UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Klamath River Renewal Corporation **Project No. 14803-001**

LICENSE SURRENDER ORDER
LOWER KLAMATH PROJECT

Aquatic Resources Management Plan

December 2022

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Aquatic Resources Management Plan

Klamath River Renewal Corporation
2001 Addison Street, Suite 317
Berkeley, CA 94704

December 2022

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

Appendices

1.0 Introduction

The Lower Klamath Project (FERC No. 14803) consists of four hydroelectric developments on the Klamath River: J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate (Figure 1-1). Specifically, the reach between J.C. Boyle Dam and Iron Gate Dam is known as the Hydroelectric Reach. In September of 2016, the Renewal Corporation filed an *Application for Surrender of License for Major Project and Removal of Project Works,* FERC Project Nos. 2082-063 & 14803-001 (License Surrender). The Renewal Corporation filed the License Surrender Application as the dam removal entity for the purpose of implementing the Klamath River Hydroelectric Settlement (KHSA). In November of 2020, the Renewal Corporation filed its Definite Decommissioning Plan (DDP) as Exhibits A-1 and A-2 to its Amended License Surrender Application (ALSA). The DDP is the Renewal Corporation's comprehensive plan to physically remove the Project and achieve a free-flowing condition and volitional fish passage, site remediation and restoration, and avoidance of adverse downstream impacts (Proposed Action). In November 2022, the Commission approved the ALSA and issued the License Surrender Order (LSO) approving facility removal and habitat restoration.

The Proposed Action includes the deconstruction of the J.C. Boyle Dam and Powerhouse (Figure 1-2), Copco No. 1 Dam and Powerhouse (Figure 1-3), Copco No. 2 Dam and Powerhouse (Figure 1-4), and Iron Gate Dam and Powerhouse (Figure 1-5), as well as associated features. Associated features vary by development, but generally include powerhouse intake structures, embankments and sidewalls, penstocks and supports, decks, piers, gatehouses, fish ladders and holding facilities, pipes and pipe cradles, spillway gates and structures, diversion control structures, aprons, sills, tailrace channels, footbridges, powerhouse equipment, distribution lines, transmission lines, switchyards, original cofferdams, portions of the Iron Gate Fish Hatchery, residential facilities, and warehouses. Facility removal will be completed within an approximately 20-month period.

This Aquatic Resources Management Plan describes the measures that the Renewal Corporation will implement to protect aquatic resources as part of the Proposed Action. The Renewal Corporation prepared 16 Management Plans to implement the DDP, and the Commission reviewed and approved these plans as conditions of its License Surrender Order. These Management Plans were developed in consultation with federal, state, and county governments and tribes.

The LSO Ordering Paragraph (HH) approves the Aquatic Resources Management Plan as filed on December 14, 2021. The Renewal Corporation now submits limited modifications to this approved plan as stated in Table 2-2. These modifications include refinement in means and methods due to further consultation with the Oregon Department of Environmental Quality, California State Water Resources Control Board, National Marine Fisheries Service, and U.S. Fish and Wildlife Service pursuant to the requirements in Ordering Paragraphs (D), (E), (F), and (H), respectively. Table 2-2 herein shows the material modifications to the approved version of this Aquatic Resources Management Plan. An updated Consultation Record for the Aquatic Resources Management Plan is included as Appendix G.

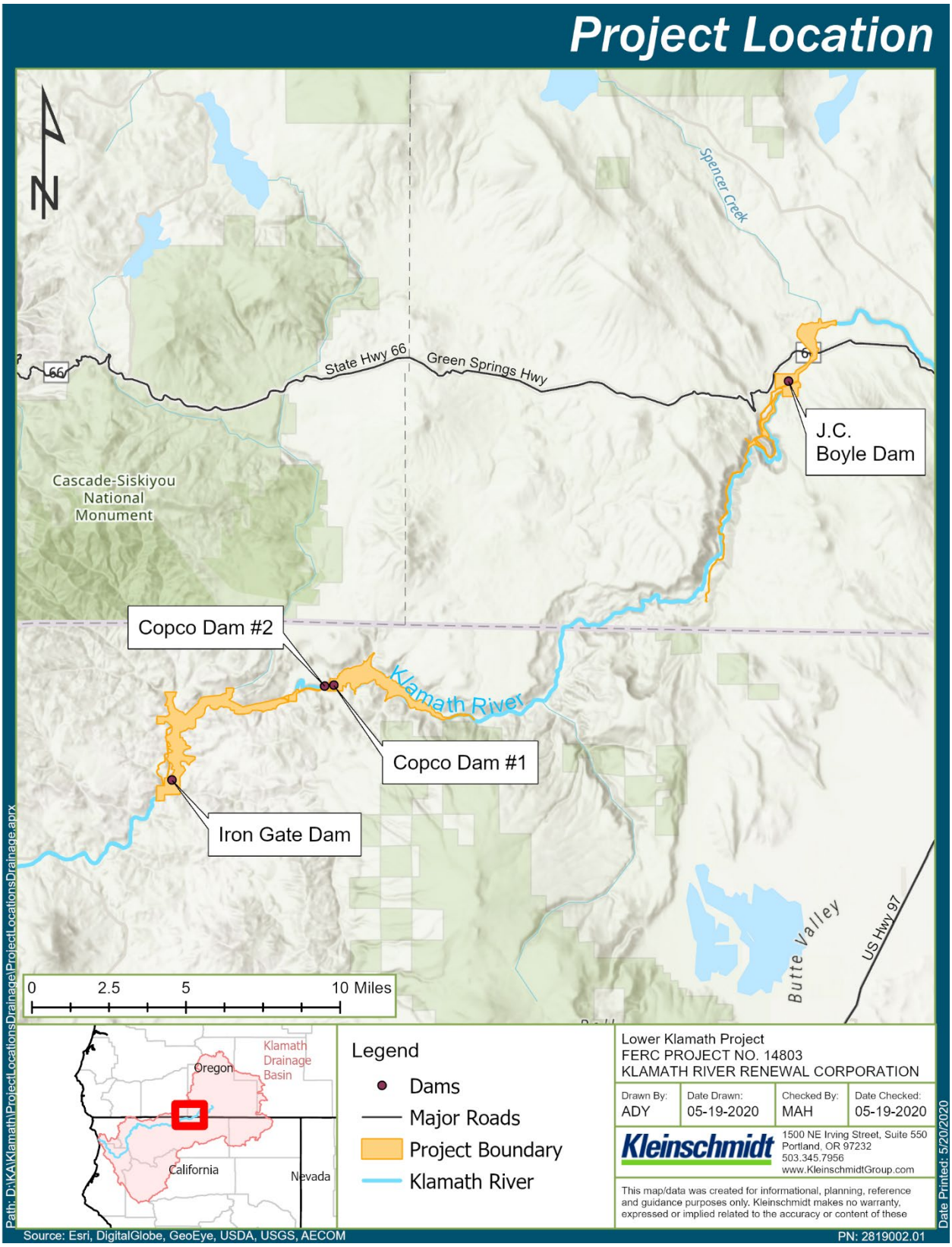


Figure 1-1. Lower Klamath Project Location

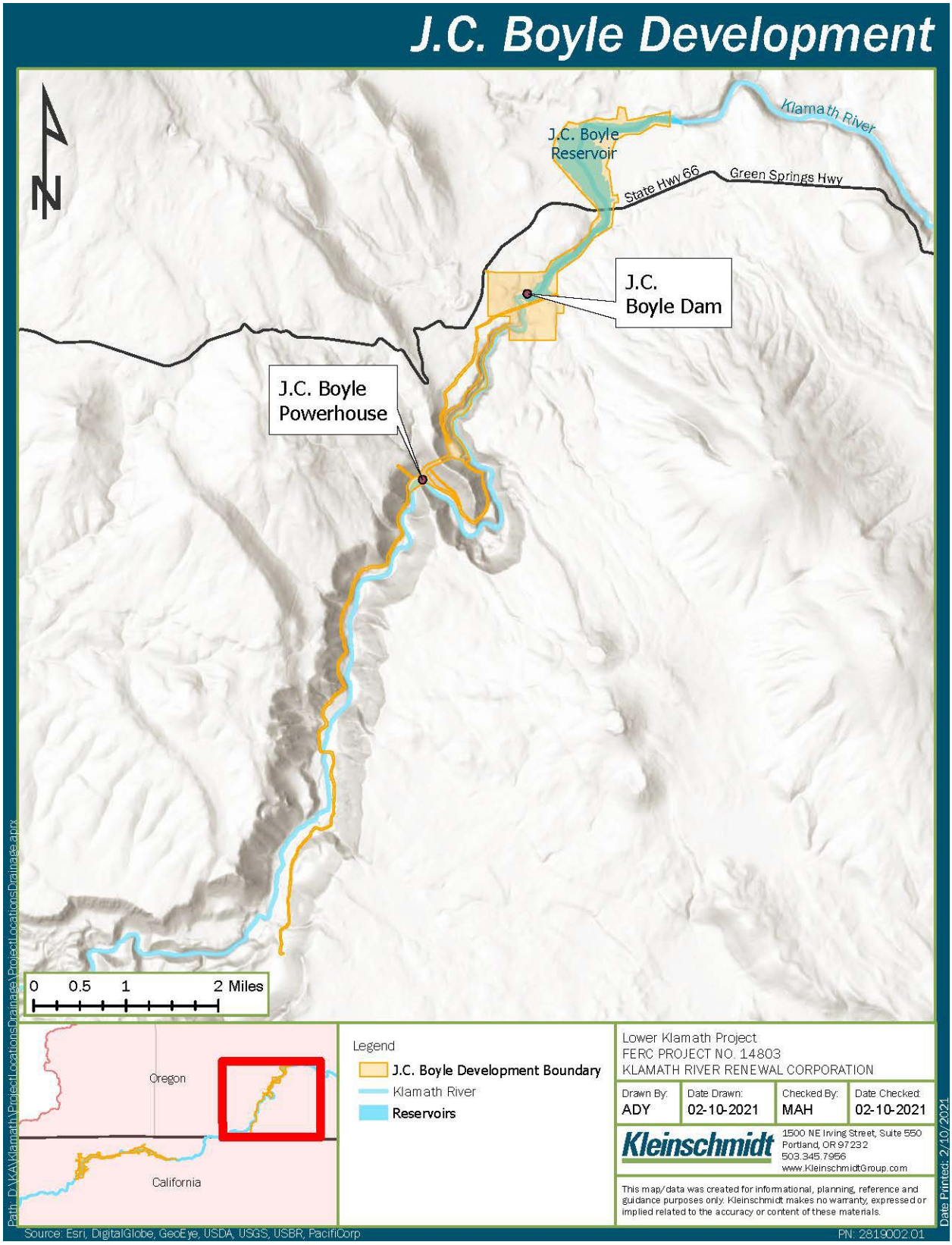


Figure 1-2. J.C. Boyle Development Facility Details

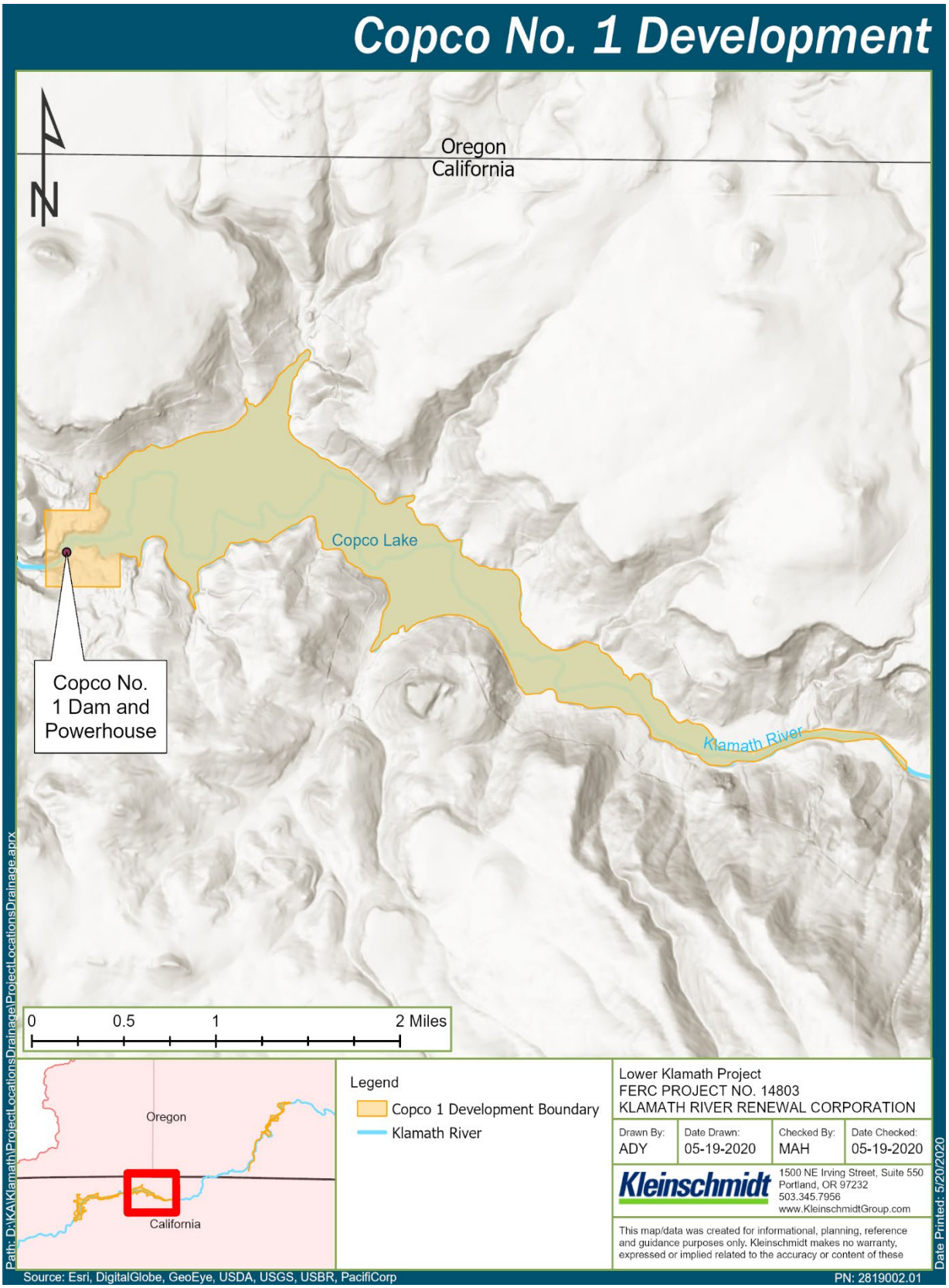


Figure 1-3. Copco No.1 Development Facility Details

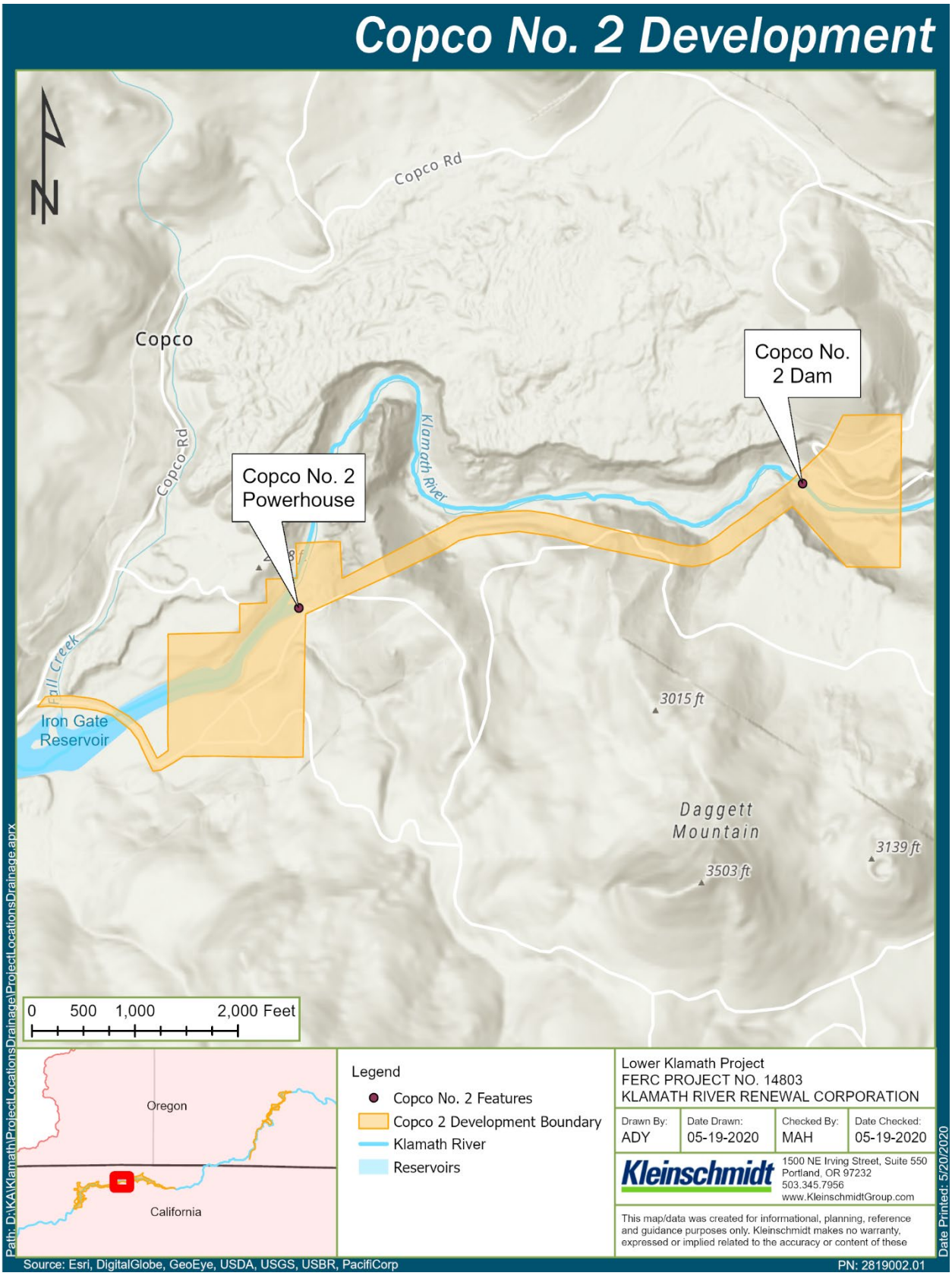


Figure 1-4. Copco No.2 Development Facility Details

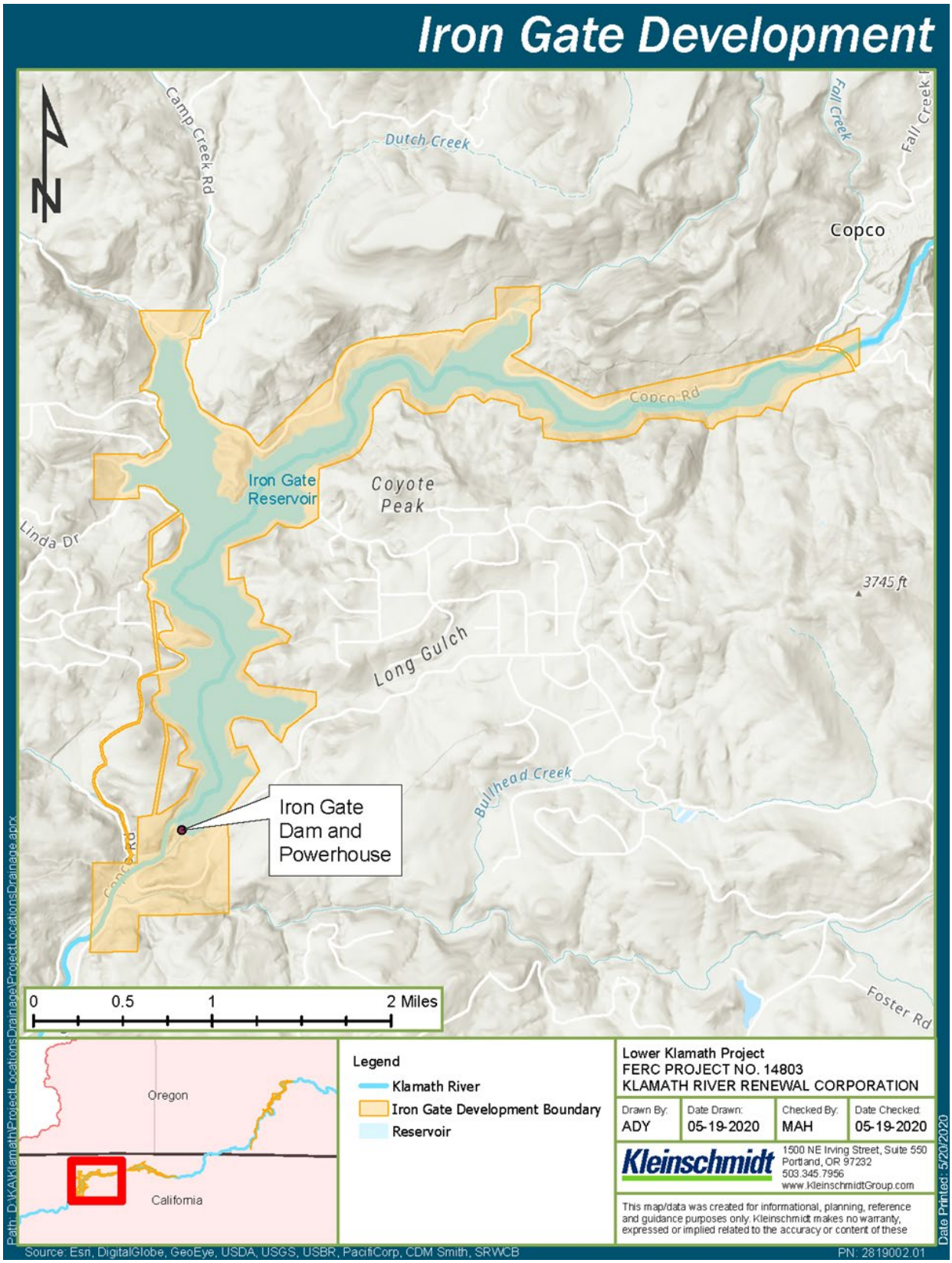


Figure 1-5. Iron Gate Development Facility Details

2.0 Regulatory Context

As described in Table 2-1, the Aquatic Resources Management Plan is one of 16 Management Plans implementing the DDP.

Table 2-1. Lower Klamath River Management Plans

1. Aquatic Resources Management Plan	9. Remaining Facilities Plan
2. Construction Management Plan	10. Reservoir Area Management Plan
3. Erosion and Sediment Control Plan	11. Reservoir Drawdown and Diversion Plan
4. Hatcheries Management and Operations Plan	12. Sediment Deposit Remediation Plan
5. Health and Safety Plan	13. Terrestrial and Wildlife Management Plan
6. Historic Properties Management Plan	14. Waste Disposal and Hazardous Materials Management Plan
7. Interim Hydropower Operations Plan	15. Water Quality Monitoring and Management Plan
8. Recreation Facilities Plan	16. Water Supply Management Plan

2.1 Organizational Structure and Definition of Terms

The Aquatic Resources Management Plan identifies the measures that the Renewal Corporation will implement to protect aquatic resources as part of the Proposed Action. Specifically, the Aquatic Resources Management Plan includes an updated Consultation Record and six sub-plans, included amongst the Appendices identified below.

- Appendix A: Spawning Habitat Availability Report and Plan
- Appendix B: California AR-6 Adaptive Management Plan-Suckers
- Appendix C: Fish Presence Monitoring Plan
- Appendix D: Tributary-Mainstem Connectivity Plan
- Appendix E: Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan
- Appendix F: Oregon AR-6 Adaptive Management Plan-Suckers
- Appendix G: Consultation Record

For purposes of the Aquatic Resources Management Plan, Year 1 refers to the year before drawdown, Year 2 refers to the drawdown year, Year 3 refers to the year following the drawdown year, Year 4 refers to the following year and so on.

For purposes of the Aquatic Resources Management Plan, Limits of Work refers to the geographic area that encompasses dam removal and restoration related activities associated

with the Proposed Action. The Limits of Work may extend beyond the Commission boundary associated with the Lower Klamath Project where specifically noted.

