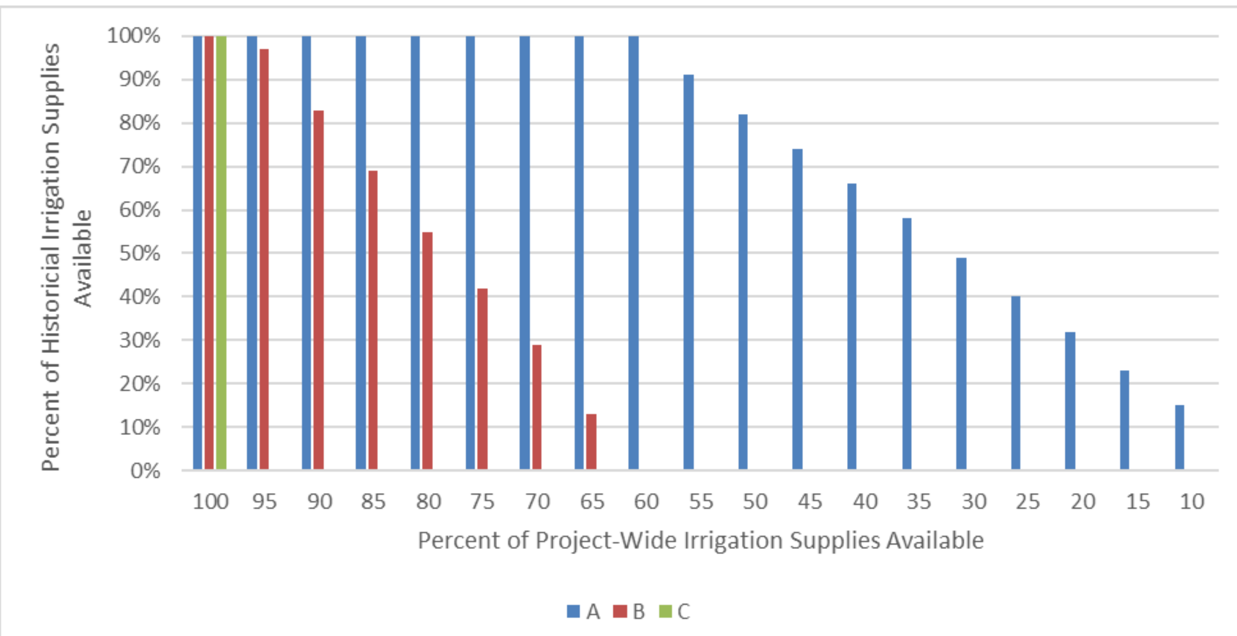

Figure 7-6. Percent of irrigation supply available to A/B/C water users under declining estimates of Project-wide irrigation supply availability. Source: Reclamation 2020.

Under the No Action Alternative, A-contract holders receive full water diversion in every year except 1992, 1994 and 2014 (*Table 1*), in all other years shortages are absorbed by the B- and C-contract holders. Shortages to B water users occur in 15 out of 39 years and range between a 0 percent and 100 percent reduction in supply.

Under the Proposed Action Alternative, the A-contract holders experience diversion shortages in four of the 39 years, 1991, 1992, 1994 and 2014 (*Table 1*). B-contract holders only receive 100 percent of full supply in 19 of the 39 years; in the remaining 20 years shortages range between 0 percent and 100 percent of historical diversions. C-contract holders experience 100 percent shortages in 19 of the 39 years and no water in all other years.

Table 7-1. Irrigation water supply as a percent of historical water diversions, study area and by water contract priority (Types A, B, C). Source: Reclamation 2020, EcoResourceGroup, 2020.

Year	No Action Alternative as a Percent of Historical Total (%)	No Action Alternative as a Percent of Historical A (%)	No Action Alternative as a Percent of Historical B (%)	No Action Alternative as a Percent of Historical C (%)	Preferred Action Alternative as a Percent of Historical Total (%)	Preferred Action Alternative as a Percent of Historical A (%)	Preferred Action Alternative as a Percent of Historical B (%)	Preferred Action Alternative as a Percent of Historical C (%)
1981	100%	100%	100%	100%	97%	100%	90%	0%
1982	100%	100%	100%	100%	100%	100%	100%	100%
1983	100%	100%	100%	100%	100%	100%	100%	100%
1984	100%	100%	100%	100%	100%	100%	100%	100%
1985	100%	100%	100%	100%	100%	100%	100%	100%
1986	100%	100%	100%	100%	100%	100%	100%	100%
1987	100%	100%	100%	100%	100%	100%	100%	100%
1988	95%	100%	84%	0%	89%	100%	63%	0%
1989	100%	100%	100%	100%	100%	100%	100%	100%
1990	94%	100%	79%	0%	86%	100%	52%	0%
1991	74%	100%	10%	0%	64%	100%	0%	0%
1992	7%	10%	0%	0%	6%	10%	0%	0%
1993	100%	100%	100%	100%	100%	100%	100%	100%
1994	34%	48%	0%	0%	34%	48%	0%	0%
1995	100%	100%	100%	100%	100%	100%	100%	100%
1996	100%	100%	100%	100%	100%	100%	100%	100%
1997	100%	100%	100%	100%	100%	100%	100%	100%
1998	100%	100%	100%	100%	100%	100%	100%	100%
1999	100%	100%	100%	100%	100%	100%	100%	100%
2000	100%	100%	100%	100%	100%	100%	100%	100%
2001	96%	100%	100%	100%	91%	100%	69%	0%
2002	100%	100%	100%	100%	94%	100%	81%	0%
2003	100%	100%	100%	100%	100%	100%	100%	100%
2004	98%	100%	93%	0%	89%	100%	62%	0%
2005	88%	100%	57%	0%	75%	100%	15%	0%
2006	100%	100%	100%	100%	100%	100%	100%	100%
2007	81%	100%	35%	0%	76%	100%	16%	0%
2008	99%	100%	95%	0%	97%	100%	88%	0%
2009	89%	100%	61%	0%	82%	100%	38%	0%

Year	No Action Alternative as a Percent of Historical Total (%)	No Action Alternative as a Percent of Historical A (%)	No Action Alternative as a Percent of Historical B (%)	No Action Alternative as a Percent of Historical C (%)	Preferred Action Alternative as a Percent of Historical Total (%)	Preferred Action Alternative as a Percent of Historical A (%)	Preferred Action Alternative as a Percent of Historical B (%)	Preferred Action Alternative as a Percent of Historical C (%)
2010	87%	100%	54%	0%	77%	100%	21%	0%
2011	100%	100%	100%	100%	100%	100%	100%	100%
2012	100%	100%	100%	100%	95%	100%	84%	0%
2013	98%	100%	92%	0%	89%	100%	64%	0%
2014	55%	79%	0%	0%	52%	79%	0%	0%
2015	86%	100%	52%	0%	78%	100%	23%	0%
2016	99%	100%	95%	0%	89%	100%	63%	0%
2017	100%	100%	100%	100%	100%	100%	100%	100%
2018	100%	100%	100%	100%	91%	100%	68%	0%
2019	100%	100%	100%	100%	100%	100%	100%	100%
Average	92%	96%	82%	62%	89%	96%	72%	49%
Min	7%	10%	0%	0%	6%	10%	0%	0%
Max	100%	100%	100%	100%	100%	100%	100%	100%

D.2.3 Estimated Baseline Economic Contribution of the Project

D.2.3.1 Summary

The Project contributes an estimated $163.2 million annually to the regional economy assuming historical water diversions, of which $122.9 million is gross on-farm revenue. An estimated 1,210 jobs are supported by this agricultural production generating over $40 million in labor income.