2.2 Additional Actions

In addition to the detailed measures set forth in the six sub-plans referenced above, the Renewal Corporation will also implement the following additional actions to protect aquatic resources:

- The Renewal Corporation will complete sampling and salvage of overwintering juvenile coho salmon from the Klamath River between Iron Gate Dam and the Trinity River confluence prior to reservoir drawdown. The Renewal Corporation will evaluate sites in the Klamath River between Iron Gate Dam and the Trinity River prior to reservoir drawdown to identify salvage locations based on the presence and relative abundance of juvenile coho salmon and the suitability of such locations for salvage. A technical memorandum identifying target capture locations and methods of salvage of overwintering juvenile coho salmon will be submitted to the Commission and National Marine Fisheries Service (NMFS) at least six months prior to salvage. The Renewal Corporation will implement the measures set forth in the technical memo prior to the commencement of reservoir drawdown at Iron Gate Dam.

- The Renewal Corporation will comply with the terms and conditions set forth in the Oregon Department of Fish and Wildlife's Fish Passage Permit (ODFW Fish Passage Permit). For informational purposes only, the ODFW Fish Passage Permit is attached as an appendix to the Tributary-Mainstem Connectivity Plan.

- The Renewal Corporation will monitor dissolved oxygen concentration in the mainstem Klamath River immediately upstream of the mouth of the Shasta River from the commencement of reservoir drawdown through the two-year anniversary of the completion of dam removal. The Renewal Corporation will make real-time estimates of the monitoring data available to the NMFS.

- The Renewal Corporation will perform one or more redd surveys in the 5-mile reach downstream of Iron Gate Dam prior to reservoir drawdown if the necessary monitoring data is not otherwise available from other parties. Prior to drawdown, the Renewal Corporation will provide NMFS with the necessary monitoring data collected by the Renewal Corporation either from other parties or during the redd survey(s) referenced above.

- During pre-drawdown construction activities immediately downstream of Iron Gate Dam, the Renewal Corporation will exclude and/or capture any juvenile coho salmon that are encountered and relocate any juvenile coho salmon found rearing in the construction zones immediately downstream of Iron Gate Dam, including construction zones related to access road construction, temporary bridge construction, armoring of the left bank access road, fire access ramp construction, and removal of temporary roads.

- During Year 2, the Renewal Corporation will place block nets at work sites immediately downstream of Iron Gate Dam in the event blasting is used to remove the fish-holding ponds at the base of the Iron Gate Dam to ensure coho salmon are excluded from aquatic habitat in or near the vicinity of the blasting site.

- If a sick, injured or dead coho salmon or eulachon is found within the Limits of Work, the Renewal Corporation will notify the NMFS' Office of Law Enforcement and follow any instructions provided by NMFS. If the Renewal Corporation observes a dead or injured coho salmon or eulachon during dam removal activities (other than relocation activities), it will be reported to NMFS within 2 days. The report will include recent suspended sediment concentration levels in the mainstem Klamath River, a concise description of the causative event (if known) and a description of resultant corrective actions taken (if any) to reduce the likelihood of future mortalities or injuries.

- If a sick or injured coho salmon or eulachon is found within the Limits of Work and the specimen's condition may worsen due to the Proposed Action before NMFS can be contacted, the Renewal Corporation will attempt to move the specimen to a suitable location near the capture site while keeping it in the water and reducing its stress as much as possible. Once the specimen is moved, it will not be disturbed. If the coho salmon or eulachon is dead, or dies while being captured or moved, the Renewal Corporation will report the following information: (1) the NMFS consultation number; (2) the date, time, and location of discovery; (3) a brief description of circumstances and any information that may show the cause of death; and (4) photographs of the coho salmon or eulachon and where it was found. The Renewal Corporation will also coordinate with local biologists to recover any tags or other relevant research information. If the specimen is not needed by local biologists for tag recovery or by NMFS for analysis, the specimen will be returned to the water in which it was found with appropriate marking to ensure that it is not subsequently recounted or otherwise discarded.

2.3 Specific Regulatory Interests

The Renewal Corporation considered the following regulatory interests in the development of the Aquatic Resources Management Plan:

- California Section 401 Water Quality Certification
- Oregon Section 401 Water Quality Certification
- California Department of Fish and Wildlife (CDFW) Memorandum of Understanding
- Oregon Memorandum of Understanding
- U.S. Fish and Wildlife Service (USFWS) Biological Opinion
- National Marine Fisheries Service (NMFS) Biological Opinion
- California Environmental Quality Act, Final Environmental Impact Report
- Federal Energy Regulatory Commission Final Environmental Impact Statement (FEIS)
- Federal Energy Regulatory Commission License Surrender Order

2.4 Modifications to the Approved Plan

The Renewal Corporation has modified the December 2021 version of this plan in the following material respects to comply with the November 17, 2022, License Surrender Order.

Table 2-2. Modifications to the Approved Plan

SUB-PLAN	MODIFICATIONS
Appendix A: Spawning Habitat Availability Report and Plan	• No material modifications.
Appendix B: California AR-6 Adaptive Management Plan-Suckers	• Added requirement that the salvage and translocation efforts be led by experienced staff with prior experience. • Added obligation for the Renewal Corporation to train and monitor any volunteers that participate in salvage and/or translocation efforts. • Added requirement that the Renewal Corporation comply with the Klamath Basin Sucker Rearing Program Fish Handling Guidelines during salvage and translocation efforts. • Added obligation for the Renewal Corporation to notify certain agencies and Tribes regarding salvage and relocation timing. • Revised to forbid the use of backpack electrofishing in connection with the salvage effort. • Added requirement that the Renewal Corporation weigh each salvaged sucker and use a new or pre-sterilized needle for each individual sucker that is PIT tagged. • Added guidelines regarding the use of boat electrofishing. • Added additional requirements related to translocation, including limitations on the number of suckers that can be transported in a 160-gallon live well at any one time and temperature changes permitted during acclimation. • Added language clarifying that the Renewal Corporation will obtain (if necessary) and comply with all permits relating to the transport of salvaged suckers across state lines.
Appendix C: Fish Presence Monitoring Plan	• No material modifications.
Appendix D: Tributary-Mainstem Connectivity Plan	• Added the ODFW Fish Passage Permit as an appendix for informational purposes only. • Revised to include the Copco No. 2 Bypass Reach within the fish passage monitoring area covered by the Tributary-Mainstem Connectivity Plan. • Removed the requirement that the first 5-year or greater flow event after drawdown must occur within 5 years to create a monitoring obligation for the Renewal Corporation.

SUB-PLAN	MODIFICATIONS
Appendix E: Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan	• Added obligation to monitor suspended sediment concentration at the following additional location: USGS Klamath River at Orleans CA gage (No. 11523000). • Added obligation to complete the initial regression analysis for each location prior to June 1 of Year 2. • Added obligation for the Renewal Corporation to measure dissolved oxygen levels at tributary confluences during site visits. • Added obligation for the Renewal Corporation to consider dissolved oxygen levels when determining whether capture and relocation is warranted.
Appendix F: Oregon AR-6 Adaptive Management Plan-Suckers	• Added requirement that the salvage and translocation efforts be led by experienced staff with prior experience. • Added obligation for the Renewal Corporation to train and monitor any volunteers that participate in salvage and/or translocation efforts. • Added requirement that the Renewal Corporation comply with the Klamath Basin Sucker Rearing Program Fish Handling Guidelines during salvage and translocation efforts. • Added obligation for the Renewal Corporation to notify certain agencies and Tribes regarding salvage and relocation timing. • Revised to forbid the use of backpack electrofishing in connection with the salvage effort. • Added requirement that the Renewal Corporation weigh each salvaged sucker and use a new or pre-sterilized needle for each individual sucker that is PIT tagged. • Added guidelines regarding the use of boat electrofishing. • Added additional requirements related to translocation, including limitations on the amount of suckers that can be transported in a 160-gallon live well at any one time and temperature changes permitted during acclimation. • Added language clarifying that the Renewal Corporation will obtain (if necessary) and comply with all permits relating to the transport of salvaged suckers across state lines.

2.5 Regulatory Approval Process

The Renewal Corporation will implement the Aquatic Resources Management Plan as approved by the Commission in the License Surrender Order. The Renewal Corporation will obtain and report to the Commission any required approvals from other agencies.

3.0 Aquatic Resources Group

The Renewal Corporation assembled an Aquatic Technical Work Group (ATWG) during development of this plan. The work group was comprised of fisheries scientists from a number of federal and state resource agencies and tribal entities, including CDFW, Oregon Department of Fish and Wildlife (ODFW), NMFS, USFWS, the California State Water Resources Control Board (SWRCB), the Bureau of Land Management (BLM)-Klamath Falls Field Office, the Yurok Tribe, the Karuk Tribe, the Hoopa Tribe, and the Klamath Tribes. The plan, including the metrics and objectives contained herein, reflect that consultation on best available science and management measures.

Upon the Commission's issuance of a License Surrender Order, the Renewal Corporation will assemble an Aquatic Resources Group (ARG) for the purpose of consultation on implementing the Aquatic Resources Management Plan. This work group will include members of the Renewal Corporation's team (e.g., RES), CDFW, ODFW, NMFS, USFWS, SWRCB, the BLM-Klamath Falls Field Office, Resighini Rancheria, the Yurok Tribe, the Karuk Tribe, and the Klamath Tribes. Each member will designate a lead who will represent it at ARG meetings and serve as its primary contact for all ARG-related matters. Under the License Surrender Order, the Renewal Corporation will be responsible for implementation of the plan and is not delegating or assigning that responsibility to the ARG.

3.1 ARG Meetings

Each member of the ARG will designate a lead who will represent it at ARG meetings and serve as its primary contact for all ARG-related matters. The Renewal Corporation will establish protocols for consultation with the ARG. These protocols will address meeting logistics and frequency, agenda development, and recordkeeping and other procedures. As to meeting frequency, the Renewal Corporation will meet with the ARG at least once prior to drawdown, approximately once per week during reservoir drawdown, and less frequently (approximately once per quarter) after drawdown. In addition, the Renewal Corporation will convene the ARG if monitoring data indicates that the amount or extent of incidental take permitted under the NMFS Biological Opinion is likely to be or has been exceeded.

The Renewal Corporation will actively consult with the ARG during implementation of the Aquatic Resources Management Plan. The Renewal Corporation will maintain a record of the topics covered, decision points reached, and actions items agreed to.

3.2 ARG Data Gathering and Reports

The Renewal Corporation will work with the ARG to gather available data regarding disease rates and other available information about juvenile Chinook salmon survival in the Klamath River. The Renewal Corporation will then prepare and submit an annual report to NMFS summarizing the data gathered from the ARG during the previous calendar year. The initial report will be submitted by April 1 of Year 4 and annually thereafter by April 1 for as long as the Renewal Corporation has performance obligations under the Reservoir Area Management Plan. The Renewal Corporation shall coordinate, as needed, with NMFS and the U.S. Bureau of

Reclamation to gain access to the agencies' S3 modeling results for inclusion in the annual report.

The Renewal Corporation will work with the ARG to gather available data as it relates to the access of Chinook salmon to newly available upstream habitat and repopulation of these habitats by Chinook salmon. The Renewal Corporation will then prepare and submit an annual report to NMFS summarizing the data gathered from the ARG during the previous calendar year. The initial report will be submitted by April 1 of Year 4 and annually thereafter by April 1 for as long as the Renewal Corporation has performance obligations under the Reservoir Area Management Plan. The report may contain data gathered through, among other things, implementation of the Fish Presence Monitoring Plan, the fish passage monitoring conducted pursuant to the Tributary-Mainstem Connectivity Plan, the Reservoir Area Management Plan, and the ODFW Fish Passage Permit, and escapement monitoring by certain agencies and Tribes.

4.0 Force Majeure

The Aquatic Resources Management Plan includes metrics, objectives, and obligations that are dependent upon natural systems, which are inherently variable. Acts of God, natural disasters, flooding, fire, drought, labor shortages, and other events beyond the control of the Renewal Corporation (Force Majeure Event) may affect or delay compliance with a given obligation in the plan. If there is a Force Majeure Event, the Renewal Corporation will, following consultation with the ARG, report to the Commission and SWRCB and/or the Oregon Department of Environmental Quality, as applicable, proposing a variance or other appropriate adjustment of the plan.

5.0 Reporting

By April 15 of each year, the Renewal Corporation will prepare and submit to the Commission an Annual Report which will include information pertaining to implementation of the Aquatic Resources Management Plan. The report will include the records of consultation described in Section 3.

Appendix A

Spawning Habitat Availability Report and Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Spawning Habitat Availability Report and Plan

Klamath River Renewal Corporation
2001 Addison Street, Suite 317
Berkeley, CA 94704

Prepared By:
RES
2125 19th Street, Suite 200
Sacramento, CA 95818

River Design Group, Inc.
311 SW Jefferson Avenue
Corvallis, OR 97333

December 2022

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

1.0 Introduction

This Spawning Habitat Availability Report and Plan is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action (Proposed Action) for the Lower Klamath Project. As described in Section 4.0 below, the Renewal Corporation will update the Spawning Habitat Availability Report and Plan following the completion of the survey activities described in Section 3.0 (Activity 2).

For purposes of the Spawning Habitat Availability Report and Plan, Year 1 refers to the year before drawdown, Year 2 refers to the drawdown year and Year 3 refers to the year following the drawdown year.

1.1 Purpose of Spawning Habitat Availability Report and Plan

The purpose of the Spawning Habitat Availability Report and Plan is to describe (1) the target metrics that will be used by the Renewal Corporation to determine whether it is necessary to implement spawning habitat enhancement activities, (2) the surveys that the Renewal Corporation will conduct to determine whether the target metrics have been met, (3) the updates that the Renewal Corporation will make to the Spawning Habitat Availability Report and Plan following completion of the surveys, and (4) the timing of the implementation of the spawning habitat enhancement activities if such activities are determined to be necessary. As recommended by the Aquatic Technical Work Group (ATWG), the Spawning Habitat Availability Report and Plan focuses primarily on the potential impacts to Chinook salmon and steelhead. See Section 3.0 of the Aquatic Resources Management Plan for additional details regarding the ATWG. As noted below, meeting the Target Metrics (as defined below) will also confirm spawning habitat availability for coho salmon and Pacific lamprey. In addition, any actions taken by the Renewal Corporation to enhance spawning habitat under Section 5.0 of the Spawning Habitat Availability Report and Plan would also be expected to enhance spawning habitat for coho salmon and Pacific lamprey.

1.2 Relationship to Other Management Plans

The Spawning Habitat Availability Report and Plan is supported by elements of the Reservoir Area Management Plan. So as not to duplicate information, elements from the Reservoir Area Management Plan are not repeated herein but are, where appropriate, referenced in this Spawning Habitat Availability Report and Plan. To facilitate its implementation in the field, the Renewal Corporation will provide the Aquatic Resources Group (ARG) with copies of the Spawning Habitat Availability Report and Plan in an electronic format that contains links to the other management plans referenced herein. See Section 3.0 of the Aquatic Resources Management Plan for additional details regarding the ARG.

1.3 Spawning Habitat Availability Report and Plan Activities

The remainder of the Spawning Habitat Availability Report and Plan describes the actions that the Renewal Corporation will take and is divided into the following sections:

- Section 2.0 Activity 1: Spawning Habitat Target Metrics: Describes the two spawning habitat target metrics that will be used by the Renewal Corporation to determine whether it is necessary to implement spawning habitat enhancement activities.

- Section 3.0 Activity 2: Spawning Habitat Availability Surveys: Provides a summary of the surveys that the Renewal Corporation will conduct to determine whether the Target Metrics have been met, including information about survey methods and survey timing.

- Section 4.0 Activity 3: Updated Spawning Habitat Availability Report and Plan: Describes the updates that the Renewal Corporation will make to the Spawning Habitat Availability Report and Plan following the completion of the surveys described in Section 3.0. The updated Spawning Habitat Availability Report and Plan will include a summary of survey results and, if determined to be necessary, a description of the spawning habitat enhancement activities that the Renewal Corporation will implement, including the location, duration, and timing of each proposed activity.

- Section 5.0 Activity 4: Spawning Habitat Enhancement Implementation: States that spawning habitat enhancement activities that are determined to be necessary will be implemented Year 2 and Year 3.

2.0 Activity 1: Spawning Habitat Target Metrics

The Renewal Corporation's analysis (2018) predicts short-term impacts to approximately 2,100 fall Chinook salmon redds and approximately 13 Southern Oregon/Northern California Coast (SONCC) coho salmon redds during reservoir drawdown. Additionally, the Renewal Corporation (2018) anticipates direct suspended sediment effects to steelhead and Pacific lamprey migrating within the mainstem Klamath River after December 31 during Year 2. Table 2-1 includes the likely and worst-case effects to adult anadromous fish species downstream from Iron Gate Dam potentially attributable to the Proposed Action based on the Renewal Corporation's analysis.

Table 2-1. 2012 EIS/R anticipated effects summary for migratory adult salmonids and Pacific lamprey

SPECIES	LIFE STAGE	LIKELY EFFECTS	WORST EFFECTS
SONCC Coho salmon	Adult spawning	Loss of 13 redds (0.7-26%)[1]	Loss of 13 redds (0.7-26%)[1]
Chinook salmon - fall	Adult spawning	Loss of 2,100 redds (8%)[1]	Loss of 2,100 redds (8%)[1]
Steelhead - summer	Migrating adults	No anticipated mortality	Loss of 0-130 adults

SPECIES	LIFE STAGE	LIKELY EFFECTS	WORST EFFECTS
Steelhead - winter	Migrating adults	Loss of up to 1,008 adults (14%)[1]	Loss of up to 1,988 adults (28%)[1]
Pacific lamprey	Adult migration and spawning	36%[2] mortality	71%[2] mortality

Source: USBR and CDFG 2012
1. Range of potential year class loss based on the average number of redds associated with the evaluated population(s).
2. The 2012 EIS/R predicted Pacific lamprey mortality based on mortality models developed for suspended sediment impacts to salmonids. Model output did not include the number of predicted Pacific lamprey mortalities.

In response to the potential impacts to Chinook salmon and steelhead, the Renewal Corporation (2018) developed targets for increased access to spawning habitat for Chinook salmon and steelhead based on typical spawning redd dimensions for the two species. These targets are anticipated to offset the anticipated short-term loss of Chinook salmon redds and adult steelhead due to reservoir drawdown. Fortune et al. (1966) used 21 yd^2 and 26 yd^2 of suitable gravel per Chinook salmon redd and steelhead redd, respectively, to calculate spawning potential in areas of the Klamath River and selected tributaries upstream of Iron Gate Dam (Table 2-2). These areas are approximately four times the approximate redd size for each species to allow for interred space when estimating the capacity of spawning gravel areas (Burner 1951).

Based on a potential loss of 2,100 Chinook salmon redds downstream from Iron Gate Dam and a 21 yd^2 area per redd, the Renewal Corporation determined that access to 44,100 yd^2 of additional spawning habitat in the mainstem of the Klamath would offset the potential loss of 2,100 Chinook salmon redds (Mainstem Target).

Based on recent winter steelhead counts, the Renewal Corporation predicts that reservoir drawdown and sediment release could affect an estimated 358 adult steelhead representing 179 spawning redds. Applying Fortune et al. (1966) steelhead redd dimensions, the Renewal Corporation determined that access to approximately 4,700 yd^2 of spawning habitat in key tributaries would offset the potential loss of 358 winter steelhead (Tributary Target).

Meeting the Target Metrics will also offset the potential impact to Pacific lamprey and the small numbers of coho salmon that use the mainstem Klamath River for spawning as it confirms spawning habitat availability for those species.

Table 2-2. Fall Chinook salmon and winter steelhead redd losses and offsets

METRIC	FALL CHINOOK SALMON	WINTER STEELHEAD
Potential redd loss due to reservoir drawdown and sediment release	2,100	179[1]
Surface area per spawning redd (yd^2)	21	26
Spawning habitat area necessary to offset redd loss (yd^2)	44,100	4,700

1. Updated anticipated winter steelhead loss based on peak steelhead return (631 in 2001) to Iron Gate Hatchery between 2000-2016 (California Department of Fish and Wildlife (CDFW) 2016). Expected mortality calculated using the methodology contained in the 2012 EIS/R (631*0.80*0.71=358). The Renewal Corporation converted the 358 adult steelhead to 179 redds that would be lost due to adult steelhead mortality.

3.0 Activity 2: Spawning Habitat Availability Surveys

Under Activity 2, the Renewal Corporation will conduct field surveys and remote sensing efforts prior to and following reservoir drawdown to evaluate and quantify the existing spawning habitat which will be available to anadromous salmonids following dam removal. The hydroelectric reach includes the Klamath River and its tributaries, from the upstream end of the J.C. Boyle Reservoir downstream to the base of Iron Gate Dam (Hydroelectric Reach). As described in more detail below, the Renewal Corporation will conduct wading surveys on Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek. The Renewal Corporation will also conduct unmanned aerial vehicle (UAV) surveys (and if necessary, field and/or Global Positioning System (GPS) surveys, as described below) on the mainstem Klamath River between Iron Gate Dam (river mile (RM) 193.1) and Keno Dam (RM 239.2). See Section 6.2.7 (Headcut Migration Monitoring) of the Reservoir Area Management Plan for additional detail. If applicable published spawning survey results are available, the Renewal Corporation will incorporate them into the updated Spawning Habitat Availability Report and Plan described in Section 4.0 below, when appropriate, to support its analysis.

3.1 Tributaries Survey

3.1.1 Overview

The Renewal Corporation will complete a targeted survey to quantify the amount of spawning habitat available to adult anadromous salmonids following reservoir drawdown and dam removal in the following four tributaries: Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek (Table 3-1). During the tributaries survey, the Renewal Corporation will walk and survey (1) Shovel Creek and Spencer Creek from their mouths upstream for two miles and (2) Jenny Creek and Fall Creek from their mouths upstream to the first natural fish passage barrier. If the Tributary Target of 4,700 yd^2 of spawning habitat is documented at any time during the tributaries survey, the tributaries survey will cease and be considered completed. If the survey does not result in the identification of 4,700 yd^2 of spawning habitat, the Renewal Corporation

will conduct a follow-up survey of the remainder of Shovel Creek and Spencer Creek upstream to the first natural fish passage barrier. If the Tributary Target is still not met after the follow-up survey, the Renewal Corporation will survey the following additional tributaries within the Hydroelectric Reach that are anticipated to support steelhead following dam removal: Camp Creek, Scotch Creek, Dutch Creek, Deer Creek and/or Beaver Creek. If the Tributary Target of 4,700 yd^2 of spawning habitat is documented at any time during these additional surveys, the tributaries survey will cease and be considered completed. Wetted side channels that meet the minimum water depth and water velocity criteria set forth in Table 3-3 will be surveyed and included in the results of the tributaries survey.

The Renewal Corporation may need to receive permission from certain property owners to conduct the wading survey on their land. If permission is required, the Renewal Corporation will ask the property owner to grant it temporary access to conduct the survey. If permission is not granted, the Renewal Corporation will skip the inaccessible section of the tributary and resume the wading survey at the next accessible location on the tributary.

The Renewal Corporation will document any man-made fish passage barriers observed during the tributaries survey.

Table 3-1. Initial existing spawning habitat survey tributaries in the Hydroelectric Reach

TRIBUTARY	TRIBUTARY CONFLUENCE LOCATION AT THE KLAMATH RIVER (RM)	TRIBUTARY LENGTH TO FIRST NATURAL BARRIER (MI)[1]	SURVEY LENGTH (MI)[2]
Jenny Creek	197.4	1.0	1.0
Fall Creek	199.8	1.2	1.2
Shovel Creek	212.0	2.7	2.0
Spencer Creek	233.4	13.0	2.0

1. Tributary length is based on pre-dam removal stream lengths. Since Jenny Creek, Fall Creek, and Spencer Creek are all expected to increase in length following the drawdown, the distance to the first natural fish passage barrier for these creeks is also anticipated to increase post drawdown.
2. If the distance to the first natural fish passage barrier for Jenny Creek, Fall Creek, and/or Spencer Creek increases post-drawdown, as expected (see footnote 1 above), there will be a commensurate increase in survey length.

3.1.2 Survey Timing

The Renewal Corporation will begin conducting the tributaries survey in either Year 1 or Year 2 and will complete the survey in Year 2. The Renewal Corporation will conduct each tributary survey in either the winter or spring during a period in which flows are similar to spawning period flows for steelhead (Table 3-2).

Table 3-2. Expected spawning periods for fall Chinook salmon and steelhead within the Klamath Hydroelectric Reach and tributaries

SPECIES	SPAWNING PERIOD	SURVEY TYPE
Fall Chinook Salmon	September 1 – December 31	Mainstem Klamath River Survey
Steelhead	December 15 – May 31	Tributaries Survey

Although tributaries in the Hydroelectric Reach are currently outside the extent of anadromy, resident adult redband trout and suckers may currently use these streams for spawning. If the Renewal Corporation observes redds or adult spawners during the tributary wading surveys, qualifying spawning patches (described in detail below) will be flagged and GPS locations will be marked with detailed habitat measurements taken at a later date to avoid disturbing spawning fish.

The Renewal Corporation will schedule surveys to target the receding limb of the hydrograph following a flow event, when flows are elevated but stable, and when water clarity is acceptable for identifying substrate size and composition. If a follow-up survey is necessary, the Renewal Corporation will, to the extent feasible, target tributary discharge comparable to the measured discharge of the previous survey.

3.1.3 Stream Discharge

The Renewal Corporation will measure tributary discharge once at the start of each survey day in the first run or glide encountered upstream from the backwater effect of the reservoir or the mainstem of the Klamath River. The Renewal Corporation will use a portable flow meter and reel tape to measure the discharge. The flow meter will be calibrated each day prior to discharge measurement. The Renewal Corporation will use the Sum of Partial Discharges Method (West Virginia Department of Environmental Protection (WVDEP), 2018) to measure and then calculate the discharge.

The Sum of Partial Discharges Method consists of: 1) measuring the average velocity of water in each of several subsections (called a vertical) of a cross-sectional transect; 2) computing the partial discharge of each subsection as the product of the velocity and area of the subsection; and 3) summing the partial discharges to obtain the total discharge (Figure 3-1).

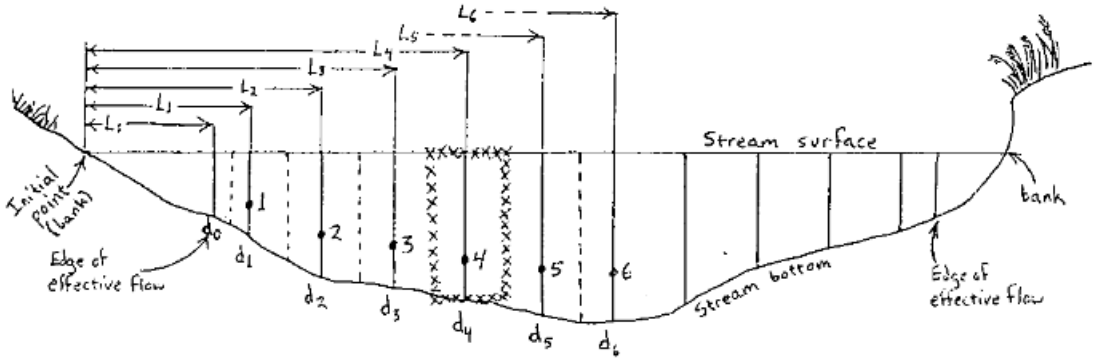


Figure 3-1. Example schematic of sum of partial discharge method

3.1.4 Spawning Habitat Patch Size

The Renewal Corporation will quantify patches of spawning habitat it encounters using a modified version of the Timber-Fish-Wildlife Cooperative Monitoring, Evaluation, and Research Committee's Salmonid Spawning Habitat Availability Survey, referred to hereafter as the TFW SHA patch survey method (Schuett-Hames et al. 1999). The Renewal Corporation will quantify a patch of spawning habitat if it meets the minimum criteria contained in Table 3-3. The Renewal Corporation selected most of the minimum criteria for identifying a spawning habitat patch as recommended by Schuett-Hames and Pleus (1996). These minimum criteria are generally due to the extensive variation in spawning habitat values both within fish stocks and between stocks and species (Burner, 1951; Smith, 1973; Bjornn and Reiser, 1991; Kondolf and Wolman, 1993). The minimum patch size criterion was adapted to meet the minimum redd sizes specified for the target species as described in Fortune et al. (1966).

Table 3-3. Minimum criteria for determining qualifying patches

PATCH METRIC	MINIMUM CRITERIA (METRIC)	MINIMUM CRITERIA (IMPERIAL)
Dominant Substrate Size	8 – 128 mm	0.3 – 5 in
Substrate Depth	≥ 23 cm	≥ 9 in
Water Depth	≥ 10 cm	≥ 4 in
Water Velocity	> Slack	> Slack
Patch Size	≥ 5 m^2	≥ 6 yds^2

To qualify as spawning habitat, more than half of the surface area of a patch must be comprised of substrate sizes ranging from small spawning gravel (8 - 64 mm) to large spawning gravel (64 - 128 mm). The Renewal Corporation will determine this by visually estimating the substrate

composition of the total patch surface. Minimum substrate depth and water depth are determined using a measuring stick or a staff with a fixed mark. Minimum velocity requirement can be determined by floating a leaf or twig to confirm the presence of water velocity. Once a qualifying patch is identified by the Renewal Corporation, the Renewal Corporation will record GPS coordinates using a handheld GPS unit positioned near the center of the patch. If GPS coverage is adequate, the Renewal Corporation will use survey grade GPS to survey the perimeter of each qualifying patch. If GPS coverage is inadequate, the Renewal Corporation will take a specific set of measurements for each qualifying patch using a reel tape. The Renewal Corporation will measure the total length of the patch along the longest axis and record to the nearest tenth of a foot. To determine the average width of the patch, the Renewal Corporation will take five width measurements perpendicular to the length measurement at approximately 10%, 30%, 50%, 70%, and 90% distance along the length axis. The Renewal Corporation will record the five width measurements to the nearest tenth of a foot. Figure 3-2 includes a schematic of the measurement locations along a qualifying spawning habitat patch.

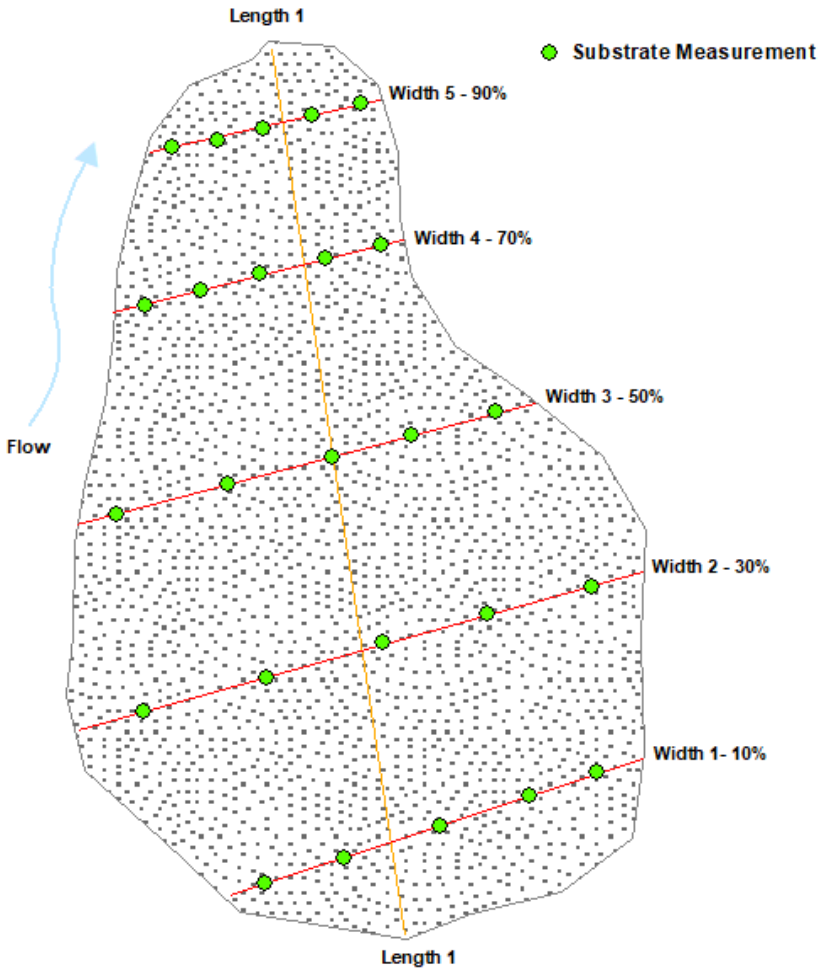


Figure 3-2. Example schematic of length, width, and substrate measurements taken on a qualifying gravel patch

In addition to the spawning habitat patch measurements, the Renewal Corporation will record the sequential patch number, habitat unit type, GPS coordinates, and any photo numbers. If a patch extends into multiple habitat units (e.g., pool and riffle), the Renewal Corporation will split the patch into multiple patches with separate measurements taken for each patch.

3.1.5 Substrate

The Renewal Corporation will estimate substrate visually to determine if a patch meets the qualifying criteria. The Renewal Corporation will estimate the total percentage of the patch that is comprised of either small spawning gravel (8 - 64 mm) or large spawning gravel (64 - 128 mm) and record each spawning patch. The Renewal Corporation will take photographs of the substrate containing a scale object at each qualifying patch.

Additionally, the Renewal Corporation will quantify and classify substrate size using a gravelometer for a subset of qualifying patches in each reach, as described below. At the first four qualifying patches encountered in each tributary surveyed, the Renewal Corporation will take a total of 25 substrate measurements by measuring five particles along each of the five width-measurement transects (see Figure 3-2). The particle measurements taken with respect to the four qualifying patches referenced above will be taken at 10%, 30%, 50%, 70%, and 90% of the distance across the width measurement transect. The Renewal Corporation will measure the substrate size along the intermediate axis of each particle or by using a gravelometer. The Renewal Corporation will then record the particle size class using the classification codes contained in Table 3-4. Additionally, at each transect, the Renewal Corporation will record a visual estimate of the percent fines (sand and silt combined) located along the transect.

Table 3-4. Substrate type, size classes, and classification codes

SUBSTRATE TYPE	SIZE (MM)	CODE[1]
Silt, Clay, Organics, Vegetation	--	1
Sand (coarse)	--	2
Small gravel	2-16	3
Medium gravel	16-32	4
Large gravel	32-64	5
Small cobble	64-128	6
Large cobble	128 - 256	7
Boulder	>256	8
Bedrock	--	9

1. For purposes of quantifying and classifying substrate size for a subset of qualifying patches in each reach, only codes 3-9 will be used.

3.2 Mainstem Klamath River Survey

The Renewal Corporation will conduct spawning habitat surveys using remote sensing techniques on the mainstem Klamath River between Iron Gate Dam (RM 193.1) and Keno Dam (RM 239.2) to determine the amount of mainstem spawning habitat in the Hydroelectric Reach suitable for immediate spawning. The surveys will be conducted during the summer or fall of Year 2. The Renewal Corporation will use a UAV to acquire air photos of the free-flowing reach following reservoir drawdown and dam removal. The Renewal Corporation will take air photos at low flows with sufficient water clarity to view the substrate. The Renewal Corporation will capture air photos at a resolution that is adequate for interpreting breaks between substrate sizes of 5 inches (128 mm) or less. If determined necessary by the Renewal Corporation, GPS and/or field surveys will be used to identify patch delineation and substrate composition and/or to otherwise aid in air photo interpretation and measurements. The Renewal Corporation will then use Geographic Information Systems (GIS) to delineate and quantify spawning patches based on the information collected using remote sensing techniques in order to determine if the Mainstem Target has been met.

Surface substrate measurements will be taken to ground truth and support UAV calibration. The number of reference locations and measurements to be taken will be determined in coordination with a UAV drone pilot, GIS analyst, and fisheries biologist following the UAV image capture and will be informed by water clarity, image resolution, and image quality at the time of the UAV flight. Ground truth locations will be reported in the updated Spawning Habitat Availability Report and Plan described in Section 4.0 below.

4.0 Activity 3: Updated Spawning Habitat Availability Report and Plan

As Activity 3, the Renewal Corporation will update the Spawning Habitat Availability Report and Plan following the completion of the tributaries and mainstem Klamath River surveys described in Section 3.0 above. For the Klamath River and each tributary stream reach surveyed, the Renewal Corporation will update the Spawning Habitat Availability Report and Plan to include a summary description of survey conditions, typical reach characteristics, total spawning habitat available, and a description of all man-made fish barriers encountered during the surveys. The Spawning Habitat Availability Report and Plan will be updated by including an appendix that summarizes data collected on each individual spawning habitat patch documented during the surveys, including patch dimensions, area, and spatial location information.

If, based on the surveys, one or more of the Target Metrics have not been met, the Renewal Corporation will, in consultation with the ARG, evaluate a range of actions to augment spawning habitat. In the event that gravel augmentation is not appropriate, the Renewal Corporation will evaluate other actions to improve spawning habitat, including installation of large woody material, riparian planting for shade coverage, wetland construction or enhancement, and cattle exclusion fencing.

If the Renewal Corporation determines, following consultation with the ARG, that it is necessary to implement actions to improve spawning habitat, the Spawning Habitat Availability Report and Plan will be updated to include the following with respect to any proposed actions: 1) a detailed description of each proposed action, including any avoidance or minimization measures that may be implemented to protect fish and wildlife resources; 2) the location(s) of each proposed action; 3) the duration and timing (e.g., season) for implementation of the proposed actions; and 4) an assessment of estimated spawning habitat benefits resulting from the proposed action in compensating for the difference between the Target Metrics and the amount of spawning habitat documented during the surveys. The updated Spawning Habitat Availability Report and Plan with descriptions of the proposed actions will then be submitted to the State Water Resources Control Board (SWRCB) for approval. If the updated Spawning Habitat Availability Report and Plan is approved by the SWRCB, the Renewal Corporation will file a report with the Federal Energy Regulatory Commission within 14 calendar days, which shall include a copy of the updated Spawning Habitat Availability Report and Plan and documentation of consultation with the SWRCB.

The Renewal Corporation may concurrently be implementing restoration measures under the Reservoir Area Management Plan that increase spawning habitat availability, including actions related to fish passage barrier removal, installation of large woody material, riparian planting for shade coverage, gravel augmentation, wetland construction or enhancement, and/or cattle exclusion fencing. To the extent measures taken or to be taken under the Reservoir Area Management Plan provide spawning habitat benefits, the Renewal Corporation will consider such benefits when determining, in consultation with the ARG, whether and what actions are necessary to improve spawning habitat under the Spawning Habitat Availability Report and Plan.

5.0 Activity 4: Spawning Habitat Enhancement Implementation

As Activity 4, if the Target Metrics have not been met, the Renewal Corporation will implement the proposed actions developed by the Renewal Corporation in accordance with Section 4.0 above. The Renewal Corporation will (if necessary) implement the proposed actions during Year 2 and Year 3 in conjunction with the Klamath River and select tributary stream restoration activities described in the Reservoir Area Management Plan.

The Renewal Corporation proposes to apply the in-water work best management practices (BMPs) set forth in Appendix C (Best Management Practices) of the Reservoir Area Management Plan. In-water work BMPs related to seasonal timing of in-stream work, work area isolation and/or dewatering, and fish rescue and relocation will likely minimize any effects to coho salmon and other aquatic species present.

6.0 Reporting

The Renewal Corporation will prepare and submit an annual report by April 1 of every year for as long as the Renewal Corporation has performance obligations under the Spawning Habitat Availability Report and Plan. Each annual report will be submitted to the SWRCB and Oregon Department of Environmental Quality, and copied to the ARG. The annual report will include the following:

1. Monitoring data, including graphical representations, as appropriate;
2. Consultation records;
3. Narrative interpretation of results; and
4. Compliance evaluations.

7.0 References

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 41-82 IN: W.R. Meehan (ed.). Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 16. Bethesda.

Burner, 1951. Characteristics of spawning nests of Columbia River salmon. USDA Fish and Wildlife Service. Fisheries Bulletin 61 Volume 52. Washington, D.C.

California Department of Fish and Wildlife (CDFW). 2016 Annual Report – Iron Gate Hatchery, 2015 – 2016.

Fortune, J.D., A.R. Gerlach, and C.J. Hanel. 1966. A study to determine the feasibility of establishing salmon and steelhead in the Upper Klamath Basin. Oregon State Game Commission and Pacific Power and Light Company, Portland, Oregon.

Klamath River Renewal Corporation (Renewal Corporation). 2018. Definite Plan for the Lower Klamath Project – Appendix I – Aquatic Resources Measures. 172 p. Available online at http://www.klamathrenewal.org/definite-plan/

Kondolf, G.M. and M.G. Wolman. 1993. The sizes of salmonid spawning gravels. Water Resources Research 29(7):2275-2285.

Smith, A.K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. Transactions of the American Fisheries Society 102(2):312-316.

Schuett-Hames, D., and A.E. Pleus. 1996. TFW Ambient Monitoring Program literature review and monitoring recommendations for salmonid spawning habitat availability. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-96-002. DNR #83. 32 p.

Schuett-Hames, D., A.E. Pleus, and D. Smith. 1999. TFW Monitoring Program method manual for the salmonid spawning habitat availability survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-007. DNR # 109. November.

U.S. Bureau of Reclamation (USBR) and California Department of Fish and Game (CDFG). 2012. Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report. Volume I and Volume II. 3063 pp. Available online at https://klamathrestoration.gov/Draft-EIS-EIR/download-draft-eis-eir.

WVDEP (West Virginia Department of Environmental Protection). 2018. Watershed Assessment Branch 2018 Field Sampling Standard Operating Procedures – Chapter 4. Stream Flow Measurement Protocols. Division of Water and Waste Management, Watershed Assessment Branch, Charleston, WV.

Appendix B

California AR-6 Adaptive Management Plan-Suckers

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

California AR-6 Adaptive Management Plan-Suckers

Klamath River Renewal Corporation
2001 Addison Street, Suite 317
Berkeley, CA 94704

Prepared By:
RES
2125 19th Street, Suite 200
Sacramento, CA 95818

River Design Group, Inc.
311 SW Jefferson Avenue
Corvallis, OR 97333

December 2022

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

1.0 Introduction

This California AR-6[1] Adaptive Management Plan - Suckers (CA Suckers Plan) is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose

This CA Suckers Plan describes the measures the Renewal Corporation has completed to better understand Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) (listed suckers) populations in Copco No. 1 Reservoir and Iron Gate Reservoir and to plan the salvage and translocation of the listed suckers from the two reservoirs prior to reservoir drawdown and dam removal. The sampling plan described herein furthered understanding of sucker demographics and genetics, population sizes, habitat use, and successful gear types and fishing methods. Informed by sampling plan results, the Renewal Corporation will conduct sucker salvage and translocation efforts to remove Lost River and shortnose suckers from the Project reservoirs prior to reservoir drawdown and dam removal.

2.0 Overview

The CA Suckers Plan entails two actions as part of the Proposed Action: Action 1: Reservoir and River Sampling and Action 2: Sucker Salvage and Translocation, both of which are summarized below. The Renewal Corporation has completed Action 1 activities as detailed in *Section 3.0 Action 1: Sampling Plan Methods and Results*. The Action 2 activities outlined in *Section 4.0 Action 2: Salvage and Translocation Plan* will be completed prior to reservoir drawdown. A similar plan for J.C. Boyle Reservoir is included in the Oregon AR-6 Adaptive Management Plan - Suckers (OR Suckers Plan).

2.1 Action 1: Reservoir and River Sampling

The Renewal Corporation coordinated a sucker sampling program with U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and the U.S. Geological Survey (USGS) from 2018 through 2020. The Renewal Corporation completed sampling in Copco No. 1 Reservoir and Iron Gate Reservoir and in Klamath River reaches upstream from the respective reservoirs between fall 2018 and spring 2020. Sampling included placing

[1] AR-6 is an acronym for Aquatic Resources Measure 6. This terminology was used in the 2018 Definite Plan to identify and describe the measures the Renewal Corporation would implement under the Aquatic Resources Management Plan to protect aquatic resources. Since the 2020 Definite Decommissioning Plan has superseded the Definite Plan, the "AR-6" terminology is no longer relevant. Regardless, the Renewal Corporation has retained the original name of this subplan to avoid confusion and ensure continuity during the consultation process.

trammel nets in the reservoirs and electrofishing, which was used in the Klamath River reaches entering the reservoirs and to augment trammel net sampling. Captured Lost River and shortnose suckers were identified by species and sex, marked with a PIT tag (Burdick 2013), fin clipped for genetic material, measured, and released. Klamath smallscale suckers (*Catostomus rimiculus*) were also processed in 2020 to collect genetic material for USFWS. It is the Renewal Corporation's understanding that USFWS will use the genetic material to develop genetic assays. Recaptured fish were used to estimate sucker abundance, and fin clips were provided to USFWS for genetic testing at the discretion of USFWS. Sampling was typically completed over two nights on Copco No. 1 Reservoir and two nights on Iron Gate Reservoir during each sampling period. The Renewal Corporation completed annual summary reports following each sampling effort and reports were submitted to CDFW and USFWS. The Renewal Corporation also presented sampling results to the Aquatic Technical Work Group (ATWG), a working group assembled to consult with the Renewal Corporation with respect to the development of the Aquatic Resources Management Plan. See Section 3.0 of the Aquatic Resources Management Plan for additional details regarding the ATWG. The sampling performed under Action 1 was completed in 2020.

2.2 Action 2: Sucker Salvage and Translocation

The Renewal Corporation will capture adult listed suckers in Copco No. 1 Reservoir and Iron Gate Reservoir using similar methods as those employed for the Action 1 sampling effort. In the spring or fall prior to reservoir drawdown, the Renewal Corporation will translocate captured suckers to the Klamath Falls National Fish Hatchery and/or Tule Lake Sump 1A. Other translocation sites may be used following consultation with the Aquatic Resources Group (ARG) and agreement between the Renewal Corporation, USFWS, CDFW and ODFW. If agreement is reached to use other translocation sites, the Renewal Corporation will file a report with the Federal Energy Regulatory Commission (Commission) within 14 calendar days that includes the location of the additional translocation site, the reasons for the additional translocation site, and documentation of consultation with USFWS, CDFW and ODFW. See Section 3.0 of the Aquatic Resources Management Plan for additional details regarding the ARG. The Renewal Corporation anticipates salvaging a combined total of approximately 300 listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir over 7 days based on sampling catch efficiencies. The 300 listed suckers equate to between 8 and 22 percent of the mean population estimates calculated for Copco No. 1 Reservoir and Iron Gate Reservoir. A similar effort will be completed on J.C. Boyle Reservoir in Oregon (see OR Suckers Plan). During the salvage action, the Renewal Corporation does not anticipate salvaging and translocating the entire populations of Lost River and shortnose suckers residing in the two reservoirs.

3.0 Action 1: Sampling Plan Methods and Results

3.1 Purpose

The Renewal Corporation coordinated a sucker sampling program with USFWS, CDFW, and the USGS from 2018 through 2020. Renewal Corporation field crews completed sampling in fall

2018, spring and fall 2019, and spring 2020. Collected data were used to develop a better understanding of sucker demographics and genetics, population sizes, habitat use, and successful gear types and fishing methods for catching Lost River and shortnose suckers. The sampling performed under Action 1 was completed in 2020, and the sampling results directly informed the salvage and translocation efforts described in *Section 4.0 Action 2: Salvage and Translocation Plan*.