Table 7-2. Summary economic metrics under historical water diversions, 2019 dollars. Source: Ecoresourcegroup.

On-Farm Gross Revenue	Output	Total Output	Employment	Labor Income
($ millions)	($ millions)	($ millions)	(full and part-time jobs)	($ millions)
122.9	40.3	163.2	1,210	40.2

Source: EcoResourceGroup, 2020.

D.2.3.2 On-Farm Revenue Estimates (KB_HEM)

The on-farm gross revenue produced on 156.4 thousand acres in the study area and irrigated by the historical surface water diversions is estimated to be $122.9 million annually (*Table 2 and 3*). Potatoes make up 33 percent of the total revenue on just 8 percent of the acres. Alfalfa hay comprises the majority of the acres in production, 64.4 thousand acres or 41 percent of the land, and produces 30 percent of the revenue.

Table 7-3. Study area on-farm gross receipts, acres by crop types 2019 dollars in millions. Source: Ecoresourcegroup 2020.

Crop Type	**On-Farm Revenue**	**Percent of Total Revenue**	**Acres in Production**	**Percent of Total Acres**
	($ millions)	**(%)**	**(000s)**	**(%)**
Alfalfa Hay	36.9	30%	64.4	41%
Irrigated pasture	4.1	3%	26.7	17%
Other	27.9	23%	7.1	4%
Potato	40.1	33%	13.1	8%
Small Grain	5.9	5%	23.5	15%
Wheat	8.0	7%	23.7	15%
Grand Total	**122.9**	**100%**	**158.4**	**100%**

Crop prices and yield used as input in the KB_HEM model are shown in Table 4.

Table 7-4. Crop price and yield, 2019 dollars. Source: Siskiyou County Agriculture Commissioner's Crop Report, 2018. California County Agricultural Commissioner Reports., UC Cooperative Extension Crop Enterprise Budgets, multiple years.

	Alfalfa hay	**Irrigated pasture**	**Potatoes**	**Other (Onions)**	**Small grains (oats)**	**Wheat**
		Grazing				
	(per ton)	(aum/aa)	(per cwt)	(per cwt)	(per ton)	(per ton)
Yield	6.5	5	450	500	2.7	3.17
Price	$185	$15	$7.4	$7.92	$186	$142

Approximately 61 percent of the land in production is served with A-priority water service contracts (Table 5). B-priority water contracts comprise nearly the rest of the study area at 38 percent. C-priority contracts only serve approximately 1 percent of the study area acres. Land served by A-priority contracts generates 75 percent of the total study area revenue.

Table 7-5. Study area on-farm gross receipts, acres by water contract type 2019 dollars in millions. Source: Ecoresourcegroup 2020.

Water Contract Priority	**On-Farm Revenue**	**Percent of Total Revenue**	**Acres in Production**	**Percent of Total Acres**
	($ millions)	**(%)**	**(000s)**	**(%)**
A	91.6	75%	94	61%
B	29.6	24%	59	38%
C	1.6	1%	6	1%
Grand Total	122.9	**100%**	**158.4**	**100%**

D.3 Regional Socioeconomic Impact

Regional economic impacts are measured as both the impact that a change in irrigation water could have on cropping patterns, and resulting output, jobs and labor income. Additionally, the cost of groundwater, pumped to mitigate for shortages in irrigation diversions, is estimated.

D.3.1 Regional Economic Impacts

Under the No Action Alternative irrigation diversion shortages occur in 22 of the 39-year POR, compared to historical deliveries. In 17 years, groundwater pumping lessens the water shortage, but completely eliminates it in only 7 years. In 5 years, the constraints on groundwater pumping preclude any pumping to mitigate for a reduction in diversions.

Estimated regional economic impacts of the No Action Alterative are presented in Table 6.

Proposed Action Alternative irrigation diversion shortages occur in 23 of the 39-year POR, compared to historical deliveries. In 15 years, groundwater pumping lessens the water shortage, but completely eliminates it in only 3 years. In 8 years, the constraints on groundwater pumping preclude any pumping to mitigate for a reduction in diversions.

Estimated regional economic impacts of the Proposed Action Alterative are presented in Table 7.

Table 7-6. Estimated regional economic impacts of No Action Alternative, all years. 2019 dollars in millions. Source: Eco Resource Group 2020.

Year	Gross ON-FARM Revenue Losses	Regional Output Losses (inc. on-farm revenue loss)	Regional Job Losses	Regional Labor Income Losses	Pumping Charges	Land Fallowed	Land Fallowed
	($ 000s)	($ 000s)	(Full and Part-time))	($ 000s)	($ 000s)	(% Hist)	(ac)
1981	0.0	0.0	0.0	0.0	868.1	0%	0.0
1982	0.0	0.0	0.0	0.0	0.0	0%	0.0
1983	0.0	0.0	0.0	0.0	0.0	0%	0.0
1984	0.0	0.0	0.0	0.0	0.0	0%	0.0
1985	0.0	0.0	0.0	0.0	0.0	0%	0.0
1986	0.0	0.0	0.0	0.0	0.0	0%	0.0
1987	0.0	0.0	0.0	0.0	641.0	0%	0.0
1988	1,798.4	2,387.7	17.7	588.0	1,062.1	4%	6.5
1989	0.0	0.0	0.0	0.0	0.0	0%	0.0
1990	1,798.4	2,387.7	17.7	588.0	1,062.1	4%	6.5
1991	10,873.4	14,436.7	107.0	3,555.0	1,062.1	25%	39.7
1992	74,919.6	99,470.8	737.5	24,494.4	155.6	93%	147.4
1993	0.0	0.0	0.0	0.0	0.0	0%	0.0
1994	38,493.6	51,107.9	378.9	12,585.2	0.0	65%	102.6
1995	0.0	0.0	0.0	0.0	0.0	0%	0.0
1996	0.0	0.0	0.0	0.0	0.0	0%	0.0
1997	0.0	0.0	0.0	0.0	0.0	0%	0.0
1998	0.0	0.0	0.0	0.0	0.0	0%	0.0
1999	0.0	0.0	0.0	0.0	0.0	0%	0.0
2000	0.0	0.0	0.0	0.0	82.8	0%	0.0
2001	0.0	0.0	0.0	0.0	1,057.6	0%	0.0
2002	0.0	0.0	0.0	0.0	1,057.6	0%	0.0
2003	0.0	0.0	0.0	0.0	458.9	0%	0.0
2004	0.0	0.0	0.0	0.0	1,062.1	0%	0.0
2005	3,617.5	4,802.9	35.6	1,182.7	264.0	10%	15.1
2006	0.0	0.0	0.0	0.0	0.0	0%	0.0
2007	8,034.3	10,667.2	79.1	2,626.8	0.0	20%	32.2
2008	0.0	0.0	0.0	0.0	0.0	0%	0.0
2009	3,617.5	4,802.9	35.6	1,182.7	0.0	10%	15.1
2010	5,633.5	7,479.6	55.5	1,841.8	82.8	15%	23.6
2011	0.0	0.0	0.0	0.0	0.0	0%	0.0
2012	0.0	0.0	0.0	0.0	977.0	0%	0.0
2013	0.0	0.0	0.0	0.0	1,062.1	0%	0.0