3.2 Previous Efforts

The Renewal Corporation reviewed previous sampling studies completed on Upper Klamath Lake (Oregon), J.C. Boyle Reservoir (Oregon), Copco No. 1 Reservoir, and Iron Gate Reservoir as part of pre-sampling planning. The literature review focused on studies that evaluated Lost River and shortnose sucker habitat use and demographics in Copco No. 1 Reservoir and Iron Gate Reservoir. Studies of interest included Coots (1965), California Department of Fish and Game (CDFG) (1980), Beak Consultants (1987), Buettner and Scoppettone (1991), and Desjardins and Markle (2000). These studies documented shortnose suckers in Copco No. 1 Reservoir and Iron Gate Reservoir. Beak Consultants (1987) and Desjardins and Markle (2000) each captured one Lost River sucker in Copco No. 1 Reservoir. Buettner and Scoppettone (1991) referenced the decline of Lost River suckers from Copco No. 1 Reservoir since the 1950s as documented by previous CDFW studies (Coots 1965; CDFG 1980). Buettner and Scoppettone (1991) also noted there was no prior evidence of Lost River or shortnose suckers inhabiting Iron Gate Reservoir, although Desjardins and Markle (2000) subsequently captured shortnose suckers in Iron Gate Reservoir. Sucker spawning habitat upstream from Copco No. 1 Reservoir and Iron Gate Reservoir is limited due to short riverine reaches, coarse bed material, and fluctuating river levels (Buettner and Scoppettone 1991; Desjardins and Markle 2000). Limited juvenile rearing habitat and predation by non-native fish species also likely limit the reproductive potential of Lost River and shortnose suckers in the reservoirs (Desjardins and Markle 2000). Beak Consultants documented shortnose sucker spawning in the Klamath River in the 1-mile reach of the Klamath River upstream from Copco No. 1 Reservoir (1987), but they found few larval shortnose suckers in Copco No. 1 Reservoir (1988). Identified sucker larvae were believed to be Klamath smallscale suckers or shortnose sucker-Klamath smallscale sucker hybrids (Beak Consultants 1988).

J.C. Boyle Dam and Keno Dam have fish ladders that do not meet current sucker passage criteria (ODFW OAR 412; FishPro 2000) and potentially impede the upstream migration of Lost River and shortnose suckers from the Lower Klamath Project reach to Upper Klamath Lake (PacifiCorp 2013). Desjardins and Markle (2000) suggested that the presence of non-native predatory fish and the lack of rearing habitat in Copco No. 1 Reservoir and Iron Gate Reservoir reduce recruitment to the reservoir populations. Reservoir fluctuations related to water management may also impact juvenile suckers due to juvenile suckers' poor swimming ability (PacifiCorp 2013). Desjardins and Markle (2000) also captured adult and larval suckers in Copco Reservoir No. 1 and Iron Gate Reservoir, but few juvenile suckers in Copco Reservoir No. 1 and no juvenile suckers in Iron Gate Reservoir. Sucker populations in Copco Reservoir

No. 1 and Iron Gate Reservoir function as sink populations whereby adults persist but there is no evidence of significant reproduction (Rasmussen 2012; USFWS 2012; PacifiCorp 2013).

3.3 Sampling Periods and Locations

The Renewal Corporation field crews completed sampling in Copco No. 1 Reservoir and Iron Gate Reservoir over four sampling periods (Renewal Corporation 2020). Spring sampling was completed in late March and mid-May, and fall sampling was completed in early November. Sampling typically began before dusk and ended after midnight. Sampling effort focused on habitats less than 20 ft deep as adult Lost River and shortnose suckers in Upper Klamath Lake preferentially selected habitats up to 15 ft deep (Reiser et al. 2001; Banish et al. 2009). In addition to target depth, field crews also prioritized habitats with similar depths over distances of at least 300 ft to accommodate the dimension of the deployed trammel nets. Nets were often placed to fish transitional features such as from the shallow shoreline into a submerged historical channel of a tributary or the Klamath River. Sampling locations were generally in coves and tributary confluence areas that met the sampling habitat criteria defined by water depths less than 20 ft deep and habitats with consistent elevations over a 300 ft distance. Habitats that were successfully sampled during previous efforts, and over the course of the Renewal Corporation's work, were repeatedly sampled.

3.4 Sampling Methods

The Renewal Corporation field crews deployed sampling boats[2] with a captain and two crew members on each boat. The captain was responsible for driving the boat and assisting with data recording during fish processing. Crew members were responsible for deploying and retrieving fishing gear and processing captured fish. Crew members used trammel nets and boat electrofishing to sample suckers. Trammel nets were most frequently used and accounted for nearly all the sampled suckers. A boat electrofisher was used in flowing portions of the Klamath River upstream from Copco No. 1 Reservoir and Iron Gate Reservoir and in select shallow coves. Table 3-1 summarizes the sampling gear employed.

Table 3-1. Gear for sampling listed suckers in Copco No. 1 Reservoir and Iron Gate Reservoir

SAMPLING EQUIPMENT ITEM	NUMBER	SPECIFICATIONS
Sampling Boat	1 or 2	18 ft and 19 ft sampling boats with necessary safety and anti-pollution equipment
Trammel Net	6	USGS specifications - 300 feet long, 6 feet high; two 12-inch mesh outer panels; one 1.5-inch mesh (3-inch

[2] Two crews conducted sampling in fall 2018, and spring and fall 2019. One crew conducted sampling in spring 2020. Sampling level of effort was comparable across the four sampling efforts.

SAMPLING EQUIPMENT ITEM	NUMBER	SPECIFICATIONS
		stretch) inner panel; foam-core float line; lead-core bottom line
Electrofishing Equipment	1	3,250 watt generator operated boat-mounted Smith-Root Model 1.5 KVA Electrofisher

3.4.1 Trammel Nets

Netting of suckers was predominantly completed at night by one or two boats. Each boat set between two and six nets during each net set. Each trammel net included two 12-inch mesh outer panels and one 1.5-inch mesh inner panel sandwiched between the outer 12-inch mesh panels. A foam-core float line and lead-core bottom line maintained net position. Nets were clipped to an end poly rope with a mushroom or pyramid anchor secured at the bottom of the poly rope and a buoy secured to the top of the poly rope. The distance between the top of the clipped net and the buoy was based on water depth such that nets were fished on the bottom. Nets were paid out from either the bow or the side of the boat depending on the boat. A second anchor and buoy were attached to the poly rope at the end of the trammel net. Each net set location was documented with either a handheld or on-board GPS. During spring 2020, one sampling boat was used to deploy six trammel nets.

Nets were generally set perpendicular to the shoreline in water depths ranging from 3 ft to 50 ft, but nets were most commonly set in 20 ft or less of water. Nets were typically fished for approximately 2 hours, but up to 6 hours during the spring 2020 sampling. At the end of each net soak, the nets were retrieved, and captured fish were removed from the nets and placed in live wells for processing. Non-target species were identified, enumerated, and released.

3.4.2 Boat Electrofishing

Boat electrofishing was an added gear type for fall 2019 and spring 2020 sampling. The electrofishing equipment included dual bow-mounted anode/cathode arrays (each with a terminal 4 wire umbrella). Dual cathode arrays were hung from each side of the boat, each with 14 terminal wires. The electrofisher components were mounted on a 17-foot jet boat. The anode/cathode arrays were operated by a Smith-Root electrofisher control module (Model 1.5 KVA) with electricity provided by a gas-powered generator (Generac GP 3250) with a maximum output of 3,250 running watts. The Smith-Root 1.5 KVA electrofisher has a maximum output power of 1,700 watts and can be set to pulsed AC or DC current that draws between 0 and 10 amps. The AC mode produces 60 Hz alternating current between the anode and cathode wires. The DC position produces direct current, pulsing at 120 pulses per second. There is no wattage adjustment on the Smith-Root 1.5 KVA electrofisher.

Per the USFWS Incidental Take Permit for listed suckers, only the DC setting was used. Following the user manual, the Smith-Root 1.5 KVA electrofisher controller was set to DC current and the voltage was set to the lowest setting. The electrofisher was then activated to determine the amount of current (amperage) drawn at the lowest voltage setting. Test electrofishing was conducted and the voltage was increased in a stepwise manner until the desired level of electrotaxis to facilitate capture was exhibited by the target species, while also minimizing injury and mortality of target and non-target species. The effective DC voltage for the Klamath Reservoir surveys was approximately 150 volts, which drew about 5 amps. During electrofishing, two fish netters stationed in the bow controlled the electrofisher via a foot switch.

Sampling focused on shallow water areas less than 6 ft deep in coves and tributary confluences to ensure electrofisher effectiveness and to minimize injury to listed suckers. Sampling areas mirrored net set locations from previous sampling, as well as flowing reaches of the Klamath River upstream of Copco No. 1 Reservoir and Iron Gate Reservoir in spring 2020. Field crews recorded boat electrofishing level of effort by recording the time the electrofishing unit was engaged by the field crew.

3.4.3 Sucker Processing Procedures

Crew members processed captured listed suckers on the boat of capture. Fish processing involved the following observations and other measurements of each captured listed sucker.

- Identified the fish species and sex, noting the presence of tubercles and anal fin shape as sex characteristics.
- Identified any external abnormalities including tumors, parasites, lamprey marks, and fin and scale anomalies.
- Measured fork length to the nearest millimeter using a wetted PVC measuring board.
- Collected a fin clip to serve as a genetic material sample.
- Confirmed absence of existing PIT tag, then inserted a PIT tag into the ventral musculature anterior to the pelvic girdle using pre-loaded single use 12-gauge hypodermic needles (HPT12 PLT) fitted onto an implant device (MK-25). Existing or inserted PIT tag numbers were recorded.
- Collected photographs of each sucker’s mouth, lateral body view, and features of concern such as lesions or parasites.

Measurement data were recorded on field sheets and photographs and GPS data were transferred from field equipment to laptop computers following sampling. Processed fish were returned to the reservoir away from the immediate sampling area to minimize repeat capture. All efforts were made to minimally handle suckers and release fish in good condition.

3.4.4 Sucker Genetics

In 2020, the USFWS-Abernathy Lab compiled genetic libraries for the four Klamath sucker species including Lost River suckers, shortnose suckers, Klamath largescale suckers

(*Catostomus snyderi*), and Klamath smallscale suckers (Smith et al. 2020). Genetic results suggested genetic variation within each of the four sucker species was primarily partitioned among subbasins (Smith et al. 2020). Smith et al. (2020) also determined there are potentially thousands of genetic markers for species and population differentiation that will be useful in the recovery of Lost River and shortnose suckers. It is the Renewal Corporation's understanding that USFWS will use the genetic results to develop assays that will likely allow fisheries managers to distinguish among the four Klamath Basin sucker species, providing an important tool for species conservation (Smith et al. 2020). The fin clips collected by the Renewal Corporation in the Lower Klamath Project reservoirs have been provided to the USFWS. USFWS will be responsible for determining whether assays are applied to the fin clips to determine sucker genetics.

3.5 Sampling Results

The four sampling efforts results completed between 2018 and 2020 on Copco No. 1 Reservoir and Iron Gate Reservoir are presented below. Results for J.C. Boyle Reservoir are provided in the OR Suckers Plan.

3.5.1 Level of Effort

Table 3-2 and Table 3-3 include the level of effort for the trammel net sets and boat electrofishing, respectively.

Table 3-2. Level of effort for trammel net sets

METRIC	SAMPLING EVENT	RESERVOIRS		NET SET COMBINED VALUES
		COPCO NO. 1	IRON GATE	
Total Net Sets (#)	Spring 2020	36	12	48
	Fall 2019	30	36	66
	Spring 2019	31	25	56
	Fall 2018	22	24	46
	Total	**119**	**97**	**216**
Total Net Soak Time (hrs)	Spring 2020	137.5	45.7	183.3
	Fall 2019	50.3	61.0	111.3
	Spring 2019	42.4	42.6	85.0
	Fall 2018	33.6	37.3	70.9
	Total	**263.8**	**186.6**	**450.5**
	Spring 2020	3.8	3.8	3.8

METRIC	SAMPLING EVENT	RESERVOIRS		NET SET COMBINED VALUES
		COPCO NO. 1	IRON GATE	
Average Net Soak Time (hrs)	Fall 2019	1.7	1.7	1.7
	Spring 2019	1.4	1.7	1.5
	Fall 2018	1.5	1.6	1.5
	Average	**2.1**	**2.2**	**2.1**

Table 3-3. Boat electrofishing level of effort for Copco No. 1 Reservoir and Iron Gate Reservoir from fall 2019 and spring 2020 sampling

SAMPLING EVENT	BOAT ELECTROFISHING EFFORT (SECONDS)	
	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR
Spring 2020	1097	1764
Fall 2019	1271	1000
Total	**2368**	**2764**

3.5.2 Catch Composition

3.5.2.1 Trammel Nets

The Renewal Corporation field crews caught 2,101 fish during the four sampling periods using trammel nets. Fish counts and native and non-native species composition are included in Table 3-4 and Table 3-5, respectively.

Table 3-4. Total trammel net catch for Copco No. 1 Reservoir and Iron Gate Reservoir

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Spring 2020	309	139	448
Fall 2019	124	146	270
Spring 2019	176	933	1109
Fall 2018	125	149	274

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Total	**734**	**1367**	**2101**

Table 3-5. The most common native and non-native fish species caught using trammel nets in Copco No. 1 Reservoir and Iron Gate Reservoir

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Rainbow Trout (*Oncorhynchus mykiss*)	255
	Smallscale Sucker (*Catostomus rimiculus*)	142
	Tui Chub (*Siphatales bicolor bicolor)*	136
	Shortnose Sucker (*Chasmistes brevirostris*)	120
	Lamprey (potentially multiple species)	5
Non-native Species	Yellow Perch (*Perca flavescens*)	782
	Crappie spp. (*Pomoxis* spp.)	290
	Brown Bullhead (*Ameiurus nebulosus*)	223
	Bluegill (*Lepomis macrochirus*)	68
	Redear Sunfish (*Lepomis microlophus*)	42

3.5.2.2 Boat Electrofishing

The Renewal Corporation field crews caught 2,347 fish during fall 2019 and spring 2020 boat electrofishing. Fish counts and native and non-native species composition are included in Table 3-6 and Table 3-7, respectively.

Table 3-6. Total boat electrofishing catch for Copco No. 1 Reservoir and Iron Gate Reservoir

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Spring 2020	1006	1241	2247
Fall 2019	50	50	100
Total	**1056**	**1291**	**2347**

Table 3-7. The most common native and non-native fish species caught using boat electrofishing in Copco No. 1 Reservoir and Iron Gate Reservoir in 2019 and 2020 sampling

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Tui Chub (*Siphatales bicolor bicolor)*	46
	Rainbow Trout (*Oncorhynchus mykiss*)	20
	Smallscale Sucker (*Catostomus rimiculus*)	5
	Shortnose Sucker (*Chasmistes brevirostris*)	1
Non-native Species	Yellow Perch (*Perca flavescens*)	2037
	Other Sunfish (*Lepomis* sp.)	110
	Crappie (*Pomoxis* sp.)	100
	Golden Shiner (*Notemigonus crysoleucas*)	100
	Largemouth Bass (*Micropterus* sp.)	11

3.5.3 Trammel Net and Boat Electrofishing Summary

Table 3-8 includes the total catch for the four sampling periods in Copco No. 1 Reservoir and Iron Gate Reservoir. Table 3-9 includes the most common native and non-native fish species caught in Copco Reservoir 1 and Iron Gate Reservoir using trammel nets and boat electrofishing.

Table 3-8. Total trammel net catch and boat electrofishing catch for Copco No. 1 Reservoir and Iron Gate Reservoir

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Spring 2020	1415	1380	2795
Fall 2019	174	196	370
Spring 2019	176	933	1109
Fall 2018	125	149	274
Total	**1890**	**2658**	**4548**

Table 3-9. The most common native and non-native fish species caught using trammel nets and boat electrofishing in Copco No. 1 Reservoir and Iron Gate Reservoir

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Rainbow Trout (*Oncorhynchus mykiss*)	255
	Smallscale Sucker (*Catostomus rimiculus*)	142
	Tui Chub (*Siphatales bicolor bicolor)*	136
	Shortnose Sucker (*Chasmistes brevirostris*)	120
	Lamprey (potentially multiple species)	5
Non-native Species	Yellow Perch (*Perca flavescens*)	2819
	Crappie (*Pomoxis* sp.)	390
	Brown Bullhead (*Ameiurus nebulosus*)	233
	Other Sunfish (*Lepomis* sp.)	220
	Golden Shiner (*Notemigonus crysoleucas*)	100

3.5.4 Sucker Catch, Size, and Condition

The Renewal Corporation caught shortnose suckers and potential shortnose sucker hybrids in Copco No. 1 Reservoir and Iron Gate Reservoir (Table 3-10). Potential hybrid suckers were individuals that had intermediate characteristics suggesting hybridization with other sucker species. One Lost River sucker was caught in Copco No. 1 Reservoir. As noted above, the Renewal Corporation provided all fin clip samples to USFWS for genetic testing at the discretion of USFWS. The Renewal Corporation did not catch Lost River suckers in Iron Gate Reservoir.

Table 3-10. Shortnose suckers and potential hybrid suckers caught in Copco No. 1 Reservoir and Iron Gate Reservoir using trammel nets and boat electrofishing

SPECIES[1]	SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR[2]	TOTAL SUCKERS CAUGHT
Shortnose Suckers	Spring 2020	48	2	50
	Fall 2019	21	10	31
	Spring 2019	16	1	17
	Fall 2018	11	12	23
	Total	**96**	**25**	**121**
	Spring 2020	0	0	0

SPECIES[1]	SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR[2]	TOTAL SUCKERS CAUGHT
Lost River Suckers	Fall 2019	1	0	1
	Spring 2019	0	0	0
	Fall 2018	0	0	0
	Total	**1**	**0**	**1**
Potential Hybrid Suckers	Spring 2020	0	0	0
	Fall 2019	0	0	0
	Spring 2019	0	0	0
	Fall 2018	2	5	7
	Total	**2**	**5**	**7**
Total Suckers	Spring 2020	48	2	50
	Fall 2019	22	10	32
	Spring 2019	16	1	17
	Fall 2018	13	17	30
	Total	**99**	**30**	**129**

[1]: Only includes maiden captures (i.e., first capture), does not include recaptured fish.
[2]: One shortnose sucker was caught using boat electrofishing in spring 2020 in Iron Gate Reservoir.

Table 3-11 includes summary length statistics for shortnose sucker caught in Copco No. 1 Reservoir and Iron Gate Reservoir over the sampling effort. The one Lost River sucker captured in fall 2019 in Copco No. 1 Reservoir measured 538 mm fork length.

Table 3-11. Shortnose sucker length statistics for Copco No. 1 Reservoir and Iron Gate Reservoir

SPECIES	STATISTIC	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	RESERVOIRS COMBINED
Shortnose Suckers	Count	96	25	121
	Maximum (mm)	555.0	549.0	555.0
	Median (mm)	437.5	480.0	453.0
	Mean (mm)	439.5	483.5	448.6
	Minimum (mm)	317.0	390.0	317.0
	1 SD (mm)	52.0	31.2	51.5

Based on length-age relationships for shortnose suckers in Upper Klamath Lake, shortnose suckers sampled in the reservoirs are likely older fish. However, fifteen shortnose suckers caught in Copco No. 1 Reservoir in spring 2020 were less than 389 mm, suggesting a cohort of younger fish that was not sampled during previous Renewal Corporation sampling efforts. These smaller fish reduced the median length of shortnose sucker caught in Copco No. 1 Reservoir from 448 mm to 435 mm.

Prior to the Renewal Corporation's sampling, sucker populations downstream of Keno Reservoir had not been sampled since the late 1990s (Desjardins and Markle 2000) and early 2000s (Desjardins and Markle, unpublished data). In four sampling years, Desjardins and Markle (2000; unpublished data) caught few Lost River suckers (5 adults: 4 in J.C. Boyle Reservoir and 1 in Copco No. 1 Reservoir), but a greater number of adult shortnose suckers in Copco No. 1 Reservoir (n = 165) and Iron Gate Reservoir (n = 22) (Desjardins and Markle 2000). In 2000-2001, Desjardins and Markle caught 40 shortnose suckers and 5 shortnose suckers in Copco No. 1 Reservoir and Iron Gate Reservoir, respectively. A comparison of shortnose sucker lengths from sampling in 1998-1999 (Desjardins and Markle 2000) and 2000-2001 (Desjardins and Markle, unpublished data), and the Renewal Corporation's sampling (2018-2020) is shown in Figure 3-1. The size distribution for shortnose suckers captured in Copco No. 1 Reservoir tended to be smaller in the 2018-2020 period compared to shortnose suckers caught during the earlier efforts, and the size distribution was similar for shortnose suckers caught in Iron Gate Reservoir over the three periods.

The Renewal Corporation captured 120 shortnose suckers and potential hybridized shortnose suckers in Copco No.1 Reservoir and Iron Gate Reservoir over four sampling periods using trammel nets, and one additional shortnose sucker was caught using boat electrofishing, for a total of 121 shortnose and potential hybridized shortnose suckers. During sampling, one shortnose sucker mortality occurred in Copco No. 1 Reservoir due to net entanglement and suffocation.

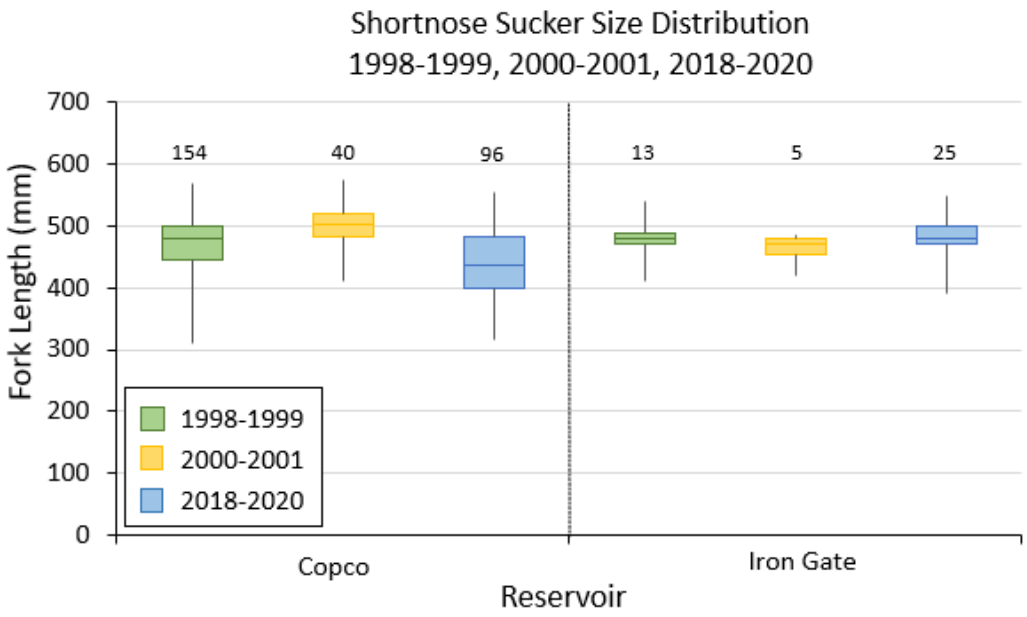


Figure 3-1. Comparison of shortnose sucker fork lengths for fish sampled by Desjardins and Markle (1998-1999 and 2000-2001) and the Renewal Corporation (2018-2020) in Copco No. 1 Reservoir and Iron Gate Reservoir[3]

Renewal Corporation field crews noted the occurrence of wounds, deformities, and growths/tumors on listed suckers in the reservoirs. Common afflictions included worn fins, caudal fin deformities, parasites, wounds from lamprey attachment, and growths/tumors (Figure 3-2). Between 11% and 33% of suckers had afflictions across the four sampling periods. Due to small sample sizes, affliction patterns across the sampling periods and reservoirs were not apparent although the most afflictions were noted for shortnose suckers (16/48 shortnose suckers with afflictions) sampled in Copco No. 1 Reservoir in spring 2020.

Figure 3-2. Example tumors and growths (left) and deformities (right) afflicting suckers in the Project Area

[3] Sample sizes are posted above each box plot in Figure 3-1.

3.5.5 Sucker Catch Per Unit Effort

Table 3-12 compares trammel net catch per unit effort (CPUE) for maiden (i.e., first capture) shortnose suckers over the four sampling events, and the previous sampling completed by Desjardin and Markle in 1998 and 1999 (Desjardins and Markle 2000) for comparison. The CPUE for shortnose suckers caught in Copco No. 1 Reservoir over the four sampling periods was 0.36 fish/net-hour. The Renewal Corporation had a higher CPUE in Copco No. 1 Reservoir than in Iron Gate Reservoir.

Table 3-12. Shortnose sucker trammel net catch per unit effort for the Renewal Corporation sampling and the Desjardins and Markle sampling (2000)

SAMPLING EFFORT[1]	CPUE (FISH/NET-HOUR)		
	RESERVOIRS		
	COPCO NO. 1	IRON GATE	RESERVOIRS COMBINED
Desjardins and Markle – 1998 and 1999[2]	0.49	0.04	0.20
Renewal Corporation – Spring 2020	0.35	0.02	0.27
Renewal Corporation – Fall 2019	0.42	0.16	0.28
Renewal Corporation – Spring 2019	0.38	0.02	0.20
Renewal Corporation – Fall 2018	0.33	0.32	0.32
Renewal Corporation - All Events Combined	0.36	0.13	0.27

[1]: Catch per unit effort does not include recaptured fish.
[2]: Desjardins and Markle 2000

3.5.6 Sucker Population Estimates

The Renewal Corporation used recaptured suckers (trammel net data only) to develop population estimates for the three reservoirs, as well as a total population estimate across the three reservoirs. Three different methods were used to develop population estimates, all yielding comparable results.

3.5.6.1 Methods

The Renewal Corporation used the PIT tag mark-recapture data to produce abundance estimates for listed suckers inhabiting each reservoir, and for the three reservoirs combined. Due to the relatively low recapture rates, mark-recapture data for shortnose, Lost River, and potential hybrid suckers were combined. All listed sucker mark-recapture data were aggregated to determine total population estimates. Any listed sucker recaptured at least one day (or longer)

after initial capture, tagging, and release was considered a recapture for the determination of the population estimates. Population estimates were then calculated using the following methods.

The Chapman Method (Chapman 1951; Johnson et al. 2007) reduces small sample size bias and estimates the total population as:

$$\hat{N} = \frac{(M)(n+1)}{(m+1)}$$

Where:

$\hat{N}$ = Estimated size of the population

n = Number of fish initially marked and released

M = Number of unmarked fish captured during subsequent survey

m = Number of recaptured fish that were marked

Meridian Environmental, Inc. (Renewal Corporation subcontractor) also used a nonparametric bootstrap method (Efron and Tibshirani 1986; Manly 2007) to calculate mean population estimates and estimate variance to produce 95 percent confidence intervals. The bootstrap was run 10 times for each estimate, with 1,000 iterations per run. Population and variance estimates represent the mean of each 10-run set. The Renewal Corporation calculated the 95 percent confidence interval as the square root of the mean bootstrap variance multiplied by 1.96.

Total population estimates were also calculated using the super-population parameterization (Schwarz and Arnason 1996) of the Jolly-Seber model to estimate listed sucker abundance while accounting for subsampling for marking. Abundance is quantified by Schwarz and Arnason (1996) as the total number of gross “births” in the area of interest, which includes listed suckers present at the beginning of the study, those that move into the study area during the monitoring period, and those that do not survive to the end of the monitoring period. The super-population parameterization (Schwarz and Arnason 1996) of the Jolly-Seber model (POPAN model) was applied with the RMark package (Laake 2013) to the capture histories of each individual PIT-tagged sucker with at least one resighting (recapture) opportunity. Intercept-only models were used for capture and survival probabilities due to the low number of recaptured individuals. Because survey occasions were distributed across a period of 18 months, the estimated abundance represents a mean for that time period. Bootstrapping was initially applied to obtain reasonable (i.e., non-negative and finite) confidence interval limits. However, bootstrapped confidence intervals resulted in unrealistically large upper bounds, so confidence intervals based on asymptotic normality were constructed.

The mark-recapture estimates include the following assumptions: 100 percent PIT tag retention (i.e., no tag loss); mortality of tagged target suckers is the same as untagged target suckers; no

emigration of tagged target suckers occurs from the reservoirs between the first and last survey; and trammel net set locations are representative of habitats used by suckers in the three reservoirs. Combining shortnose sucker, Lost River sucker, and potential hybrid sucker mark-recapture data also assumes that the trammel net catchability of these three categories of fish is the same.

An additional assumption is that each sucker species identification is correct. The field teams have collected genetic samples from all shortnose sucker, Lost River sucker, and potential hybrid suckers captured during the three survey efforts, and all target suckers were PIT-tagged. As noted above, once genetic assays are available, USFWS will decide whether the genetic samples provided by the Renewal Corporation will be used to confirm sucker genetics. If they are, reservoir mark-recapture population estimates could be further refined based on species genetic assignment of each fish in the dataset.

3.5.6.2 Results

The Renewal Corporation's population estimates suggest that the total number of adult listed suckers is highest in Copco No. 1 Reservoir, slightly less in J.C. Boyle Reservoir, and lowest in Iron Gate Reservoir (Table 3-13). The 95 percent confidence intervals suggest that there are several thousand adult suckers in Copco No. 1 Reservoir and J.C. Boyle Reservoir, and several hundred adult suckers in Iron Gate Reservoir. Based on sampling results, shortnose suckers are more abundant than Lost River suckers in J.C. Boyle Reservoir, and Lost River suckers are at low population levels in Copco No. 1 Reservoir and potentially absent from Iron Gate Reservoir. Due to the low number of recaptured suckers over the sampling effort, the 95 percent confidence intervals for the population estimates are large compared to the magnitude of the population estimate (i.e., confidence interval widths greater than ±100 percent of the population estimate for Copco No. 1 Reservoir and J.C. Boyle Reservoir).

Using the Chapman Method, the Renewal Corporation estimated 4,509 listed suckers in all three reservoirs. The bootstrap method yielded a mean estimate of 5,540 listed suckers and a 95% confidence maximum estimate of 11,531 listed suckers across the three reservoirs. The Jolly-Seber model estimated 2,201 listed suckers and a 95% confidence maximum estimate of 4,615 listed suckers across the three reservoirs.

Table 3-13. Population estimate attributes and estimates for listed and potential hybrid suckers in the Lower Klamath Project reservoirs

POPULATION ESTIMATE ATTRIBUTES	RESERVOIRS			
	J.C. BOYLE	COPCO NO. 1	IRON GATE	RESERVOIRS COMBINED
Total Maiden Suckers Captured (Fall 2018 through Spring 2020)	95	98	29	222
Total Target Suckers PIT-tagged and Available for Recapture (Fall 2018, Spring 2019, Fall 2019, Spring 2020)[1]	71	83	27	181
Total Tagged Suckers Recaptured (Fall 2018 through Spring 2020)	3	3	2	8
Recapture Efficiency (# Recaptured / # Tagged)	4.2%	3.6%	7.4%	4.4%
Chapman Method - Population Estimate	1,727	2,078	279	4,509
Bootstrap Method - Mean Population Estimate	2,766	3,371	399	5,540
Bootstrap Method - 95% Confidence Interval	±3,730	±4,508	±544	±5,991
Jolly-Seber Model - Mean Population Estimate	864	1,235	102	2,201
Jolly-Seber Model - 95% Confidence Interval	±951	±1,374	±89	±2,414

[1]: Although all target suckers captured on the final night of sampling at each reservoir were PIT-tagged, they were not available for subsequent recapture, and therefore, they were excluded from the total number of target suckers PIT-tagged and released for the mark-recapture estimate.

4.0 Action 2: Salvage and Translocation Plan

4.1 Purpose

The Renewal Corporation will undertake salvage and translocation measures to remove adult listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir prior to reservoir drawdown and dam removal to reduce Project effects on listed suckers residing in the reservoir.

During the development of the sampling and salvage plan, the Renewal Corporation coordinated with the ATWG to develop aquatic resource plan components. The Renewal Corporation initially proposed salvaging 100 Lost River and 100 shortnose suckers from each of the three reservoirs for a total of 600 suckers (Renewal Corporation 2017). Based on the sampling results presented in *Section 3 Action 1: Sampling Plan Methods and Results,* the original proposal was not feasible, especially with respect to Lost River suckers, which are at low numbers in Copco No. 1 Reservoir and potentially absent from Iron Gate Reservoir.

Under this CA Suckers Plan, the Renewal Corporation will salvage suckers over a 14-day period including a total of 5 days on Copco No. 1 Reservoir, 2 days on Iron Gate Reservoir, and 7 days on J.C. Boyle Reservoir. Based on catch efficiencies from the sampling effort, the Renewal Corporation anticipates catching a combined total of approximately 300 listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir and approximately 300 listed suckers from J.C. Boyle Reservoir. The 300 listed suckers equate to between 8 percent and 23 percent of the sucker mean population estimates calculated for Copco No. 1 Reservoir and Iron Gate Reservoir (see *Section 3.5.7 Sucker Population Estimate*). Salvage at Copco No. 1 Reservoir and Iron Gate Reservoir will continue for a total of 7 days even if the 300-sucker estimate is exceeded. Salvaged suckers caught in Copco No. 1 Reservoir and Iron Gate Reservoir will be translocated to the Klamath Falls National Fish Hatchery and/or Tule Lake Sump 1A. Other translocation sites may be used following consultation with the ARG and agreement between the Renewal Corporation, USFWS, CDFW and ODFW. If agreement is reached to use other translocation sites, the Renewal Corporation will file a report with the Commission within 14 calendar days that includes the location of the additional translocation site, the reasons for the additional translocation site, and documentation of consultation with USFWS, CDFW and ODFW.

The salvage and translocation efforts will be led by experienced staff with prior experience salvaging or sampling suckers using trammel nets, tangle nets and/or electrofishing equipment. At least one month prior to salvage, the Renewal Corporation will provide Field Supervisors at both the Klamath Falls and Yreka Fish and Wildlife Field Offices with a list of experienced staff that will be leading the effort along with a summary of their qualifications. Volunteers (if any) that participate in the salvage and/or translocation effort will receive training from experienced staff regarding, among other things, capture and handling techniques. All volunteers will also be monitored by experienced staff throughout the effort.

During the salvage and translocation effort, the Renewal Corporation will, to the extent practicable, adhere to the “Klamath Basin Sucker Rearing Program Fish Handling Guidelines” (USFWS, 2008) when capturing, handling and transporting suckers.

4.2 Regulatory Compliance

This CA Suckers Plan supports compliance with the federal Endangered Species Act of 1973, the California Endangered Species Act, and the California State Water Resources Control Board 401 Water Quality Certification pertaining to the Lost River and shortnose suckers. In addition, this CA Suckers Plan is consistent with Assembly Bill No 2640, Chapter 586 (2018), which revised Section 2081.11 of the state Fish and Game Code to read: “*The take authorization requires department approval of a sampling, salvage, and relocation plan to be implemented and that describes the measures necessary to minimize the take of adult Lost River sucker and shortnose sucker associated with the department’s authorization. The plan shall provide for a sampling effort, the results of which will provide information used to make decisions and to implement the plan while utilizing the principles of adaptive management.*”

4.3 Salvage Period

The Renewal Corporation will perform sucker salvage and translocation in the spring or fall prior to reservoir drawdown. At least three months prior to salvage, the Renewal Corporation will send an email to the Klamath Tribes and the Klamath Falls National Fish Hatchery notifying them of the proposed dates for both salvage and translocation at Copco No. 1 Reservoir and Iron Gate Reservoir. Each will be promptly notified if the dates for salvage and/or translocation change to ensure that staff from the Klamath Falls National Fish Hatchery and the Klamath Tribes' sucker rearing facility have the option of being onsite during salvage and translocation efforts and that the translocation sites are prepared to receive the salvaged suckers. In addition, at least three weeks prior to salvage, the Renewal Corporation will send an email to the Klamath Tribes and the Field Supervisor of the Klamath Falls USFWS Field Office confirming the dates for both salvage and translocation at Copco No. 1 Reservoir and Iron Gate Reservoir.

During the spring, shortnose suckers congregate in shallower habitats in advance of and during the spring spawning period. Initiation of shortnose sucker spawning runs in Upper Klamath Lake coincides with water temperatures approaching or exceeding 12 °C in the Williamson River (Hewitt et al. 2017). A similar temperature-related spawning migration pattern was documented by Beak Consultants (1987) for shortnose suckers in Copco No. 1 Reservoir. In the Beak Consultants study, shortnose suckers began spawning when average water temperatures exceeded 12 °C on April 15, 1987. Spawning peaked between April 22 and April 30 and spawning ended approximately May 15, 1987 (Beak Consultants 1987). Therefore, a spring salvage period would be completed between mid-April and early May. The Renewal Corporation previously sampled Copco No. 1 Reservoir and Iron Gate Reservoir in late March 2019, and mid-May 2020 and captured shortnose suckers. These previous efforts likely bracketed the listed suckers spawning period.

If sucker salvage and translocation cannot be performed in the spring for any reason, the Renewal Corporation will perform this measure in the fall prior to reservoir drawdown. A fall salvage period is less dependent on water temperature-related sucker behavior and habitat use, although suckers inhabited deeper habitats in a study conducted on Upper Klamath Lake (Reiser et al. 2001). A fall salvage period would take place after water temperatures decrease to less than 16 °C and Copco No. 1 Reservoir's microsystin levels decline to concentrations below human health advisory levels. A fall salvage period would occur between late October and early November.

4.4 Salvage Locations

Copco No. 1 Reservoir and Iron Gate Reservoir salvage locations will correspond to the previous sampling locations and include shallower habitats associated with coves and tributary confluences. During a spring salvage, the Klamath River in the 1.0 mile upstream of Copco Road Bridge in the reach Beak Consultants previously documented shortnose sucker spawning

(Beak Consultants 1987) would be prioritized for salvage. Similar reservoir locations would be targeted in a fall salvage period.

4.5 Salvage Methods

The Renewal Corporation will employ similar methods for processing salvaged suckers as were used during the sucker sampling effort. The Renewal Corporation will use trammel nets and boat electrofishing. The Renewal Corporation will not use backpack electrofishing in connection with the salvage of suckers. While the Renewal Corporation expects to fish primarily at night, it may also use boat electrofishing during the day if the Renewal Corporation thinks that day fishing will be effective based on its professional judgment and expertise. Two boats will each deploy eight trammel nets in Copco No. 1 Reservoir and Iron Gate Reservoir.

The Renewal Corporation will set trammel nets sequentially and fish the nets for 3-6 hours in previously sampled reservoir habitats. Two or three net sets will be completed per night depending on catch efficiency and bycatch. Boat electrofishing will focus on shallow areas in coves and the Klamath River upstream from Copco No. 1 Reservoir. Tangle nets may also be used in riverine reaches if congregations of shortnose suckers are encountered during boat electrofishing. Captured shortnose suckers, and while less likely to be encountered, Lost River suckers will be weighed, identified to species and sex, measured, fin clipped, photographed, and PIT tagged using a new or pre-sterilized needle for each individual injection. Each sucker will also be scanned to detect existing PIT tags. Salvaged suckers will be held in aerated live wells and periodically transferred to net pens near boat access sites where suckers will be held until transport. If a captured sucker is identified as a hybrid based on a visual inspection of its physical characteristics, it will be released back into the salvage reservoir.

When boat electrofishing, the Renewal Corporation will select settings to minimize potential injury or mortality to suckers, use only direct current or pulsed direct current, and avoid egg deposition areas. As in the sucker sampling effort, the Renewal Corporation will set the Smith-Root 1.5 KVA electrofisher (or equivalent) to DC current and set the voltage to the lowest setting. The electrofisher will then be activated to determine the amount of current (amperage) drawn at the lowest voltage setting. Test electrofishing will then be conducted, and the voltage will be increased in a stepwise manner until the desired level of electrotaxis to facilitate capture is exhibited by the target suckers, while also minimizing injury and mortality of target and non-target species. During boat electrofishing, two people will be stationed in the boat's bow to control the electrofisher via a foot switch.

The Renewal Corporation may also use tangle nets or a resistance board weir to salvage suckers from the upstream extent of Copco No. 1 Reservoir, or in flowing portions of the Klamath River upstream from Copco No. 1 Reservoir and Iron Gate Reservoir.

The Renewal Corporation will acquire current information on water quality to better anticipate water quality conditions in the salvage reservoirs, the Klamath Falls National Fish Hatchery,

Tule Lake Sump 1A, and other translocation sites (if any). The information will be used to understand water quality conditions in the salvage and translocation sites. Water quality constituents of interest include water temperature, dissolved oxygen, salinity concentrations, and pH levels. Acquiring this information in advance of the salvage will be necessary to condition the water in the transport live well and to plan the acclimation period at the release locations.

4.6 Transport and Translocation Methods

The Renewal Corporation will remove suckers following the two-day Iron Gate Reservoir salvage, and then after the second day and fifth day of the Copco No. 1 Reservoir salvage and transport them to the translocation sites. At the time of transport, the Renewal Corporation field crews will remove suckers from net pens and scan them for PIT tag identification prior to loading fish into aerated live wells (approximately 200-300 gallons) for transport. The Renewal Corporation will coordinate with USFWS, CDFW, ODFW, U.S. Bureau of Reclamation, the Klamath Tribes, and the Yurok Tribe to access transport vehicles. Large live wells will be fiberglass, steel, or polyethylene and will be sized to fit in the open bed of a standard pickup truck or on a trailer. Live wells will be baffled to limit sloshing during transport. The live well will be filled to 75% capacity (about 150 gallons) with salvage reservoir water in the vicinity of the net pens. Transported fish will be large (>300 mm) and care will be required to minimize overstocking the live well. Densities should be the equivalent of approximately 1 lb. of fish per gallon of water. While the transport density will be adjusted based on sucker size, sucker species, conditions, and sucker response, in no event will more than 165 pounds of suckers be transported at any one time in a 160-gallon live well. The following methods will be used to prepare the transport tanks (USBR, 2008; USFWS, unpublished report).

- Live wells are to be disinfected using a Virkon (1.3 oz/gallon) solution or other approved disinfectant. Live wells are to be disinfected daily and thoroughly rinsed following disinfection.
- Water will be pumped from the salvage reservoir into the live well using a portable pump. A handheld YSI meter will be used to measure water quality constituents including water temperature, dissolved oxygen, salinity, and pH prior to adding suckers to the live well. The live well will be refilled at the salvage reservoir prior to each transport.
- Water temperature will be monitored in the live well during initial transport runs from each location. Water temperature will be monitored during subsequent transport runs as necessary. Water temperature in the live well should remain within 4 °C of the initial ambient water temperature during the transport. Water temperature will be modified by chillers or heaters.
- Dissolved oxygen concentrations will be monitored in the live well during initial transport runs from each location. Dissolved oxygen levels will be monitored during subsequent transport runs as necessary. Dissolved oxygen levels should be maintained at

approximately 100 percent saturation. If needed, a portable aeration system will be installed to maintain dissolved oxygen levels at approximately 100 percent saturation.

- Salinity levels should be approximately 0.5%. Coarse ground sodium chloride will be added in small increments to the live well until a 0.5% salinity level is achieved. Since Tule Lake Sump 1A is more saline than the Klamath River, additional ground sodium chloride may need to be added to the live well when fish are being transported to Tule Lake Sump 1A. Additional coordination with USFWS will be completed prior to the salvage of fish that will be transported to Tule Lake Sump 1A.
- The Renewal Corporation field crews transporting the listed suckers will be attentive to the condition of the equipment throughout the transport process.
- To acclimate suckers at the receiving waterbody, salvage reservoir water in the live well will be replaced with recipient waterbody water over the course of at least an hour. Approximately a quarter to a half of the salvage reservoir water will be drained from the live well and replaced with recipient waterbody water that will be pumped into the live well. Tempering the live well will be important for acclimating the suckers to the recipient waterbody's water quality constituents. Live well water will be drained away from Tule Lake Sump 1A to avoid discharging salvage reservoir water directly to Tule Lake Sump 1A. Additional live well discharge strategies (if any) will be coordinated with USFWS. Water quality constituents should be consistently measured during the tempering process. USFWS suggests the target suckers can tolerate a 0.5 °C temperature change every 15 minutes when tempering and, to the extent practicable, overall tempering should not exceed a greater than 4 °C change.

4.6.1 Translocation Sites

The Klamath Falls National Fish Hatchery and Tule Lake Sump 1A are expected to be the primary translocation sites for suckers salvaged from Copco No. 1 Reservoir and Iron Gate Reservoir. Other translocation sites may be used following consultation with the ARG and agreement between the Renewal Corporation, USFWS, CDFW and ODFW. If agreement is reached to use other translocation sites, the Renewal Corporation will file a report with the Commission within 14 calendar days that includes the location of the additional translocation site, the reasons for the additional translocation site, and documentation of consultation with USFWS, CDFW and ODFW.

Salvaged suckers will first be taken to the Klamath Falls National Fish Hatchery where they will be isolated and receive an external parasite treatment before they are integrated into hatchery groups. USFWS has requested a ratio between 60:40 and 70:30 shortnose suckers to Lost River suckers be provided to the hatchery, of which, half of the salvaged shortnose suckers originate in Copco No. 1 Reservoir and half originate in J.C. Boyle Reservoir. Because Lost River suckers appear to be at low population levels in Copco No. 1 and Iron Gate reservoirs, Lost River suckers from J.C. Boyle Reservoir will be provided to the Klamath Falls National Fish Hatchery.

Salvaged suckers exceeding the capacity of the Klamath Falls National Fish Hatchery will be released into Tule Lake Sump 1A. Historically, Tule Lake was the terminal lake for the Lost River. Agricultural development in the basin has altered the Lost River, and Lost River and shortnose suckers in Tule Lake Sump 1A are now isolated to the Tule Lake sump complex and a 5-mile reach of the Lost River between Tule Lake Sump 1A and Anderson-Rose Dam. Tule Lake Sump 1A functions as an agricultural sump that is maintained by agricultural return flow. Until 2018, USFWS used Tule Lake Sump 1A as a translocation site for Lost River suckers and shortnose suckers salvaged from other areas in the basin. However, since 2018, USFWS has translocated salvaged suckers from other areas of the basin to the Klamath Falls National Fish Hatchery rather than to Tule Lake Sump 1A. Adult Lost River and shortnose suckers are known to occupy Tule Lake Sump 1A and listed suckers have been relocated from the sump to Upper Klamath Lake in the past (Courter et al. 2010). Management of Tule Lake Sump 1A is complicated by multiple user groups and the periodic need to draw down the reservoir for sediment maintenance. USFWS will continue to manage Tule Lake Sump 1A for multiple uses.

If salvaged suckers are transported to Oregon, the Renewal Corporation will obtain and comply with the permits (if any) required to transport the salvaged suckers across the state line between California and Oregon.

4.6.2 Transport Route

The preferred transport route between Copco No. 1 Reservoir and the Klamath Falls National Fish Hatchery is approximately 100 miles and includes two lane county road and state highway. The travel time is estimated at 2 hours. The preferred route includes the following roadways.

- Ager Beswick Road from Copco No. 1 Reservoir to Ager, CA (14 miles)
- Montague Grenada Road from Ager to Grenada, CA (17 miles)
- 99-97 Cutoff Road from Grenada, CA to Highway 97 to Township Road (79 miles)
- Township Road to Lower Klamath Lake Road (8 miles)
- 1 mile on Lower Klamath Lake Road to the Klamath Falls National Fish Hatchery

The preferred transport route between Copco No. 1 Reservoir and the Tule Lake Sump 1A is approximately 115 miles. The entire route is improved roads including two lane county road and state highway. The travel time is estimated at 2 hours. The preferred route includes the following roadways.