Year	Gross ON-FARM Revenue Losses	Regional Output Losses (inc. on-farm revenue loss)	Regional Job Losses	Regional Labor Income Losses	Pumping Charges	Land Fallowed	Land Fallowed
2014	29,156.6	38,711.3	287.0	9,532.5	1,062.1	45%	70.8
2015	5,633.5	7,479.6	55.5	1,841.8	798.9	15%	23.6
2016	0.0	0.0	0.0	0.0	0.0	0%	0.0
2017	0.0	0.0	0.0	0.0	0.0	0%	0.0
2018	0.0	0.0	0.0	0.0	0.0	0%	0.0
2019	0.0	0.0	0.0	0.0	0.0	0%	0.0
AVG	4,707.1	6,249.6	46.3	1,538.9	328.6	0.1	12.4
AVG/occr.	16,688.8	22,157.7	164.3	5,456.3	753.9	0.3	43.9
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX	74,919.6	99,470.8	737.5	24,494.4	1,062.1	0.9	147.4

Table 7-7. Estimated regional economic impacts of No Action Alternative, all years. 2019 dollars in millions. Source: Ecoresourcegroup 2020.

Year	Gross ON-FARM Revenue Losses	Regional Output Losses (inc. on-farm revenue loss)	Regional Job Losses	Regional Labor Income Losses	Pumping Charges	Land Fallowed	Land Fallowed
	($ 000s)	**($ 000s)**	**(Full and Part-time))**	**($ 000s)**	**($ 000s)**	**(% Hist)**	**(ac)**
1981	1,798.4	2,387.7	17.7	588.0	1,062.1	4%	6.5
1982	0.0	0.0	0.0	0.0	0.0	0%	0.0
1983	0.0	0.0	0.0	0.0	0.0	0%	0.0
1984	0.0	0.0	0.0	0.0	0.0	0%	0.0
1985	0.0	0.0	0.0	0.0	0.0	0%	0.0
1986	0.0	0.0	0.0	0.0	0.0	0%	0.0
1987	0.0	0.0	0.0	0.0	980.4	0%	0.0
1988	3,617.5	4,802.9	35.6	1,182.7	1,062.1	10%	15.1
1989	0.0	0.0	0.0	0.0	0.0	0%	0.0
1990	5,633.5	7,479.6	55.5	1,841.8	878.3	15%	23.6
1991	19,049.0	25,291.3	187.5	6,227.9	1,062.1	36%	56.2
1992	74,919.6	99,470.8	737.5	24,494.4	0.0	93%	147.4
1993	0.0	0.0	0.0	0.0	0.0	0%	0.0
1994	38,493.6	51,107.9	378.9	12,585.2	0.0	65%	102.6

Year	Gross ON-FARM Revenue Losses	Regional Output Losses (inc. on-farm revenue loss)	Regional Job Losses	Regional Labor Income Losses	Pumping Charges	Land Fallowed	Land Fallowed
1995	0.0	0.0	0.0	0.0	0.0	0%	0.0
1996	0.0	0.0	0.0	0.0	0.0	0%	0.0
1997	0.0	0.0	0.0	0.0	0.0	0%	0.0
1998	0.0	0.0	0.0	0.0	0.0	0%	0.0
1999	0.0	0.0	0.0	0.0	0.0	0%	0.0
2000	0.0	0.0	0.0	0.0	82.8	0%	0.0
2001	3,617.5	4,802.9	35.6	1,182.7	1,062.1	10%	15.1
2002	1,798.4	2,387.7	17.7	588.0	1,062.1	4%	6.5
2003	0.0	0.0	0.0	0.0	888.6	0%	0.0
2004	3,617.5	4,802.9	35.6	1,182.7	887.3	10%	15.1
2005	10,873.4	14,436.7	107.0	3,555.0	0.0	25%	39.7
2006	0.0	0.0	0.0	0.0	0.0	0%	0.0
2007	10,873.4	14,436.7	107.0	3,555.0	0.0	25%	39.7
2008	1,798.4	2,387.7	17.7	588.0	0.0	4%	6.5
2009	8,034.3	10,667.2	79.1	2,626.8	0.0	20%	32.2
2010	10,873.4	14,436.7	107.0	3,555.0	82.8	25%	39.7
2011	0.0	0.0	0.0	0.0	0.0	0%	0.0
2012	1,798.4	2,387.7	17.7	588.0	1,062.1	4%	6.5
2013	3,617.5	4,802.9	35.6	1,182.7	1,062.1	10%	15.1
2014	31,297.0	41,553.1	308.1	10,232.3	1,062.1	50%	79.8
2015	8,034.3	10,667.2	79.1	2,626.8	713.8	20%	32.2
2016	3,617.5	4,802.9	35.6	1,182.7	0.0	10%	15.1
2017	0.0	0.0	0.0	0.0	0.0	0%	0.0
2018	3,617.5	4,802.9	35.6	1,182.7	0.0	10%	15.1
2019	0.0	0.0	0.0	0.0	0.0	0%	0.0
AVG	6,332.8	8,408.1	62.3	2,070.5	333.6	0.1	6,332.8
AVG/occr.	12,349.0	16,395.8	121.6	4,037.4	867.4	0.2	12,349.0
MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX	74,919.6	99,470.8	737.5	24,494.4	1,062.1	0.9	74,919.6

D.3.2 Groundwater Pumping Impacts

Under both the No Action Alternative and the Proposed Action Alternative annual groundwater pumping is limited by two constraints; 1) an 80 TAF maximum annual withdraw and 2) a 10-year rolling average annual withdrawal of 30 TAF. These constraints reduce the amount of groundwater available to use as replacement for a shortage of surface water diversion (see Figure

4). Under the No Action Alternative estimated average annual groundwater pumping costs in years in which groundwater is pumped is $753,900. Under the No Action Alternative estimated average annual groundwater pumping costs in years in which groundwater is pumped is $867,400.