- Ager Beswick Road from Copco No. 1 Reservoir to Ager, CA (14 miles)
- Montague Grenada Road from Ager to Grenada, CA (17 miles)
- 99-97 Cutoff Road from Grenada, CA to Highway 97 (18 miles)
- Highway 97 to Tule Lake Sump 1A (66 miles)

The preferred transport route between Iron Gate Reservoir and the Klamath Falls National Fish Hatchery is approximately 102 miles. The travel time is estimated at 2 hours. The preferred route includes the following roadways:

- Copco Road from Iron Gate Reservoir to Hornbrook, CA (12 miles)
- CA I-5 to Ashland, OR (21 miles)
- Deer Indian Memorial Road to OR-140 E (36 miles)
- OR-140 E to Volcanic Legacy Scenic Byway (6 miles)
- Volcanic Legacy Scenic Byway to Weed Rd E (22 miles)
- Weed Rd E to Loosely Road (0.5 mile)
- Loosely Road to OR-62 E (1.5 miles)
- OR-62 E to Klamath Fish Hatchery (2 miles)

The preferred transport route between Iron Gate Reservoir and the Tule Lake Sump 1A is approximately 121 miles. The travel time is estimated at 2.5 hours. The preferred route includes the following roadways:

- Copco Road from Iron Gate Reservoir to Ager Road (8 miles)
- Ager Road to 99-97 Cutoff Road (20 miles)
- 99-97 Cutoff Road to US-97 N (18 miles)
- US-97 N to Township Road (44 miles)
- Township Road to CA-161 E (11 miles)
- Hill Rd to SW Sump South Rd (18 miles)
- SW Sump South Rd to Tule Lake Sump 1A (2 miles)

4.7 Reporting

The Renewal Corporation will process sucker salvage data including information on the salvaged and transported suckers and water quality constituents. Collected fin clips (i.e., sucker genetic material) will be linked to the individual sampled via unique PIT tag identification numbers. The Renewal Corporation will provide the USGS and the ARG with an electronic copy of the Microsoft Excel data workbook and photographs. The genetic material will be provided to USFWS.

Summary reports will be submitted to the Commission, the California State Water Resources Control Board and the Oregon Department of Environmental Quality, and copied to USGS and the ARG, within three months of completing the salvage. The summary report will contain, at a minimum, the following information:

1. Data for any suckers that die during the capture and translocation effort. This includes information on when an individual died (e.g., during capture, holding, or transport), and the species, sex, measurements, and photographs;
2. The date, time, and location data for each translocation, including water temperature data at the translocation site and time of translocation (e.g., dusk);
3. The stocking densities of the live wells (e.g. number of fish per lb. of water) when the fish are transported;
4. The sex ratio of the salvaged suckers;

5. The results of disease and pathogen screening (if any) conducted by ODFW and USFWS; and
6. All fin clip data with the associated passive integrated transponder (PIT) tag codes.

The Renewal Corporation's sucker salvage responsibilities end once suckers are released at the intended facility or waterbody. USFWS and CDFW will maintain management responsibilities for Lost River and shortnose suckers through and after the salvage effort.

4.8 Salvage Plan Summary

The Renewal Corporation completed four sampling efforts to gain a better understanding of current sucker demographics and population sizes in the Lower Klamath Project reservoirs.

The Renewal Corporation will conduct a combined 7 days of salvage and translocation of listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir. Based on catch efficiencies from the sampling effort, the Renewal Corporation anticipates relocating a combined total of approximately 300 listed suckers from the two reservoirs. The Renewal Corporation will continue to coordinate sucker salvage planning, including the estimated dates for capture and translocation, with USFWS, CDFW, and the Klamath Tribes.

5.0 References

Banish, N. P., B. J. Adams, R. S. Shively, M. M. Mazur, D. A. Beauchamp, and T. M. Wood. 2009. Distribution and habitat associations of radio-tagged adult Lost River and shortnose suckers in Upper Klamath Lake, Oregon. Transactions of the American Fisheries Society 138:153-168.

Beak Consultants Incorporated. 1987. Shortnose and Lost River sucker studies: Copco Reservoir and the Klamath River. Unpublished manuscript. Project No. D3060.01. Portland, Oregon, 37 pp. and appendix.

Beak Consultants Incorporated. 1988. Shortnose and Lost River sucker studies: Larval Sucker Study between Copco Reservoir and the Proposed Salt Caves Diversion Pool. A Response to a FERC Request for Additional Information. Project No. 73060.03. Portland, Oregon, 36 pp.

Buettner, M.E., and G.G Scoppettone. 1991. Distribution and information on the taxonomic status of the shortnose sucker (Chasmistes brevirostris) and Lost River sucker (Deltistes luxatus) in the Klamath River Basin, California. Completion Report. Study conducted for the California Department of Fish and Game under Contract FG-8304. 110 pp.

Burdick, S.M. 2013. Assessing movement and sources of mortality of juvenile catostomids using passive integrated transponder tags, Upper Klamath Lake, Oregon—Summary of 2012 effort: U.S. Geological Survey Open-File Report 2013-1062, 12 p.

California Department of Fish and Game (CDFG). 1980. Copco Lake, Siskiyou County, Fish Sampling Spring 1980. Unpublished report.

Chapman, D.G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. University of California Publications on Statistics 1:131–160.

Coots, M. 1965. Occurrences of the Lost River sucker, Deltistes luxatus (Cope), and shortnose sucker, Chasmistes brevirostris Cope, in Northern California, California Fish and Game 51:68-73.

Courter, I., J. Vaughan, and S. Duery. 2010. 2010 Tule Lake Sucker Relocation Project – Summary Report. Prepared for The Bureau of Reclamation – Klamath Basin Area Office. 11 p.

Desjardins, M., and D.F. Markle. 2000. Distribution and Biology of Suckers in the Lower Klamath Reservoirs, 1999. Final Report. Prepared for PacifiCorp, Portland, OR, by Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR.

Desjardins, M., and D.F. Markle. Unpublished sucker sampling results for Copco No. 1 Reservoir and Iron Gate Reservoir for 2000-2001.

Efron, B., and R. Tibshirani. 1986. Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. Statistical Science, Vol. 1, No. 1, 54 77.Federal Energy Regulatory Commission (FERC). 2018. Order Amending License and Deferring Consideration of Transfer Application FERC Project Nos. 2082-062 and 14803-000. 162 FERC ¶ 61,236. Washington, DC, Federal Energy Regulatory Commission, Office of Energy Projects, Division of Hydropower Licensing.

FishPro. 2000. Fish Passage Conditions on the Upper Klamath River. Submitted to The Karuk Tribe and PacifiCorp. 132 p.

Hewitt, D.A., Janney, E.C., Hayes, B.S., and Harris, A.C. 2017. Status and trends of adult Lost River (Deltistes luxatus) and shortnose (Chasmistes brevirostris) sucker populations in Upper Klamath Lake, Oregon, 2015: U.S. Geological Survey Open-File Report 2017–1059, 38 pp., https://doi.org/10.3133/ofr20171059.

Johnson, D.H., B.M. Shrier, J.S. O'Neal, J.A. Knutzen, X. Augerot, T.A. O'Neil and T.N. Pearsons. 2007. Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations. American Fisheries Society, Bethesda, Maryland.

Klamath River Renewal Corporation (Renewal Corporation). 2017. Klamath River Renewal Project – California Environmental Quality Act (CEQA) and California and Oregon 401 Water Quality Certifications Technical Support Document. 994 p.

Laake, J.L. 2013. RMark: An R Interface for Analysis of Capture-Recapture Data with MARK. AFSC Processed Rep 2013-01, 25p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Manly, B. 2007. Randomization, Bootstrap, and Monte Carlo Methods in Biology, 3rd edition. Chapman and Hall, Boca Raton, Florida.

Oregon Department of Fish and Wildlife (ODFW). State of Oregon Administrative Rules Chapter 635 – Division 412 Fish Passage. Website https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=173471

PacifiCorp. 2013. PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Lost River and Shortnose Suckers. Prepared by PacifiCorp Energy, Inc., Portland, OR. Submitted to the U.S. Fish and Wildlife Service, Klamath Falls Fish and Wildlife Office, Klamath Falls, OR.

Rasmussen, J.E. 2012. Status of Lost River sucker and shortnose sucker. Western North American Naturalist: Vol. 71:4, Article 2. https://scholarsarchive.byu.edu/wnan/vol71/iss4/2.

Reiser, D.W., M. Loftus, D. Chaplin, E. Jeanes, and K. Oliver. 2001. Effects of Water Quality and Lake Level on the Biology and Habitat of Selected Fish Species in Upper Klamath Lake. Prepared for Bureau of Indian Affairs, Portland, Oregon. 147 p.

Renewal Corporation. 2020. Lower Klamath Project Annual Monitoring Report. 39 p.

Schwarz, C.J., and A.N. Arnason. 1996. A general method for analysis of capture-recapture experiments in open populations. Biometrics 52:860-873.

Smith, M., J. Von Bargen, C. Smith, M. Miller, J. Rasmussen, and D.A. Hewitt. 2020. Characterization of the genetic structure of four sucker species in the Klamath River. Final Report. U.S. Fish and Wildlife Service. 34 p.

U.S. Bureau of Reclamation (USBR). 2008. Handling Guidelines for Klamath Basin Suckers. 20 pp.

U.S. Fish and Wildlife Service (USFWS). 2008. Klamath Basin Sucker Rearing Program Fish Handling Guidelines. Unpublished report. 18 p.

U.S. Fish and Wildlife Service (USFWS). 2012. Revised recovery plan for the Lost River sucker (Deltistes luxatus) and shortnose sucker (Chasmistes brevirostris). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. xviii + 122 pp.

Appendix C

Fish Presence Monitoring Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Fish Presence Monitoring Plan

Klamath River Renewal Corporation
2001 Addison Street, Suite 317
Berkeley, CA 94704

Prepared By:
RES
2125 19th Street, Suite 200
Sacramento, CA 95818

December 2022

This page intentionally left blank.

Table of Contents

Appendices

1.0 Introduction

This Fish Presence Monitoring Plan is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action (Proposed Action) for the Lower Klamath Project (Lower Klamath Project). The geographic area that encompasses dam removal-related activities associated with the Proposed Action is referred to as the Limits of Work.

1.1 Purpose of the Fish Presence Monitoring Plan

The Fish Presence Monitoring Plan specifically describes monitoring efforts the Renewal Corporation will undertake to document adult anadromous fish presence within the hydroelectric reach of the Lower Klamath Project following dam removal. The hydroelectric reach includes the Klamath River and its tributaries, from the upstream end of the J.C. Boyle Reservoir downstream to the base of Iron Gate Dam (Hydroelectric Reach). The Fish Presence Monitoring Plan also describes additional fish monitoring that will be undertaken following dam removal by the California Department of Fish and Wildlife (CDFW) in the California portion of the Hydroelectric Reach and by the Oregon Department of Fish and Wildlife (ODFW) in the Oregon portion of the Hydroelectric Reach. Collectively, the monitoring by CDFW, ODFW, and the Renewal Corporation will document anadromous fish presence within the full Hydroelectric Reach. As discussed in more detail in Section 2.3, the Renewal Corporation will regularly coordinate with CDFW and ODFW regarding their fish monitoring efforts.

1.2 Relationship to Other Management Plans

The Fish Presence Monitoring Plan is supported by elements of the following management plans for effective implementation: Reservoir Area Management Plan and the Hatcheries Management and Operations Plan. So as not to duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referenced in this Fish Presence Monitoring Plan.

2.0 Adult Anadromous Fish Presence Monitoring

2.1 Monitoring Overview

2.1.1 Renewal Corporation Obligations

The Fish Presence Monitoring Plan describes the geographic area that the Renewal Corporation will monitor, the period during which monitoring will occur, and the methods that will be used by the Renewal Corporation during monitoring. In addition, Section 2.3 of this Fish Presence Monitoring Plan describes the monitoring that the CDFW and ODFW are expected to undertake within the Hydroelectric Reach. The Renewal Corporation will coordinate with the CDFW and ODFW with respect to their monitoring within the Hydroelectric Reach.

2.1.2 Target Species

Under the Fish Presence Monitoring Plan, monitoring efforts by the Renewal Corporation will target the following anadromous fish species: coho salmon (*Oncorhynchus kisutch*), spring-run and fall-run Chinook salmon (*O. tshawytscha*), steelhead (anadromous form of rainbow trout; *O. mykiss*[1]), and Pacific lamprey[2] (*Entosphenus tridentatus*) (collectively, the Target Species). While all of the Target Species were historically found above Iron Gate Dam, each varied in their distribution throughout the tributaries in the Upper Klamath Basin (Hamilton *et al.*, 2005).

2.1.3 Monitoring Area

Several tributaries in the Hydroelectric Reach are thought to currently have viable anadromous fish habitat, including Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek (Huntington, 2006). Other tributaries that historically provided anadromous fish habitat include Camp Creek and Scotch Creek (i.e., the Camp-Scotch Creek complex; Hamilton *et al.*, 2005) and Beaver Creek (DOI, 2007). In addition, more than 40 miles of potential salmonid spawning habitat will become available on the mainstem Klamath River following dam removal (Huntington, 2006).

Renewal Corporation will conduct fish presence monitoring at (1) the Camp-Scotch Creek complex, Jenny Creek, and Beaver Creek channel lengths within the former reservoir footprints and (2) a reach of the mainstem Klamath River from RM 213.6 to the confluence with Shovel Creek (collectively, the Project Monitoring Area). Figures depicting each portion of the Project Monitoring Area and an overview map (Figure 1) are provided in the map book in Appendix A. As discussed in more detail in Section 2.3, the CDFW will conduct fish presence monitoring at Fall Creek and Shovel Creek following dam removal, while the ODFW will conduct fish presence monitoring at Spencer Creek.

2.1.4 Monitoring Duration

For purposes of this Fish Presence Monitoring Plan, Year 2 refers to the drawdown year, Year 3 refers to the year following the drawdown year, and Year 4 refers to the following year and so on. The Renewal Corporation will begin monitoring for the Target Species in October of Year 3 and will continue monitoring for a total of four consecutive years through Year 6. During the monitoring period, surveys on the mainstem Klamath River will be conducted every other week from the second week of October until the last week of November. Surveys in the tributaries will be conducted every other week beginning in the first two weeks of November and continuing through the first two weeks of January. A minimum of four (4) weeks prior to monitoring, the Renewal Corporation will notify the Aquatic Resources Group (ARG) so that staff of the ARG member agencies may (if desired) participate in the Renewal Corporation's monitoring activities.

[1] For the purposes of the Fish Presence Monitoring Plan, *O. mykiss* with fork lengths longer than approximately 16 inches will be considered anadromous. This standard conforms with CDFW fishing regulations (CDFW, 2020) and roughly aligns with the typical maximum length of resident rainbow trout (Moyle, 2002).

[2] For the purposes of the Fish Presence Monitoring Plan, lamprey with total lengths greater than 11 inches will be considered Pacific lamprey (Moyle, 2002).

See Section 3.0 of the Aquatic Resources Management Plan for additional details regarding the ARG.

If commencement of the monitoring period needs to be delayed for any reason, including safety considerations or high turbidity, the Renewal Corporation will immediately notify the ARG. The Renewal Corporation will then determine, following consultation with the ARG, whether the commencement of monitoring under the Fish Presence Monitoring Plan needs to be delayed by one (1) year until October of Year 4. If commencement of monitoring is delayed, the Renewal Corporation will file a report with the Federal Energy Regulatory Commission (Commission) within 14 calendar days, which shall include the reasons for the delay.

Finally, the Renewal Corporation may request a reduction in the duration or scope of monitoring under the Fish Presence Monitoring Plan based on new information (e.g., monitoring results that substantiate either anadromous fish presence or the absence of fish passage barriers resulting from the Proposed Action). The Renewal Corporation may, following consultation with the ARG, submit such a request to the California State Water Resources Board (SWRCB) at any time during the monitoring period. If the request is approved by the SWRCB, the Renewal Corporation will file a report with the Commission within 14 calendar days, which shall include a description of the request, the reasons for the request (including the new information on which it was based), and documentation of consultation with the SWRCB.

2.2 Monitoring Actions

2.2.1 Tributary Fish Presence Monitoring

The primary monitoring method used by the Renewal Corporation in tributaries will target adults during their spawning period and will include redd[3] and carcass surveys. The Renewal Corporation will follow methodology similar to that used by the Mid Klamath Watershed Council to survey tributaries in the mid-Klamath watershed (MKWC, 2017). Surveys will be conducted by a crew of two persons, with at least one person who is trained in the survey method being used.

Surveys will be conducted primarily by walking along the tributary, though snorkeling may be used to survey select holding pools if the Renewal Corporation determines that adequate data cannot be collected by a walking survey. Data will be collected on electronic tablets or paper data sheets (an example is provided in Appendix B). The Renewal Corporation will record the tributary name, crew members, date, start and end times, weather, and a description of water visibility. Global positioning system (GPS) points will be collected for the start and stop points as well as for observations of live anadromous fish, carcasses, and/or redds. Redd measurements (length and width) and photographs will be taken when practical. To minimize potential transport of aquatic invasive species, restoration staff will implement the relevant BMPs set forth

[3] If adult fish are observed on or within the immediate vicinity of a redd, it will be inferred that the adult fish and redd are of the same species. If there are no adult fish on or within the immediate vicinity, the Renewal Corporation will take measurements of the redd, where feasible, to help identify the species of the redd.

in Appendix C (Best Management Practices) of the Reservoir Area Management Plan during monitoring.

If a monitoring survey documents the presence of adult anadromous fish in a given tributary, the Renewal Corporation will finish surveying the tributary. Any further monitoring for that year in that tributary will cease because fish presence in the tributary demonstrates that anadromous fish currently have access to the tributary and the mainstem below the tributary. Monitoring of the tributary will resume the following year.

The sections below provide additional information that is specific to each tributary, including the length of the survey reaches, length of the historical channels being restored, and the Target Species that are expected to be encountered in the tributary. The Renewal Corporation will monitor each tributary from its confluence with the Klamath River (or Camp Creek, in the case of Scotch Creek) to the Limits of Work. This monitoring area will include all portions of these tributaries that are being restored by the Renewal Corporation. The restoration activities related to Jenny Creek and the Camp-Scotch Creek Complex are described in more detail in Section 5.6 of the Reservoir Area Management Plan while the restoration activities related to Beaver Creek are described in more detail in Section 5.5 of the Reservoir Area Management Plan.

2.2.1.1 Camp-Scotch Creek Complex

Camp Creek is the first major tributary upstream of Iron Gate Dam. Following reservoir drawdown, approximately 1.35 miles of historical channel will be restored upstream of the Camp Creek confluence with the Klamath River. Based on historical channel alignments, Scotch Creek will flow into Camp Creek at approximately river mile (RM) 1.20. Together, these tributaries form the Camp-Scotch Creek complex, which was historically important for Chinook salmon and steelhead trout (Hamilton *et al.*, 2005). Both Camp Creek and Scotch Creek currently support resident *O. mykiss* (BLM, 2000).

Beginning in November of Year 3, the Renewal Corporation will survey Camp Creek from its confluence with the Klamath River to the Copco Road crossing as shown in Appendix A, Figure 2. This reach is approximately 1.40 miles long. The Renewal Corporation will survey Scotch Creek from its confluence with Camp Creek to the Copco Road crossing as shown on Appendix A, Figure 2. This reach is approximately 0.25 miles long. In the aggregate, the Renewal Corporation will survey 1.65 miles of the Camp-Scotch Creek complex for Target Species.

2.2.1.2 Jenny Creek

Jenny Creek is a major, perennial tributary within the Iron Gate Reservoir footprint. Following reservoir drawdown, approximately 0.50 mile of historical channel will be restored upstream of the Jenny Creek confluence with the Klamath River. Historically, Jenny Creek was an important tributary for Chinook salmon and coho salmon (Hamilton *et al.*, 2005). In addition, Jenny Creek is currently occupied by resident *O. mykiss* (BLM, 2000). Based on the historical and current occurrence records, Chinook salmon, coho salmon, and steelhead are expected to occur in Jenny Creek following dam removal.

Beginning in November of Year 3, the Renewal Corporation will monitor Jenny Creek from its confluence with the Klamath River to just upstream of the Copco Road crossing as shown on Appendix A, Figure 3. This reach is approximately 0.65 miles long.

2.2.1.3 Beaver Creek

Beaver Creek is the longest anadromous fish-bearing tributary located within what is currently Copco No. 1 Reservoir. This tributary contains habitat for steelhead, Chinook salmon, coho salmon, and Pacific lamprey (DOI, 2007). Following reservoir drawdown, approximately 1.10 miles of historical channel on Beaver Creek will be restored. Beginning in November of Year 3, the Renewal Corporation will monitor Beaver Creek from its confluence with the Klamath River confluence to the Copco Road crossing as shown on Appendix A, Figure 4. This reach is approximately 1.30 miles long.

2.2.2 Mainstem Klamath River Fish Presence Monitoring

The Renewal Corporation will monitor an approximately 1.60-mile-long reach on the mainstem Klamath River in the California portion of the Hydroelectric Reach from RM 213.6 (PacifiCorp Fishing Access Site 6) to the confluence with Shovel Creek as shown on Appendix A, Figure 5.

The primary survey method employed by the Renewal Corporation will be redd and carcass surveys from inflatable catarafts. This technique is currently used by the U.S. Fish and Wildlife Service (USFWS) and the Karuk Tribe to conduct redd and carcass surveys of the Klamath River below Iron Gate Dam (USFWS, 2020). The Renewal Corporation has consulted with both USFWS and the Karuk Tribe regarding their survey methods and will continue coordinating with their survey crews throughout the monitoring period.

Cataraft surveys are anticipated to be conducted by a crew of two persons, with one person rowing and one person observing and recording data. Data will be collected on electronic tablets or paper sheets and will include the survey reach name, crew members, date, start and end times, weather condition, and water visibility description. GPS points will be collected for the start and stop points as well as for observations of live anadromous fish, carcasses and redds. Redd measurements (length and width) and photographs will be taken when practical. If raft-based observation is insufficient to collect the necessary data, the Renewal Corporation may use masks and snorkels to conduct a snorkel survey for fish presence and/or to verify redd presence, subject to safety considerations. If necessary for species identification, the observation crew will stop at fish carcasses.

2.3 Agency Monitoring

Following dam removal, several different state and federal agencies, as well as Tribal fisheries programs, will be engaged in efforts to monitor and study the response of anadromous fish to the restored access of hundreds of miles of habitat. These monitoring programs will vary in terms of their management objectives and research questions, and, by extension, the methodologies they employ. A commonality will be their focus on documenting anadromous fish presence.

2.3.1 Coordination

The Renewal Corporation will consult with the relevant regulatory agencies (e.g., ODFW, CDFW, SWRCB, USFWS and NMFS) on a quarterly basis regarding the scope of fish presence monitoring to be conducted. In addition, the Renewal Corporation will regularly communicate and coordinate its efforts with members of the relevant Tribal fisheries programs, including the fisheries programs of the Karuk Tribe, Yurok Tribe, and Klamath Tribes. Finally, coordination and communication are anticipated with academic institutions to better understand the scope of their anadromous fish presence monitoring activities and data to be collected.

2.3.1.1 CDFW Monitoring

CDFW currently conducts anadromous salmonid surveys in the Lower Klamath Basin in coordination with federal, Tribal, local government, and NGO partners. Following dam removal, CDFW is expected to monitor anadromous fish presence in several tributaries in the Upper Klamath Basin in California, including Fall Creek and Shovel Creek (K. Bainbridge, pers. comm., 2020). CDFW's monitoring is expected to follow similar protocols to the monitoring currently conducted under CDFW's Klamath River Project. These monitoring efforts include underwater video surveillance of returning adult salmonids, spawning ground and carcass surveys, and juvenile outmigration monitoring on Bogus Creek, Scott River, and Shasta River (CDFW, 2018, 2019a, 2019b). The Renewal Corporation will coordinate with CDFW on the location and species of anadromous fish observed during the Fish Presence Monitoring Plan's monitoring period.

2.3.1.1.1 Fall Creek

Under the Hatcheries Management and Operations Plan, the Fall Creek Fish Hatchery will be modified prior to reservoir drawdown to support salmonid production goals in the Upper Klamath Basin. Priority species for production include fall-run Chinook salmon and coho salmon. Production will continue for eight years following dam removal. CDFW is expected to monitor anadromous fish returns at the Fall Creek Fish Hatchery following dam removal. Coordination with CDFW will determine the species of anadromous fish that return to Fall Creek during the Fish Presence Monitoring Plan's monitoring period.

2.3.1.1.2 Shovel Creek

Historically, Shovel Creek was an important tributary for Chinook salmon and steelhead (Hamilton *et al.*, 2005). Positioned upstream of Copco No. 1 Reservoir and downstream of the California-Oregon border, it is located outside of reservoir influence and therefore outside of the Proposed Action's tributary restoration area. Following dam removal, CDFW is expected to monitor Shovel Creek for anadromous fish presence (K. Bainbridge, pers. comm., 2020). In addition, CDFW's Heritage and Wild Trout Program currently includes backpack electrofishing, habitat typing, and spawning surveys for trout on Shovel Creek at five-year intervals (CDFW, 2016). Monitoring efforts from these two CDFW programs are expected to document anadromous fish presence in Shovel Creek.