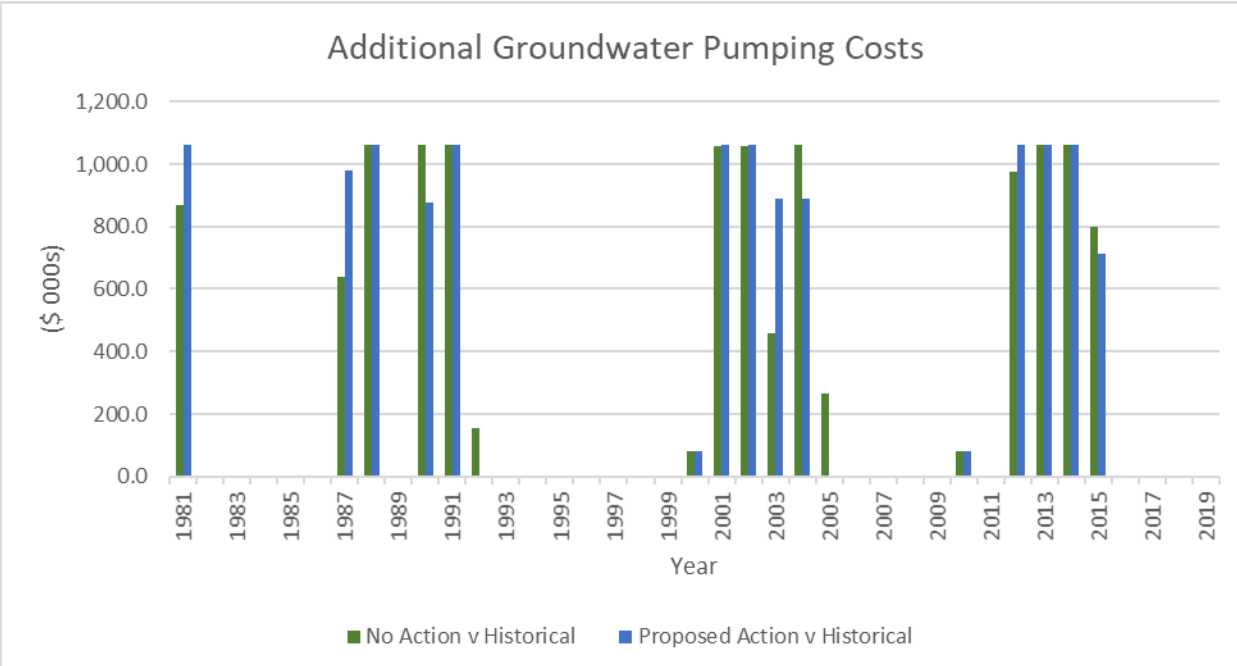

Figure 7-7. Estimated annual cost of pumping additional groundwater. Source: EcoResourceGroup 2020.

The weighted average cost of groundwater pumping was estimated to be $13.27/acre foot pumped. This weighted average is based on the facts that “in Oregon, the primary OPUC-approved rate for Schedule 41 energy use is 9.6 cents per kilowatt-hour (¢/kWh) and in California, the CPUC-approved rate for Schedule PA-20 is 13.4 ¢/kWh” (Reclamation 2016). The cost of pumping water is based on the following equation: kWh/AF = 1.0241 * TDH / OPE where: kWh/AF = kilowatt-hours required to pump an acre-foot of water through the irrigation system TDH = Total dynamic head required by the system in ft, assumed to be 60 ft OPE = Overall pumping plant efficiency as a decimal, assumed to be 60 percent. Two thirds of all pumping is assumed to occur in Oregon, where the majority of the B-contract holders are located.

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ECO Resource Group. 2020.

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U.S. Bureau of Reclamation. 2020. Biological Assessment on Project Operations 2020-2004

U.S. Bureau of Reclamation. 2016. Klamath Comprehensive Agricultural Power Plan, Status and Next Steps to Reduce Basin Power Costs. 176 pp.

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Appendix E Water Acquisition Related Activities

Table 7-8. Source and volume of water acquired by Reclamation in 2018 and place of use for fish and wildlife purposes.

Water Source Acquired	Volume (Acre-Feet)	Place of Use
Tule Lake Sump (D Plant)	8,936	LKNWR
Lost River (via LRDC)	4,795	LKNWR
UKL Storage	3,510	LKNWR
TID Return Flows	9,230	TLNWR
Clear Lake Storage	2,800	CLNWR

Summary of non-federal demand management activities in 2018.

Of the funds obtained from Reclamation under temporary contracts districts and/or their representative entities, approximately $2.3 million went to districts' general operating budgets and were presumably used to cover district expenses, thereby reducing landowner assessments. Approximately $1.7 million was reserved for future drought activities. Approximately $4.7 million was paid to landowners (at the rate of $300 per acre) who had not used water during the 2018 spring/summer period. Such payments covered 15,703 acres within the Project. Lastly, $960,000 was used to pay or reimburse landowners for power incurred in pumping groundwater. Because the program did not require measurement or accounting of water, it is unknown how much water was pumped with the power that the landowner was later paid or reimbursed for. In addition, landowners who pumped groundwater were given a payment of 60 percent of their power costs, to compensate for the other O&M costs of their pumps.

Appendix F Interim Operations Plan Transmittal Letter and Technical Enclosure

Note: An identical letter was transmitted to NMFS on March 27, 2020

United States Department of the Interior

BUREAU OF RECLAMATION
Klamath Basin Area Office
6600 Washburn Way
Klamath Falls, OR 97603-9365

IN REPLY REFER TO:

KO-100
2.2.1.06 (ENV-7.00)

MAR 27 2020

VIA ELECTRONIC and USPS

MEMORANDUM

To: Field Supervisor, U.S. Fish and Wildlife Service
Attn: Mr. Daniel Blake

From: Jeffrey Nettleton JEFFREY NETTLETON Digitally signed by JEFFREY NETTLETON Date: 2020.03.27 09:33:19 -07'00'
Area Manager

Subject: Transmittal of Proposed Interim Operations Plan for operation of the Klamath Project for Water Years 2020-2022

The purpose of this letter is for the Bureau of Reclamation (Reclamation) to describe and transmit a proposed Interim Operations Plan (Interim Plan) developed to allow for the continued operation of the Project during the ongoing reinitiated consultation effort under Section 7 of the Endangered Species Act (ESA).

<u>Background</u>

On March 29, 2019, Reclamation completed reinitiated consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS; collectively the Services) pursuant to Section 7(a)(2) of the ESA on the effects of a five-year plan of operations for the Klamath Project (Project) (2019-2024) on Federally-listed species and their critical habitats, including the listed Southern Oregon/Northern California Coast evolutionarily significant unit of coho salmon (SONCC coho), Southern Resident Killer Whales, and Lost River and shortnose suckers. As a result, the Services provided Reclamation with written biological opinions (NMFS 2019 BiOp and USFWS 2019 BiOp) concluding the proposed 2018 Operations Plan was not likely to jeopardize the continued existence of SONCC coho salmon and Lost River and shortnose suckers nor destroy or adversely modify their critical habitat.