2.3.1.2 ODFW Monitoring

Following dam removal, ODFW is expected to implement an anadromous salmonid monitoring program in the Upper Klamath Basin (ODFW, 2020) to, among other things, monitor anadromous fish presence with the Oregon portion of the Hydroelectric Reach. As described below, this program is expected to include monitoring at Spencer Creek as well as in the mainstem Klamath River from Keno Dam to the state line. The Renewal Corporation will coordinate with ODFW following dam removal to aid in the documentation of the location and species of anadromous fish that are observed in Oregon's portion of the Hydroelectric Reach during the Fish Presence Monitoring Plan's monitoring period. If anadromous fish are documented by ODFW within the Oregon portion of the Hydroelectric Reach, it would confirm fish presence throughout California's portion of the mainstem Klamath River.

2.3.1.2.1 Spencer Creek

Historically, Spencer Creek was an important tributary for Chinook salmon, coho salmon, steelhead trout, and Pacific lamprey (Hamilton *et al.*, 2005). ODFW is expected to conduct salmonid life cycle monitoring at Spencer Creek, which is expected to include a combination of electrofishing surveys and spawning ground and carcass surveys. On the lower reach of Spencer Creek, ODFW's monitoring is expected to include an outmigrating juvenile fish trap, a video weir, and passive integrated transponder (PIT) tag arrays.

2.3.1.2.2 Oregon Reach: State Line to Spencer Creek

ODFW is expected to monitor approximately 13 miles of the mainstem Klamath River from Keno Dam to the state line for anadromous salmonid spawning and carcasses. The survey reaches include the Keno Reach, which extends 6.8 miles from Keno Dam to just downstream of Spencer Creek, and the Frain Ranch Reach, which extends 6 miles from the Spring Island Boat Ramp to Caldera Rapid. In addition, ODFW's monitoring is expected to include the operation of a rotary screw trap on the Klamath River downstream of the Spencer Creek confluence and/or on the lower end of the Frain Ranch Reach.

3.0 Reporting

If the presence of an adult anadromous fish is documented during a monitoring survey in either a tributary or the mainstem Klamath River, the Renewal Corporation will promptly notify the ARG and provide it with the species, location, and number of documented fish.

In addition, the Renewal Corporation will prepare and submit an annual report by April 1 of every year for as long as the Renewal Corporation has performance obligations under the Fish Presence Monitoring Plan. Each annual report will be submitted to the SWRCB and ODEQ, and copied to the ARG. Each annual report will include the following information:

1. A summary of the fish presence results; and
2. An overall assessment of fish presence in the newly accessible mainstem Klamath and tributaries, including a consideration of fish return projections and observations.

The final annual report will include a summary of the obstructions (if any) identified by the Renewal Corporation during fish passage monitoring conducted under the Tributary-Mainstem Connectivity Plan and Reservoir Area Management Plan as well as a description of the impacts (if any) that the identified obstructions had on fish presence in the Project Monitoring Area.

The information obtained under the Fish Presence Monitoring Plan will be used to help determine whether adaptive management is required to meet the fish passage objectives of the Lower Klamath Project. The Renewal Corporation will make decisions regarding adaptive management based on the framework described in Section 6.2.9 of the Reservoir Area Management Plan.

4.0 References

Bainbridge, K. 2020. Klamath Watershed Program, California Department of Fish and Wildlife, Yreka, CA. Personal communication with Dan Chase, Resource Environmental Solutions, December 18, 2020.

Bureau of Land Management (BLM). 2000. Klamath-Iron Gate Watershed Analysis. Medford District Ashland Resource Area. January 2000. Available online at: https://www.blm.gov/or/districts/medford/plans/files/KlamIronGateWAOptimized_acc.PDF

California Department of Fish and Wildlife (CDFW). 2016. Upper Klamath River Fishery Management Plan. Prepared by Rogers, D., D.R. Maria, and M. Dean. Heritage and Wild Trout Program, Northern Region. 25 pp. Available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=121271&inline

CDFW. 2018. Bogus Creek Salmon Studies, 2017 Final Report. Prepared by M. Knechtle and D. Giudice. Klamath River Project. Yreka, CA. Available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174872&inline

CDFW. 2019a. 2018 Scott River Salmon Studies, Final Report. Prepared by M. Knechtle and D. Giudice. Klamath River Project. Yreka, CA. Available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174880&inline

CDFW. 2019b. Shasta River Salmonid Monitoring 2018, Siskiyou County, CA. Prepared by D. Giudice and M. Knechtle. Klamath River Project. Yreka, CA. Available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174881&inline

CDFW. 2020. California 2020-2021 freshwater sport fishing regulations. Available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=177572&inline

Department of the Interior (DOI). 2007. Modified Terms and Conditions, Section 18 Prescriptions, Klamath River Hydroelectric Project – FERC No. 2082. Bureau of Land Management, Bureau of Reclamation, Fish and Wildlife Service, and National Marine Fisheries Service. Sacramento, California. Available online at: https://www.fws.gov/yreka/P2082/20060327/5%20FWS%20NMFS%20Preliminary%20Fishway%20Prescriptions.pdf

Hamilton, J.B., G.L. Curtis, S.M. Snedaker, and D.K. White 2005. Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams – A Synthesis of the Historical Evidence. Available online at: https://fisheries.org/docs/fisheries_magazine_archive/fisheries_3004.pdf

Huntington, C.W. 2006. Estimates *of Anadromous Fish Runs above the Site of Iron Gate Dam*. January 15, 2006. Available online at: http://www.klamathbasincrisis.org/settlement/documents/Huntington%282006%29-FishEstimatesUpdate.pdf

Mid Klamath Watershed Council (MKWC). 2017. Mid Klamath 2016 Winter Coho Spawner Survey. Prepared by Dennis, T., M.M. Hentz, and C. Wickman. Fisheries Program, Orleans, CA. April 2017.

Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley.

Oregon Department of Fish and Wildlife (ODFW). 2020. Draft Implementation Plan for the Reintroduction of Anadromous Fishes into the Oregon Portion of the Upper Klamath Basin.

U.S. Fish and Wildlife Service (USFWS). 2020. Fall-Run Chinook Salmon Run Characteristics and Escapement in the Mainstem Klamath River Below Iron Gate Dam, 2019. Prepared by Gough, S.A., K.I. Wilcox, T.T. Daley, and N.A. Som. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2020–64, Arcata, CA. Available online at: https://www.fws.gov/arcata/fisheries/reports/dataSeries/2019%20klamath%20spawn%20survey%20report%20final.pdf

Appendix A

Map Book

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Monitoring Plan

Figure 1. Project Monitoring Area

December 2, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. McMillen Jacobs Associates has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. McMillen Jacobs Associates assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Legend

- ☆ Reference Sites
- ● Tributaries
- Monitoring Reaches
- Historic Klamath River Aligment Within California

N

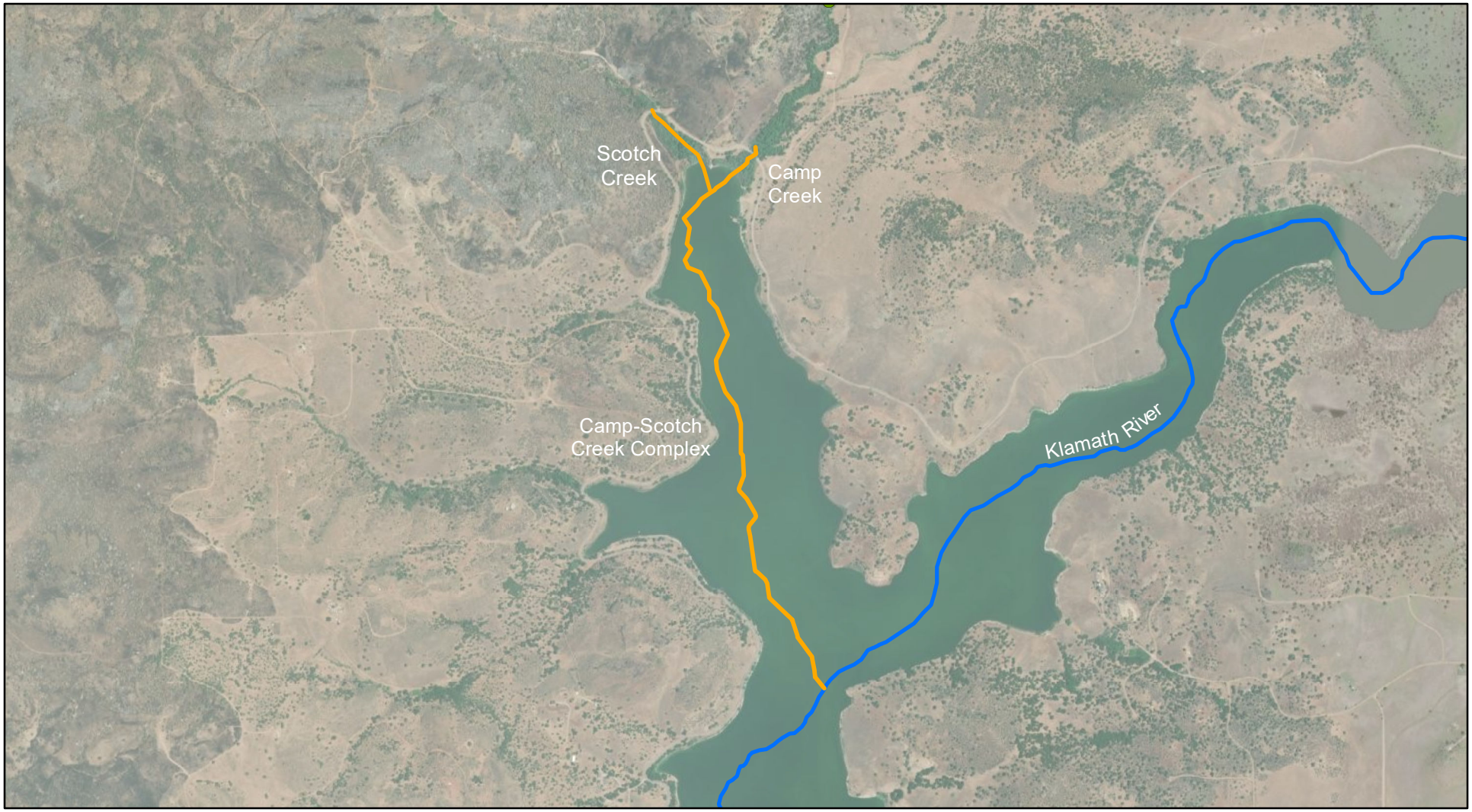
0 1.5 3 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*



KLAMATH
RIVER RENEWAL
CORPORATION

Lower Klamath Project

Fish Presence Monitoring Plan

Figure 2. Camp-Scotch Creek Complex Monitoring Reaches

December 3, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. McMillen Jacobs Associates has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. McMillen Jacobs Associates assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Legend

- Monitoring Reaches
- Historic Klamath River Aligment

N

0 0.3 0.6 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Monitoring Plan

Figure 3. Jenny Creek Monitoring Reach

December 3, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. McMillen Jacobs Associates has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. McMillen Jacobs Associates assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Legend

- Monitoring Reach
- Historic Klamath River Aligment

N

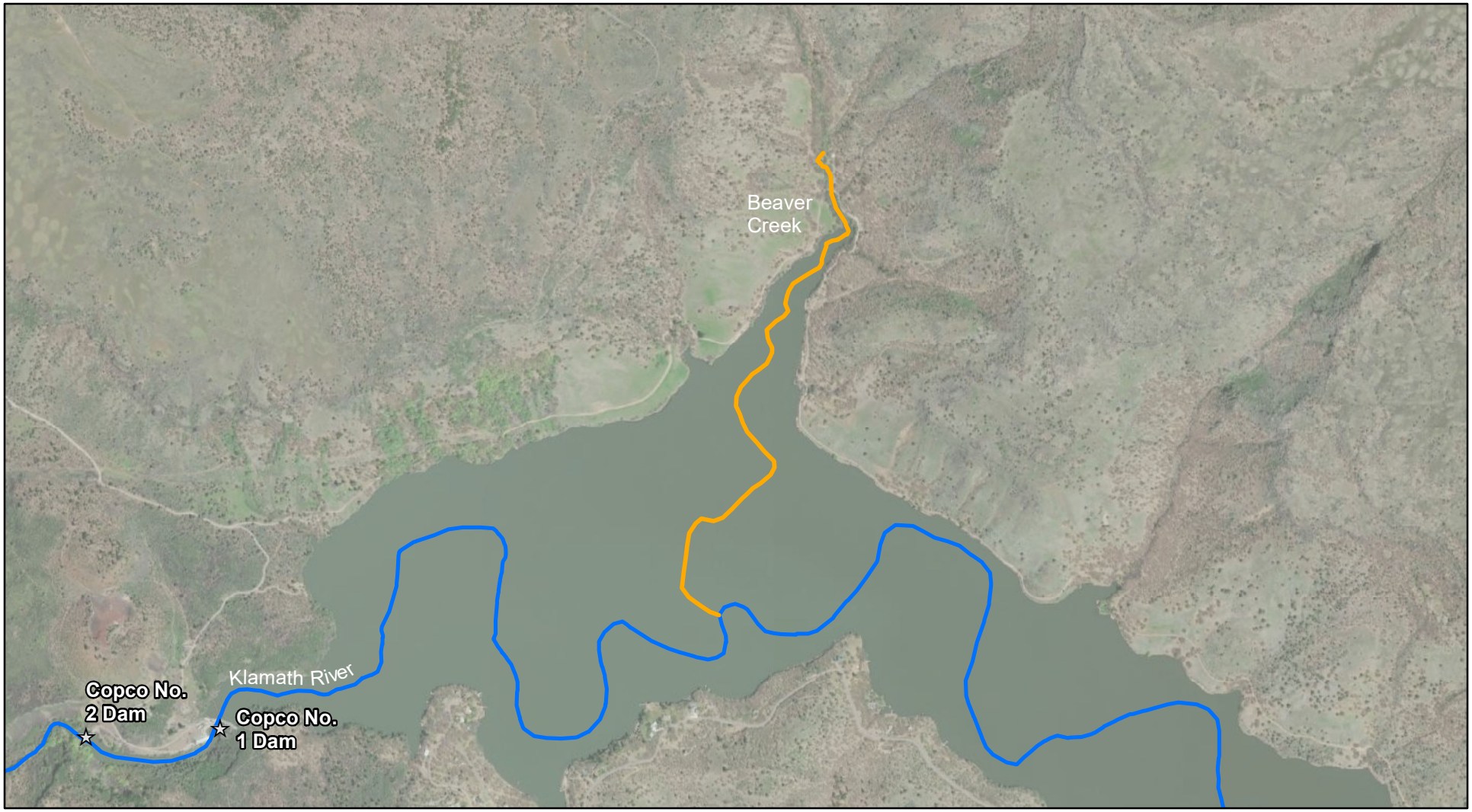
0 0.1 0.2 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*



KLAMATH
RIVER RENEWAL
CORPORATION

Lower Klamath Project

Fish Presence Monitoring Plan

Figure 4. Beaver Creek Monitoring Reach

December 3, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. McMillen Jacobs Associates has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. McMillen Jacobs Associates assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Legend

☆ Reference Sites

Monitoring Reach

Historic Klamath River Aligment

N

0 0.3 0.6 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Monitoring Plan

Figure 5. Mainstem Klamath River Monitoring Reach

December 3, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. McMillen Jacobs Associates has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. McMillen Jacobs Associates assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Legend

- ☆ Reference Sites
- ● Tributary
- Monitoring Reach
- Historic Klamath River Aligment Within California

N

0 0.65 1.3 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

Appendix B

Monitoring Data Sheets

Lower Klamath Project

Fish Presence Monitoring Plan

Survey Data Sheet

Monitoring Reach: _____

Survey Date: _____

Crew: _____

_____

Weather: _____

Water Visibility: _____

Start Time: _____

Start GPS Point Name: _____

End Time: _____

End GPS Point Name: _____

Redd Observations					
GPS Point Name	**Photo taken (Y/N)**	**Previously marked (Y/N)**	**Species**	**Fish on redd (Y/N)**	**L (in.) x W (in.)**

Notes and field observations:

Fish Presence Monitoring Plan – Survey Data Sheet Continued

Monitoring Reach: _____ Survey Date: _____

Fish Observations					
GPS Point Name	**Live fish / carcass**	**Species**	**Carcass length (in.)**	**Photo taken (Y/N)**	**Tissue/otolith taken**

Notes and field observations:

Appendix D

Tributary-Mainstem Connectivity Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Tributary-Mainstem Connectivity Plan

Klamath River Renewal Corporation
2001 Addison Street, Suite 317
Berkeley, CA 94704

Prepared by:
RES
2125 19th Street, Suite 200
Sacramento, CA 95818

Stantec Consulting Services Inc.
101 Providence Mine Road, Suite 202
Nevada City, CA 95959

December 2022

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

Appendices

1.0 Introduction

This Tributary-Mainstem Connectivity Plan is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action (Proposed Action) for the Lower Klamath Project (Lower Klamath Project).

1.1 Purpose of Tributary-Mainstem Connectivity Plan

The purpose of the Tributary-Mainstem Connectivity Plan is to describe the fish passage monitoring efforts the Renewal Corporation will undertake to identify potential fish barrier formation along the mainstem Klamath River and at identified fish-bearing tributary confluences within the Tributary-Mainstem Connectivity Plan fish passage monitoring area (as described in Section 2.2.1). In particular, the Tributary-Mainstem Connectivity Plan describes the geographic area that will be monitored by the Renewal Corporation, the period during which monitoring will occur, and the methods that will be used by the Renewal Corporation during monitoring. In addition, the Tributary-Mainstem Connectivity Plan summarizes the adaptive management framework that the Renewal Corporation will use to interpret monitoring data and take adaptive management actions.

1.2 Relationship to Other Management Plans

The Tributary-Mainstem Connectivity Plan is supported by elements of the following management plans for effective implementation: Reservoir Area Management Plan, Fish Presence Monitoring Plan, Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan, and Cultural Resources Plan, a subplan of the Historic Properties Management Plan. So as not to duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referenced in this Tributary-Mainstem Connectivity Plan.

More specifically, the Tributary-Mainstem Connectivity Plan is a subpart to the Renewal Corporation's larger fish passage monitoring effort for the Proposed Action, parts of which are also included in the Reservoir Area Management Plan. In particular, Sections 6.2.5 and 6.2.6 of the Reservoir Area Management Plan describe fish passage monitoring that the Renewal Corporation will conduct on sections of the mainstem Klamath River as well as portions of Spencer Creek, Beaver Creek, Fall Creek, Jenny Creek, and the lower Camp/Scotch Creek Complex. When combined, the fish passage monitoring and reporting procedures described in the Tributary-Mainstem Connectivity Plan and the Reservoir Area Management Plan provide a comprehensive framework for the fish passage monitoring that will be conducted in California in connection with the Proposed Action. The Renewal Corporation will conduct additional fish passage monitoring in Oregon in accordance with the conditions set forth in the Oregon Department of Fish and Wildlife's Fish Passage Permit (ODFW Fish Passage Permit). For informational purposes only, the ODFW Fish Passage Permit is included as Appendix B. When combined, the fish passage monitoring and reporting procedures described in the ODFW Fish Passage Permit and the Reservoir Area Management Plan provide a comprehensive framework for the fish passage monitoring that will be conducted in Oregon in connection with the

Proposed Action. Figure 1-1 provides a graphical depiction of fish passage monitoring coverage for the Proposed Action.

Adaptive management actions, depending on their breadth and complexity, may entail consultation by the Renewal Corporation with the Habitat Restoration Group (HRG) and/or Aquatic Resources Group (ARG). Member entities of the HRG are listed in Appendix I of the Reservoir Area Management Plan, and member entities of the ARG are listed in Section 3.0 of the Aquatic Resources Management Plan. These work groups largely include members from the same tribes and agencies, which will facilitate coordination across management plans.

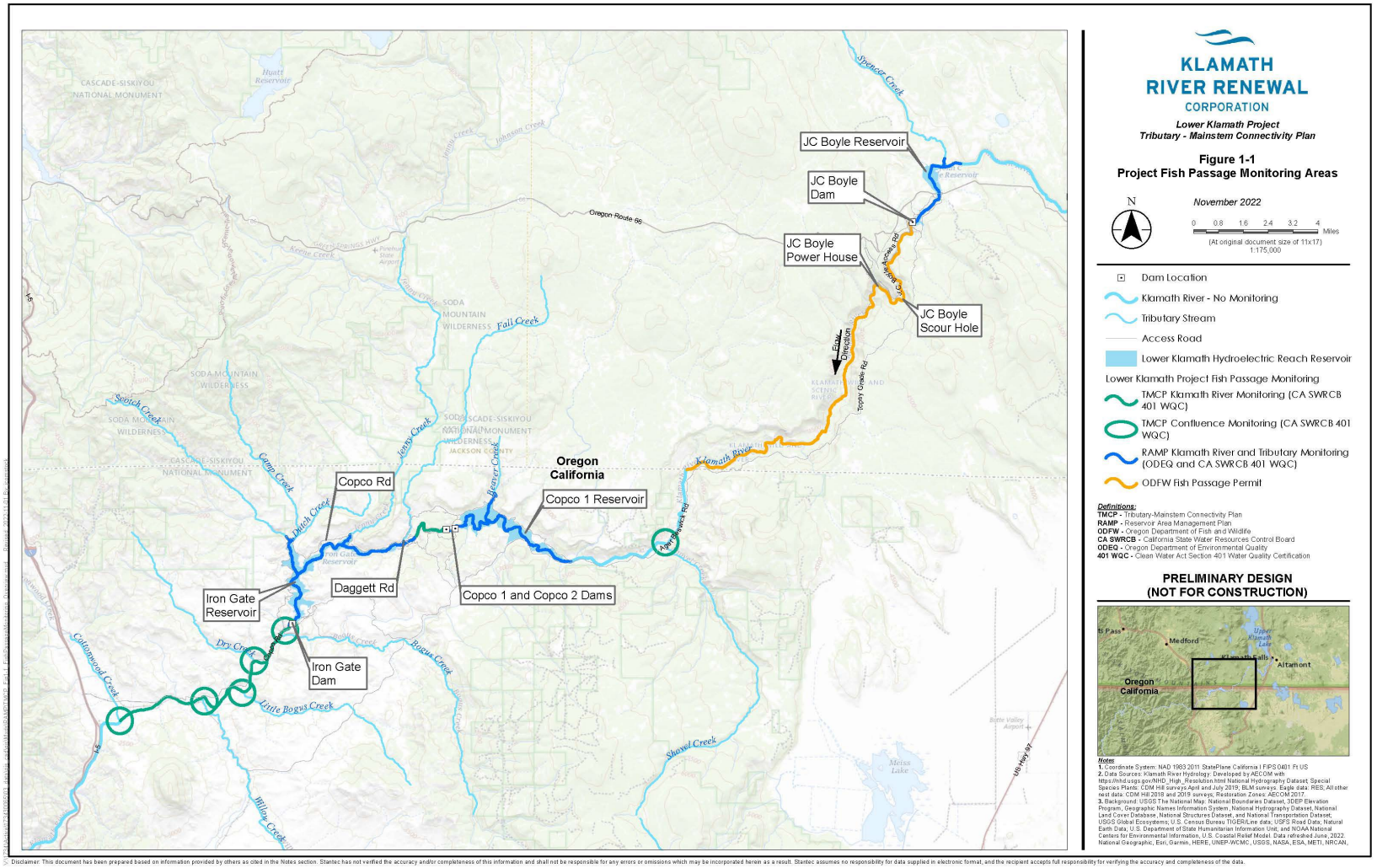


Figure 1-1. Lower Klamath Project Fish Passage Monitoring Area

2.0 Management Plan Measures

2.1 Fish Passage Monitoring Overview

The Renewal Corporation will conduct fish passage monitoring along the 8-mile reach of the mainstem Klamath River (8-Mile Mainstem Reach) from the downstream side of the Iron Gate Dam footprint (river mile (RM) 193.1) to Cottonwood Creek (RM 185.1); at the confluence locations of five tributaries within the 8-Mile Mainstem Reach (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek); at the Shovel Creek confluence with the Klamath River above the Copco No. 1 Reservoir; and within the Copco No. 2 Bypass Reach. The 5 tributaries within the 8-Mile Mainstem Reach were selected because they are recognized as influential tributaries (e.g., historical fisheries of importance or important freshwater sources) in the mid-Klamath River (Soto et al., 2008). While Shovel Creek is outside the 8-Mile Mainstem Reach (i.e., upstream of Copco No. 1 Reservoir), the Renewal Corporation selected it for connectivity monitoring due to its historical and/or potential habitat for adult salmonids (Huntington, 2006). The Tributary-Mainstem Connectivity Plan fish passage monitoring area is depicted in Figure 2-1 and presented in the Map Book in Appendix A.