Reinitiation of Consultation

Based on information related to Weighted Usable Area (WUA) curves provided by a third party, which were confirmed in October 2019 and revealed effects of the 2018 Operations Plan on listed species or critical habitat (specifically to SONCC coho salmon) in a manner or to an extent not previously considered, Reclamation requested reinitiation of formal consultation with both Services on November 13, 2019, under Section 7 of the ESA (50 C.F.R. § 402.16 (a)(2)). In written letters dated November 14, 2019 and December 9, 2019, NMFS and FWS, respectively, accepted Reclamation's request to reinitiate consultation.

As part of the reinitiated consultations, on February 7, 2020, Reclamation transmitted a *Final Biological Assessment on the Effects of the Proposed Action to Operation the Klamath Project* (Project) *from April 1,* *2020 through March 31, 2024 on Federally Listed, Threatened, and Endangered Species* (2020 Biological Assessment (2020 BA)) to both Services on Project operations during the period of April 1, 2020 through March 31, 2024. Reclamation requested that the formal consultations be completed by March 31, 2020. However, Reclamation and the Services agree that it is in the public interest that additional time be provided to complete the consultations on Project operations. Subject to Reclamation's final approval of the Interim Plan, Reclamation will develop and submit to the Services a modified or new proposed operations plan in lieu of the one set forth in the 2020 BA, informed by a collaborative process similar to the consultation process that was conducted in regards to the 2012 operations plan and Biological Assessment. Representatives of the Yurok Tribe have informed Reclamation staff that they have convened a team of individuals with demonstrated technical expertise in modeling and operations to exchange technical information and provide input to Reclamation for consideration in the development of a subsequent proposed action. Reclamation and the Services will participate and provide technical assistance, including Klamath Basin Planning Model runs and other support, to this workgroup throughout the reinitiation process.

While Reclamation completes the consultations that it reinitiated with the Services in 2019, it proposes to operate the Project in accordance with the Interim Plan, which it believes would be consistent with the Services' 2019 BiOps and the associated October 11, 2019, amendment, with the exception of specific deviations described below.

<u>Proposal</u>

Interim Operations Plan

Reclamation proposes an Interim Plan that would be in effect until the earlier of September 30, 2022, or the completion of reinitiated ESA Section 7 consultations on a modified or new proposed Operations Plan developed through the process described above to supersede Reclamation's 2018 Operations Plan analyzed by the Services in their 2019 BiOps and the Proposed Interim Plan, which Reclamation would request be completed by September 30th of the year preceding the start of the upcoming irrigation season to give time for a smooth transition from the Interim Plan to the new operations plan. The Interim Plan includes deviations from Reclamation's 2018 Operations Plan analyzed by the Services in their 2019 BiOps, specifically with the augmentation of the Environmental Water Account (EWA; water allocated for Klamath River flows) in certain water year types.

As part of the Interim Plan, Reclamation proposes to provide a base EWA augmentation of 40,000 acre-feet (AF) in water years with an Upper Klamath Lake (UKL) Supply at or above 550,000 AF and at or below 950,000 AF. The 40,000 AF of EWA augmentation would be comprised of 23,000 AF from Project Supply and 17,000 AF from storage volume in UKL. An initial determination on whether the 40,000 AF of EWA augmentation would occur will be based on the March 1 Natural Resources Conservation Service (NRCS) UKL inflow forecast and the resulting UKL Supply. A final determination of EWA augmentation would be made in early April, with the April 1 NRCS inflow forecast and the resulting UKL Supply. In the rare instance that a portion of the EWA augmentation volume is utilized in March, that volume would be subtracted from that available beyond March. If a volume of EWA augmentation is used in March and the subsequent April 1 EWA augmentation calculation does not provide EWA augmentation, then all water utilized in March above and beyond formulaic release of EWA (i.e., augmentation volume) would be counted against the EWA.

When the EWA augmentation is triggered, it would result in a reduction to Project Supply that is limited to, and shall not exceed, 23,000 AF. The EWA augmentation would not otherwise affect Project operations, including Project diversion rates and timing other than that caused by the above-described potential reduction in Project Supply during the spring-summer period.

The 40,000 AF of EWA augmentation included in the Interim Plan is in addition to an enhanced May/June flows provision in the 2018 Operations Plan as amended in February 2019 (as analyzed in the Services 2019 BiOps; NMFS 2019 BiOp pp. 33-34 and USFWS 2019 BiOp p. 27) as well as the October 11, 2019 amendment, although slight modifications to this provision are proposed below. As described in the 2018 Operations Plan, and as will continue under the Interim Plan, Reclamation proposes to provide up to a full enhancement volume of 20,000 AF, split evenly between Project Supply and from UKL (the split is even at all enhancement volumes). Reclamation would utilize the May UKL Supply volume, based on the May 1 NRCS inflow forecast and the resulting UKL Supply, to determine whether enhanced May/June flows would occur, and the actual volume available for flow enhancement. The enhanced May/June flows would begin to increase linearly relative to UKL Supply from zero at a UKL Supply of 625,000 AF, reaching a maximum volume of 20,000 AF between a UKL Supply range of 717,000 and 858,000 AF, then decreasing linearly relative to UKL Supply to zero at an UKL Supply volume of 950,000 AF.

As described in Reclamation's 2018 Operations Plan (as analyzed in the Services' 2019 BiOps), Reclamation would maintain a flexible approach to utilizing the proposed 40,000 AF of EWA augmentation and enhanced May/June flows. With the exception that the EWA augmentation water and enhanced May/June flows would be utilized within the March through June timeframe, Reclamation would allow for flexibility in the timing and distribution of augmentation volumes. EWA augmentation and enhanced May/June water use would be tracked separately from formulaic use of EWA during March through June. Any unused portion of the augmentation water would remain in the EWA after June and the formulaic approach to EWA release would be followed in the July through September period. The existing Flow Accounting Scheduling Technical Advisory (FASTA) process would be used to allow salmon and sucker biologists from Reclamation and the Services, as well as other Klamath Basin experts, to provide real-time operational input into the use of this water to maximize ecological benefits to SONCC coho and Southern Resident Killer Whales, whether those benefits be improved habitat conditions, minimized disease conditions, or both, while maintaining UKL elevations and conditions protective of Lost River and shortnose suckers.

To provide additional certainty that the EWA augmentation volumes can be utilized at the time and in the manner that address disease and habitat concerns for coho salmon, Reclamation has coordinated with PacifiCorp on potential springtime water borrowing operations. The spring operations agreed to with PacifiCorp would assist in providing augmented river flows while safeguarding against UKL elevations below those that are sufficiently protective of spawning suckers, and releases from Upper Klamath Lake would repay the PacifiCorp reservoirs later in the season. Reclamation and PacifiCorp have finalized an agreement on how these operations would occur.

In the event PacifiCorp is unable to provide the water, and/or if modeling shows that implementation of the 40,000 AF of EWA augmentation releases is likely to result in UKL elevations below 4,142.0 feet in April or May, despite good faith efforts to rearrange the 40,000 AF of EWA releases within reasonable bounds, Reclamation will coordinate with the Services and PacifiCorp to best meet the needs of ESA-listed species as well as coordinate and obtain input from Yurok and other affected Klamath River Basin Tribes through government-to-government consultation on how to manage water.

If modeling shows that implementation of the EWA augmentation releases is likely to result in an annual minimum below 4,138.0 feet in a given water year, Reclamation will coordinate with the Services and PacifiCorp to ensure the annual minimum elevation in that water year is achieved as well as coordinate and obtain input from the Yurok and other affected Tribes through government-to-government consultation on how to manage water in a way that best meets the needs of Federally-listed species.

With respect to the above coordination and ensuing management of 40,000 AF of EWA augmentation releases and consequences for Upper Klamath Lake elevations, there can be no effect on Project irrigation supplies/water availability (e.g., no change in quantity, rate, timing) other than that caused by the above-described potential reduction in Project Supply during the spring-summer period.

Hydrologic Modeling

Utilizing the Klamath Basin Planning Model (KBPM), the hydrologic modeling tool utilized in the 2019 consultation efforts, Reclamation has prepared final model output and a technical description of 40,000 AF of EWA augmentation and the enhanced May/June provisions (both enclosed). Reclamation used the final KBPM output to evaluate the Interim Plan's potential effects to Federally-listed species, which are further described below.

Evaluation

Upper Klamath Lake

Changes to UKL elevations included in the Interim Plan would alter the range of elevations that were analyzed in the USFWS 2019 BiOp. However, Reclamation closely coordinated with the USFWS in developing the Interim Plan to ensure that the resultant conditions in UKL proposed in the Interim Plan would continue to be protective of suckers. Additionally, PacifiCorp's commitment to adjust operations of the Klamath Hydroelectric Project to support river flows important to coho salmon downstream of Iron Gate Dam, while achieving certain UKL elevations, provides additional assurances that the Interim Plan would be protective of suckers in UKL.

Simulation of the Interim Plan within the KBPM results in both higher and lower end of month UKL surface elevations, but the overall trend is lower due to UKL contributions to 40,000 AF of augmented flows in years where UKL Supply is between 550,000 AF and 950,000 AF. A key hydrologic elevation for protecting sucker spawning habitat is maintaining UKL surface elevation above 4142.0 feet through the end of May, once this elevation has been achieved earlier in the spring. The 2018 Operations Plan maintains this elevation in 35 years out of the 39-year period of record. The Interim Plan would achieve this elevation in 33 years out of 39. In the additional two years that the Interim Plan would reduce UKL elevations (water year types experienced in 2005 and 2015), UKL surface elevations would be maintained above 4142.0 feet for portions of the April-May spring spawning period but would drop below this benchmark for multiple consecutive days. Even with implementation of the additional 40,000 AF of EWA augmentation included in the Interim Plan, the modeled output indicates that the frequency at which reduced habitat may concentrate spawning or compel suckers to skip spawning at the shoreline areas is relatively low (i.e., 6 out of 39 years or 15 percent).

Although KBPM simulations can help frame potential implications, in real-time operations, Reclamation would work with PacifiCorp to borrow water or modify augmentation releases in coordination with the FASTA process to ensure that UKL elevations would not fall below 4,142.0 feet during April and May during that water year.

The other key elevation is the minimum UKL surface elevation during the summer and fall. Modeling analyzed in the USFWS 2019 BiOp showed a minimum surface elevation of 4138.26 feet in water year 1981. The Interim Plan flow scenario would result in an UKL minimum surface elevation of 4138.00 feet, in water year 2016. While this is lower than the USFWS 2019 BiOp minimum of 4,138.26 feet, it exceeds the 2013 BiOp minimum of 4137.76 feet and still provides sufficient depth for suckers to access refugial habitat within Pelican Bay.

In general, the differences would result in an average decrease of 0.07 feet during sucker spawning from February to May and an average decrease of 0.15 feet for August and September that results in minimal reductions of habitat available to adult suckers in late summer in the preferred depths in the northern part of UKL.

Klamath River

Based on current available science utilizing 80 percent WUA as a conservation standard, increased flows as a result of the proposed 40,000 AF of EWA augmentation and enhanced May/June provision would likely improve rearing and outmigration conditions for juvenile coho salmon. The augmentation volumes would likely increase the amount of suitable habitat for juvenile salmonids and the amount of time the habitat conservation standard is met. Additionally, the ability to optimize the utilization of the augmentation volumes (timing and distribution) could allow for the volume used to coincide with the peak outmigration timing for coho and Chinook salmon. The additional volume could potentially reduce water temperatures (depending on timing) and dilute actinospore concentrations of the parasite *Ceratanova shasta* thereby reducing disease risk for juvenile salmon. Similarly, increased habitat availability, reduced water temperatures, and reduced actinospore concentrations could benefit coho salmon and designated critical habitat as well as essential fish habitat for coho and Chinook salmon (thereby benefitting the Federally-listed Southern Resident Killer Whale).

<u>Conclusion</u>

The Interim Plan as described above, is expected to provide additional habitat availability for SONCC coho salmon which would contribute toward meeting the habitat conservation standard and potentially reduce disease risk for this species. As such, Reclamation believes that implementation of the proposed Interim Plan would result in reduced effects from those previously analyzed in NMFS' 2019 BiOp and therefore be consistent with NMFS' determinations that Project operations are not likely to jeopardize the continued existence of SONCC coho salmon or destroy or adversely modify their designated critical habitat.
The proposed Interim Plan may reduce sucker habitat and concentrate spawning or compel suckers to skip spawning at the shoreline areas, although these events would appear to be infrequent when examining the period of record. Regardless, for the duration of the Interim Plan, if the 40,000 AF of EWA augmentation is triggered on April 1 in any given year, UKL elevation will not drop below 4142.0 feet during the months of April and May in that water year.

Additionally, while implementation of the 40,000 AF of EWA augmentation could cause UKL minimum surface elevation to be reduced below elevation 4,138.26 to an elevation of 4138.0, that is expected to be an infrequent occurrence (modeled year 2016). This elevation would still be expected to provide sufficient depth for suckers to access refugial habitat within Pelican Bay. In general, the differences would result in an average decrease of 0.07 feet during sucker spawning from February to May and an average decrease of 0.15 feet for August and September that results in minimal reductions of habitat available to adult suckers in late summer in the preferred depths in the northern part of UKL. In addition, Reclamation believes that the ability to borrow water from PacifiCorp reservoirs provides assurances that the Interim Plan would be protective of suckers in UKL at critical life stages and associated UKL elevations (4,142.0 feet in April and May and 4,138.0 feet as an annual minimum) that avoid jeopardizing the continued existence of Lost River and shortnose suckers and does not destroy or adversely modify their designated critical habitat.

Overall, Reclamation believes this proposed Interim Plan meets Reclamation's ESA responsibility to not jeopardize Federally-listed species or destroy or cause adverse modification of their designated critical habitat.

<u>Request for Confirmation of Reclamation's Conclusions</u>

Reclamation requests the Services review the enclosed modeled output for the Interim Plan derived from the KBPM and provide separate responses related to confirmation of Reclamation's conclusions.

Reclamation is appreciative of the collaboration and inter-agency coordination that has taken place to date. If you have any questions, please contact Jared Bottcher at (541) 880-2544, or via e-mail at jbottcher@usbr.gov.

Attachment (1)

cc: Jim Simondet

Interim Operations Plan Technical Attachment

The purpose of this document is to provide additional technical explanation of the proposed Interim Operations Plan and the modeling done to analyze its effects on Iron Gate Dam flows and Upper Klamath Lake elevations. To the extent it restates, paraphrases, or contradicts anything in the Interim Operation Plan letter accompanying this addendum, the letter controls.

Base EWA Augmentation

As part of the Interim Plan, Reclamation proposes to provide a base EWA augmentation of 40,000 acre-feet (AF) in water years with an Upper Klamath Lake (UKL) Supply at or above 550,000 AF and at or below 950,000 AF. The 40,000 AF of EWA augmentation would be comprised of 23,000 AF from Project Supply and 17,000 AF from volume within UKL. An initial determination on whether the 40,000 AF of EWA augmentation would occur will be based on the March 1 Natural Resources Conservation Service (NRCS) UKL inflow forecast and the resulting UKL Supply. A final determination of EWA augmentation would be made in early April, with the April 1 NRCS inflow forecast and the resulting UKL Supply. If a portion of the EWA augmentation volume is utilized in March, that volume would be subtracted from the EWA augmentation available beyond March. If a volume of EWA augmentation is used in March and the subsequent April 1 UKL Supply calculation does not provide EWA augmentation, then all water utilized in March above and beyond formulaic release of EWA (i.e., augmentation volume) would be counted against the EWA. The EWA augmentation scheme related to UKL Supply is shown in Figure 1.

National Marine Fisheries Service (NMFS) has requested flexibility in the distribution of the 40,000 AF of EWA augmentation to optimize the use of this water, while maintaining UKL elevations/conditions necessary for listed suckers. As modeled, the 40,000 AF of EWA augmentation was released according to a NMFS-specified schedule that was unique to each year's hydrologic circumstances. Simulated release of the flexible flows started as early as March 23 and as late as May 18. Actual releases of the EWA augmentation may vary significantly in real time operations and Reclamation, NMFS, the U.S. Fish and Wildlife Service (FWS), along with input from the Flow Account Scheduling Technical Advisory (FASTA) team, will determine the final release schedule. The EWA augmentation flows can continue through June and are assumed to overlap and add to the enhanced May/June flows described in the following section.

General rules used for the modeling of the implementation of the 40,000 AF of EWA augmentation are as follows:

1. An initial calculation of EWA augmentation occurs in early March using the March 1 NRCS UKL net inflow forecast. This volume is available for use in March, subject to the rules laid out in 2.b.

2. Using the April 1 NRCS UKL net inflow forecast, calculate whether the 40,000 AF of EWA augmentation is triggered according to the relationship shown in Figure 1;

   a. May and June calculation of UKL Supply does not affect the EWA augmentation volume determined in April.
   b. If a portion of the EWA augmentation is utilized in March, that volume would be subtracted from that available beyond March. If a volume of EWA augmentation is used in March and the subsequent April 1 UKL Supply calculation does not provide EWA

augmentation, then all water utilized in March above and beyond formulaic release of EWA (i.e., augmentation volume) would be counted against the EWA

3. Release of the 40,000 AF of EWA Augmentation will be according to a schedule set by Reclamation, NMFS, and FWS, with input from the FASTA team;
   a. As discussed above, if the March UKL Supply is within the EWA Augmentation range, the augmentation can be partially used in March under FASTA consultation

4. Project supply calculations, based on the April 1, May 1, and June 1 UKL inflow forecasts are reduced by 23,000 AF when the EWA augmentation scheme is triggered (April UKL Supply at or above 550,000 AF and at or below 950,000 AF)

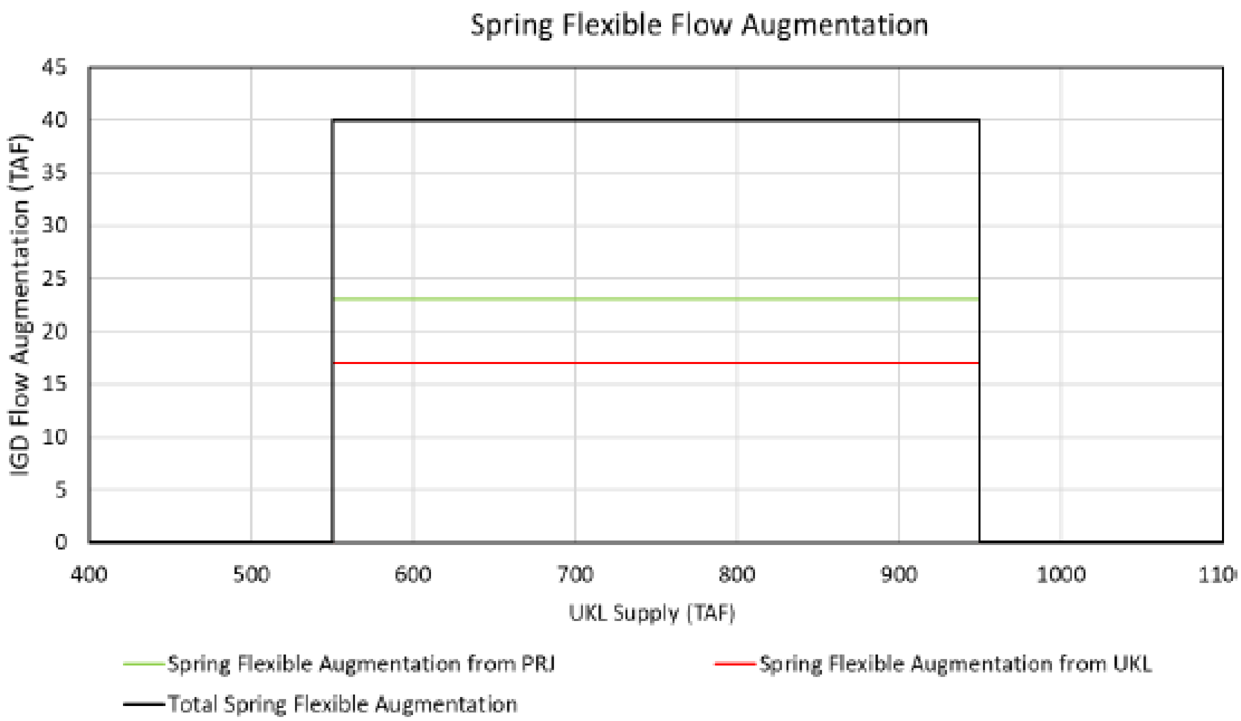

Figure 1. Base EWA Augmentation as related to UKL Supply. UKL Supply is as defined as it is in Reclamation's 2018 Operations Plan (as analyzed in the Services 2019 BiOps). Spring Flexible Augmentation is the amount of water to be contributed from Project Supply, limited to 23,000 AF, under this operation as a function of UKL Supply. Spring Flexible Augmentation from UKL is the amount of water to be contributed from Upper Klamath Lake under this operation as a function of UKL Supply. Total Spring Flexible Augmentation is the total amount of EWA augmentation to be provided as a function of UKL Supply from all sources.

Because the EWA augmentation is counted against EWA when the flows are implemented (when the intention is for this volume to be in addition to EWA), the aggregate augmentation (as determined in April) is added to the July 1 EWA to ensure proper EWA accounting for the remainder of the spring/summer season. Additionally, the default rules assume that when enhanced May/June flows are implemented and IGD flow targets would otherwise be at minimums, Reclamation would implement flow variability (up to +/- 75 cfs around enhanced IGD flow targets).

With regard to Upper Klamath Lake elevations, implementation of EWA augmentation will be carried out as described in the Interim Operations Plan letter.

Enhanced May/June Flows

In years in which May UKL Supply is greater than 625,000 AF and less than 950,000 AF, an additional volume of up to 20,000 AF (shared equally at all volumes between Project Supply and UKL) is distributed in May and June. The Enhanced May/June flows scheme as it relates to UKL Supply is shown in Figure 2. For UKL Supply values from 625,000 AF to 717,000 AF, the May/June Augmentation scheme increases linearly in relation to increasing UKL Supply from 0 AF to 20,000 AF. With UKL Supply between 717,000 AF to 858,000 AF, the May/June Augmentation is a constant 20,000 AF. May/June Augmentation decreases linearly in relation to increasing UKL Supply from 20,000 AF to 0 AF over the UKL Supply range of 858,000 AF to 950,000 AF. The May/June Augmentation is 0 AF if UKL Supply is below 625,000 AF or above 950,000 AF based on the May 1 NRCS UKL net inflow forecast. This replaces the enhanced May/June flow provision in Reclamation's 2018 Operations Plan (as analyzed in the Services' 2019 BiOps) that was dependent on EWA allocations instead of UKL Supply.

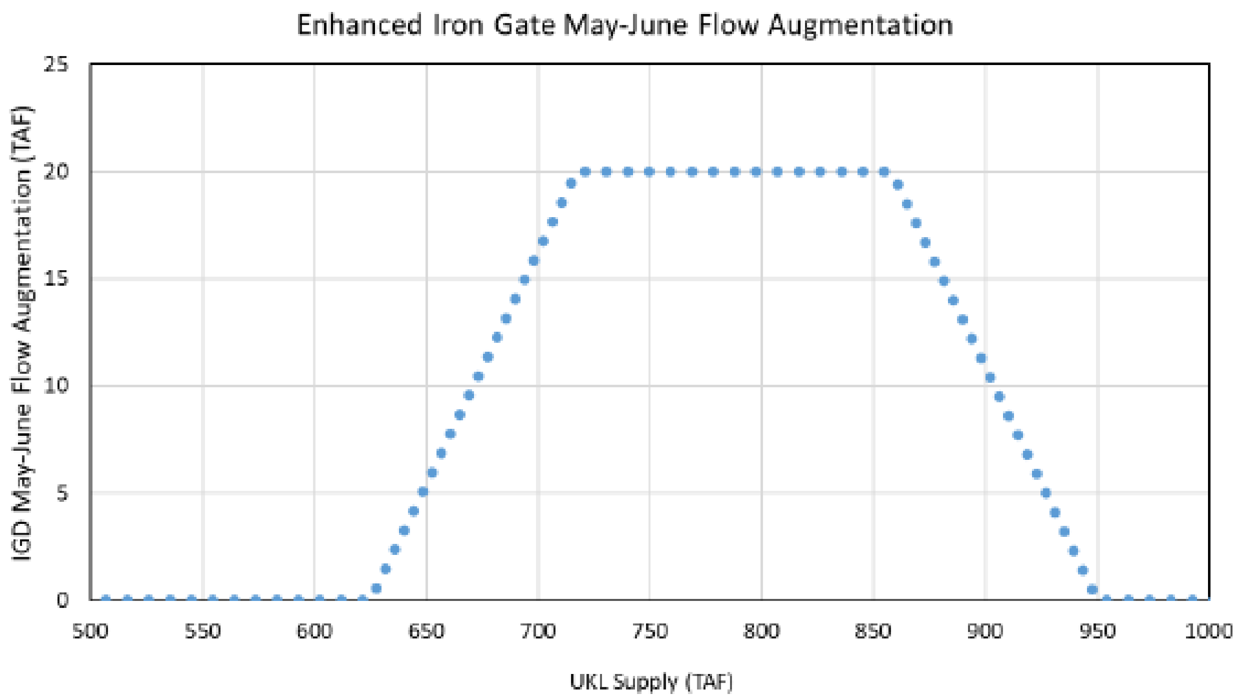

Figure 2. Enhanced May/June Flow Augmentation as related to UKL Supply. The above May/June augmentation scheme replaces the enhanced May/June provision in Reclamation's 2018 Operations Plan (as analyzed in the Services 2019 BiOps) that was dependent on EWA allocations instead of UKL Supply. The enhanced May/June augmentation volumes are shared equally (at all volumes) between Project Supply and UKL.

This action is meant to improve coho habitat in specific years of concern to NMFS. NMFS has requested flexibility in the distribution of the May/June Augmentation to maximize the benefit to listed coho, while maintaining UKL elevations/conditions necessary for listed suckers. However, for purposes of modeling effects of the enhanced May/June flows and Reclamation's planning needs (unless NMFS requests alternative management scenarios in a given water year), the specific "default" rules for implementing enhanced May/June flows are as follows:

1. Using the May 1 NRCS UKL net inflow forecast, calculate the May/June Augmentation according to the relationship shown in Figure 2;

   a. No volume of May/June Augmentation is available for release prior to May 1.
   b. June calculation of UKL Supply does not affect the May-June Augmentation determined in May.

2. Sixty percent of the May-June Augmentation volume is applied uniformly as a daily increase in calculated IGD release over the month of May;

3. Forty percent of the May-June Augmentation volume is applied uniformly as a daily increase in calculated IGD release over the month of June; and

4. May and June Project Supply estimates are reduced by 50 percent of the enhanced May-June flow augmentation volume.

Because the enhanced May/June flows are counted against EWA when the flows are implemented (when the intention is for this volume to be in addition to EWA), the aggregate augmentation (as determined in May) is added to the July 1 EWA to ensure proper EWA accounting for the remainder of the spring/summer season. Additionally, the default rules assume that when enhanced May/June flows are implemented and IGD flow targets would otherwise be at minimums, Reclamation would implement flow variability (up to +/- 75 cfs around enhanced IGD flow targets).

With regard to Upper Klamath Lake elevations, implementation of EWA augmentation (including enhanced May/June flows) will be carried out as described in the Interim Operations Plan letter.

Reclamation anticipates NMFS will recommend alternative distributions to default rules 2 and 3 described above, based on information specific to environmental conditions and forecasts, as a means to optimize the use of this water. NMFS will lead annual efforts to evaluate and seek input from the FASTA team members on alternatives to deviate from default rules.