The Renewal Corporation will monitor the 8-Mile Mainstem Reach for sediment deposition and potential fish barrier formation resulting from the Proposed Action. The fish passage monitoring and associated adaptive management activities in the Tributary-Mainstem Connectivity Plan focus on fish passage impediments caused by anthropogenic features, including residual reservoir sediments and anthropogenic debris. Anthropogenic debris includes human-made structures and natural debris caused by dam removal activities. Fish passage barriers may occur within the 8-Mile Mainstem Reach during reservoir drawdown and dam removal because of sediment evacuation or after dam removal when the Klamath River flows freely, allowing for active sediment transport of residual reservoir sediments. Fish passage barriers in the Tributary-Mainstem Connectivity fish passage monitoring area could potentially impact the following anadromous fish species: coho salmon (*Oncorhynchus kisutch*), spring-run and fall-run Chinook salmon (*O. tshawytscha*), steelhead (anadromous form of rainbow trout; *O. mykiss*), and Pacific lamprey (*Entosphenus tridentatus*). The Renewal Corporation predicts increased levels of sediment aggradation in the mainstem Klamath River from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1) during reservoir drawdown based on hydraulic and sediment transport modeling completed by United States Bureau of Reclamation (USBR) (USBR, 2011). Areas in the mainstem Klamath River downstream of Cottonwood Creek are expected to have only minor deposition (USBR, 2011).

The Renewal Corporation will conduct tributary confluence fish passage monitoring at the confluence locations of five tributaries within the 8-Mile Mainstem Reach (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek) to support volitional passage at each confluence site following drawdown and dam removal. For the purpose of this Tributary-Mainstem Connectivity Plan, the confluence is defined as the reach of tributary stream that extends 150 feet upstream in the tributary from the point where the downstream (in relation to the Klamath River) bank of the tributary stream transitions and becomes a bank of the Klamath River, the area of the tributary where a fish barrier resulting from the Proposed Action is most

likely to occur. Based on the Renewal Corporation's professional experience, it is highly unlikely that material amounts of residual reservoir sediment or anthropogenic debris will travel more than 150 feet upstream in any of the monitored tributaries.

The Renewal Corporation will also conduct tributary confluence fish passage monitoring at Shovel Creek (RM 209.0) to support volitional passage at the confluence site following drawdown and dam removal of the J.C. Boyle Dam. The potential for fish passage barrier formation at this site is anticipated to be relatively low because the J.C. Boyle Reservoir has less stored sediment than Copco No. 1 Reservoir or Iron Gate Reservoir and because the confluence is more than 18 miles from the dam removal site.

Finally, the Renewal Corporation will monitor the Copco No. 2 Bypass Reach for sediment deposition and potential fish barrier formation resulting from the Proposed Action. Ward's Canyon is the reach of the mainstem Klamath River in which Copco No. 1 and Copco No.2 Dams were constructed. Ward's Canyon extends from a point approximately 1,000 feet upstream of the Copco No. 1 Dam to the Copco No. 2 Powerhouse. The Copco No. 2 Bypass Reach is within Ward's Canyon and extends from Copco No. 2 Dam to the Copco No. 2 Powerhouse.

Culturally sensitive areas will be designated by the Renewal Corporation prior to drawdown to ensure that these areas are not entered with machinery. The identification of previously unknown culturally sensitive areas post-drawdown may unexpectedly constrain or delay the implementation of the Tributary-Mainstem Connectivity Plan. If required by these or other unexpected post-drawdown conditions, the Renewal Corporation will, in consultation with the HRG and ARG, develop adaptive management measures that are tailored to the site-specific conditions referenced above and permit the Renewal Corporation to conduct the monitoring required under the Tributary-Mainstem Connectivity Plan, to the extent possible.

2.2 Monitoring Area, Schedule, and Methods

The fish passage monitoring in the Tributary-Mainstem Connectivity Plan focuses on identifying and evaluating barriers and potential barriers caused by anthropogenic debris, as defined in Section 2.2.5, and sediment accretion. The following sections describe the monitoring efforts that the Renewal Corporation will take under the Tributary-Mainstem Connectivity Plan.

2.2.1 Fish Passage Monitoring Area

The Renewal Corporation will conduct the volitional fish passage monitoring described in the Tributary-Mainstem Connectivity Plan in the following 4 locations along the Klamath River:

- The 8-Mile Mainstem Reach;
- At the confluence of five tributaries (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek) in the 8-Mile Mainstem Reach;
- At the confluence of Shovel Creek (RM 209.0); and
- Within the Copco No. 2 Bypass Reach. The Copco No. 2 Bypass Reach is within Ward's Canyon and extends from Copco No. 2 Dam to the Copco No. 2 Powerhouse.

The Tributary-Mainstem Connectivity Plan fish passage monitoring area is depicted in Figure 2-1 and presented in the Map Book in Appendix A.

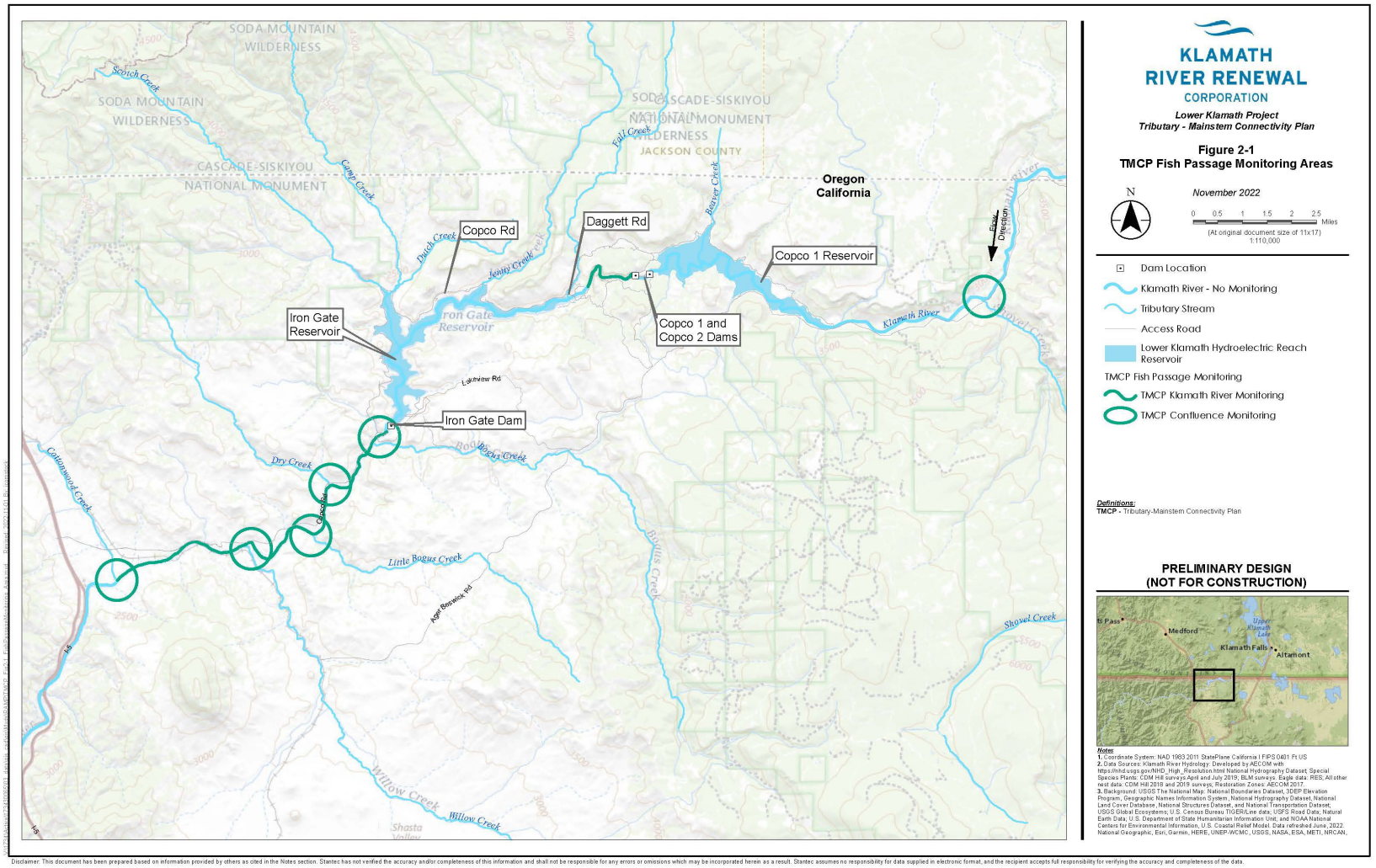


Figure 2-1. Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area

2.2.2 Fish Passage Monitoring Schedule

The schedule for Tributary-Mainstem Connectivity Plan fish passage monitoring is presented in Table 2-1. For purposes of this Tributary-Mainstem Connectivity Plan, Year 1 refers to the year before drawdown, Year 2 refers to the drawdown year, Year 3 refers to the year following the drawdown year, Year 4 refers to the following year and so on. During Year 2, the Renewal Corporation will monitor in the spring, post-final drawdown (which is anticipated to occur in late spring or early summer depending on hydrologic conditions), and in the fall. During Year 3, the Renewal Corporation will monitor in June/July after the rainy season and in the fall. The Renewal Corporation will monitor during Year 4 (the final year of the Tributary-Mainstem Connectivity Plan) in June/July after the rainy season. The Renewal Corporation will conduct additional monitoring following the first 5-year or greater flow event to occur following the completion of drawdown. The additional monitoring will occur within one month of the 5-year flow event unless it is unsafe for field crews, in which case the monitoring will occur as soon thereafter as it can safely be conducted.

As described in Section 1.2 (Relationship to Other Management Plans), the Renewal Corporation will also conduct annual fish passage monitoring in Oregon in accordance with the ODFW Fish Passage Permit and in both California and Oregon pursuant to the Reservoir Area Management Plan.

Table 2-1. Schedule for Tributary-Mainstem Connectivity Plan Fish Passage Monitoring

YEAR	SURVEY PERIOD	LOCATION
Year 2	Spring	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area
	Post Final Drawdown	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area
	Fall	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area
Year 3	After rainy season[1]	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area
	Fall	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area
Year 4	After rainy season	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area
To Be Determined	Additional monitoring event will be conducted following the first 5-year or greater flow event to occur following the completion of drawdown. [2]	Tributary-Mainstem Connectivity Plan Fish Passage Monitoring Area

Notes:
1. Monitoring during the survey period "after rainy season" is anticipated to occur between June 15 and July 31. The exact dates will be determined based on the 14-day weather forecast to avoid significant storms forecast to cause 0.25 or more inches of rain. During this period, the monthly flow on the mainstem of the Klamath River should be approximately 1,050 to 1,280 cfs, some of the lowest monthly average flow periods for the mainstem.
2. 5-year Flow Event of 10,908 cubic feet per second or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA Gage (#11516530).

2.2.3 Desktop Monitoring, Field Surveys, and Fixed Photo Points

The Renewal Corporation will undertake fish passage monitoring through a combination of the desktop and field review procedures, as described below and in Section 6.2.7 of the Reservoir Area Management Plan (Headcut Migration Monitoring). The reference to survey period in Table 2-1 refers to a scheduled desktop evaluation. If the desktop evaluation of a potential fish passage barrier is inconclusive or if a potential barrier is identified by desktop methods or field personnel, the Renewal Corporation will conduct a field investigation. If the Renewal Corporation determines that a field-based fish passage barrier evaluation is required, the Renewal Corporation will notify the HRG and ARG approximately two (2) weeks prior (or at least 48 hours in the case of an emergency) to the field investigation to allow staff the opportunity to participate in the monitoring effort. The field evaluation will be led by a fisheries biologist or geomorphologist who will assess barriers to volitional fish passage.

Where access allows, the Renewal Corporation will also establish fixed photo point monitoring locations at each of the tributary confluences within the Tributary-Mainstem Connectivity Plan fish passage monitoring area during the initial survey period to establish that confluence sites are not blocked by sediment and that the sediment present does not block fish passage. At least two fixed photo points will be established at each location with a minimum of one downstream view and one upstream view. The precise locations of the fixed photo points will be determined during the initial survey period in the spring of Year 2. If access is not granted by one or more property owners, the Renewal Corporation will determine, in consultation with the HRG and ARG, an alternative monitoring method to replace the absent fixed photo points. At least one photo will be taken from each fixed photo point during every survey period listed in Table 2-1.

2.2.4 Anthropogenic Debris

During the period from drawdown until completion of the survey after the rainy season in Year 4 (Table 2-1), the Renewal Corporation will remove human-made structures and natural debris barriers caused by dam removal activities within the Tributary-Mainstem Connectivity Plan fish passage monitoring area if such structures or barriers are visible within channel beds and present as potential fish passage barriers. For purposes of this Tributary-Mainstem Connectivity Plan, human-made structures and debris present potential fish passage barriers if they cause greater than a 12-inch discontinuity in water surface elevation.

2.2.5 Natural Barriers

The Renewal Corporation will not remove any natural barriers consisting of non-residual reservoir sediments, bedrock, or other pre-dam channel elements, such as woody debris and boulders. If a natural barrier materially and unexpectedly restricts fish passage within the Tributary-Mainstem Connectivity Plan fish passage monitoring area, the Renewal Corporation will work with the ARG and HRG to evaluate whether removal or manipulation of the natural barrier is required to permit fish passage around the barrier.

2.2.6 Headcut Migration Monitoring

Discontinuities in the channel bed due to uneven evacuation of sediments may lead to temporary headcuts that could act as barriers to fish migration. Depending on the nature of the residual sediment and subsequent flows experienced, such headcuts may be short-lived and/or unlikely to pose a sustained threat to fish passage or long-term habitat function. The Renewal Corporation's methods for identifying and evaluating residual reservoir sediment headcuts are set forth in Section 6.2.7 of the Reservoir Area Management Plan (Headcut Migration Monitoring), which is incorporated by reference into this Tributary-Mainstem Connectivity Plan.

2.2.7 Accreted Sediment Monitoring

2.2.7.1 Initial Establishment

Pre-drawdown topographic data is based on the 2018 baseline bathymetry, which is stored at www.opentopography.org. The open topography website is open to the public and will serve as the baseline data hub for topography and bathymetry. Lower Klamath Project baseline data can be downloaded at https://opentopography.org/news/klamath-river-renewal-project-data-access-through-opentopography and https://doi.org/10.5069/G9DN436N. The Renewal Corporation will continue gathering data following drawdown, run-of-the-river operation, and construction operations to inform conditions for monitoring and adaptive management.

2.2.7.2 Accreted Sediment Monitoring Methods

The Renewal Corporation will conduct monitoring of potential sediment accretion within the fish passage monitoring area through fixed photo point monitoring at each of the tributary confluences within the Tributary-Mainstem Connectivity Plan fish passage monitoring area to establish that each confluence site is not blocked by sediment and/or the sediment present does not obscure fish passage. In addition, during headcut migration monitoring (Section 2.2.6), the Renewal Corporation will review low-elevation, geolocated oblique aerial video to assess potential barriers at the tributary confluence sites. While this monitoring protocol is intended for headcut migration monitoring, it also serves to identify potential barriers resulting from accreted residual reservoir sediment to assure connectivity and passability. The presence of accreted sediment alone does not necessitate intervention. Rather, it is the formation of barriers to the fish species listed in Section 2.1 that may trigger adaptive management measures as described in the following sections.

2.3 Adaptive Management

If the monitoring described in Section 2.2 identifies fish passage barriers, the Renewal Corporation will use the adaptive management framework set forth in Section 6.2.9 of the Reservoir Area Management Plan (Adaptive Management), which is incorporated by reference into this Tributary-Mainstem Connectivity Plan. The Renewal Corporation will use this adaptive management framework to interpret monitoring data and take adaptive management actions, including the correction of tributary confluence blockages, when necessary to achieve the Tributary-Mainstem Connectivity Plan's purpose.

2.3.1 Adaptive Measures and Changing Circumstances

The Renewal Corporation will update the Tributary-Mainstem Connectivity Plan as appropriate to address unanticipated fish passage barriers if: (1) a natural disaster or other force majeure event (defined as events beyond the control of the Renewal Corporation, including without limitation wildfires, flooding, and drought) occurs, (2) sediment evacuation or other assumptions used by the Renewal Corporation are updated following dam removal, or (3) other unforeseen circumstances result in more fish passage barriers than anticipated (together, Unforeseen Circumstances). In the event Unforeseen Circumstances occur, the Tributary-Mainstem Connectivity Plan may be updated to adjust the monitoring measures the Renewal Corporation takes within the Tributary-Mainstem Connectivity Plan fish passage monitoring area during Years 2, 3 and/or 4 (and after the first 5-year or greater flow event to occur following the completion of drawdown) and/or the criteria the Renewal Corporation uses to determine if intervention is required. All updates to the Tributary-Mainstem Connectivity Plan will be submitted to the California State Water Resources Water Control Board (SWRCB) for approval and be consistent with the purpose of the Tributary-Mainstem Connectivity Plan. If an updated Tributary-Mainstem Connectivity Plan is approved by the SWRCB, the Renewal Corporation will file a report with the Federal Energy Regulatory Commission within 14 calendar days, which shall include a copy of the updated Tributary-Mainstem Connectivity Plan, a description of the Unforeseen Circumstances, and documentation of consultation with the SWRCB.

2.3.2 In-Water Work Best Management Practices for Significant Interventions

Significant adaptive management interventions involve in-water work and the need for work zone isolation measures. The Renewal Corporation will implement the relevant BMPs set forth in Appendix C (Best Management Practices) of the Reservoir Area Management Plan during significant adaptive management interventions within the Tributary-Mainstem Connectivity Plan fish passage monitoring area.

3.0 Reporting

The Renewal Corporation will prepare and submit an annual report by April 1 of Year 3 (i.e., the year following the drawdown year), Year 4, and Year 5. Each annual report will be submitted to the SWRCB and Oregon Department of Environmental Quality, and copied to the HRG and ARG. The annual report will include the following:

1. Monitoring results, including maps and graphical representations, as appropriate;
2. Obstructions (if any) observed during monitoring events, including photos of fish passage barriers that required significant interventions;
3. Minor and significant barrier interventions, including the results of each intervention;
4. Consultation records; and
5. An overall assessment of fish passage within the Tributary-Mainstem Connectivity fish passage monitoring area.

4.0 References

California State Water Resources Control Board (SWRCB). 2020. Water Quality Certification for the Klamath River Renewal Corporation Lower Klamath Project License Surrender Federal Energy Regulatory Commission Project No. 14803. April 7, 2020. Available online at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/lkp_final_wqc_7april2020.pdf

Huntington, C.W. 2006. Estimates of Anadromous Fish Runs above the Site of Iron Gate Dam. Clearwater BioStudies, Inc., Canby, Oregon.

Oregon Department of Environmental Quality (ODEQ). 2019. Clean Water Act Section 401 Certification for the Klamath River Renewal Corporation Lower Klamath Project License Surrender (FERC No. 14803), Klamath County, Oregon. September 7, 2018. Available online at: https://www.oregon.gov/deq/FilterDocs/ferc14803final.pdf

Oregon Department of Fish and Wildlife (ODFW). 2022. ODFW Fish Passage Authorization PA-14-0038 - JC Boyle Dam Removal Project Klamath River --Lower Klamath Project (FERC Project No. 14803), Klamath County, Oregon. September 30, 2022.

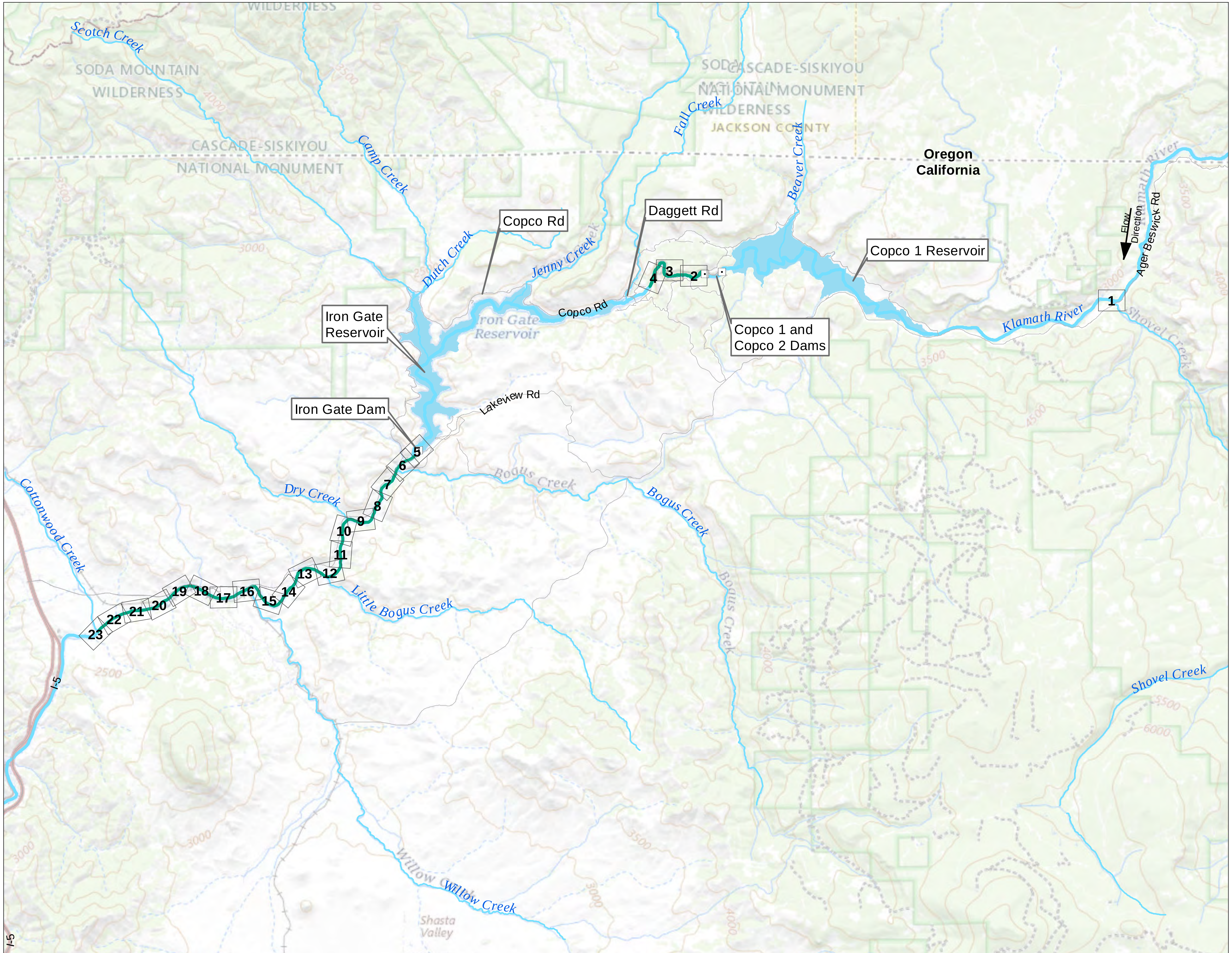
Soto, T., A. Corum, H. Voight, D. Hillemeir, and L. Lestelle. 2008. The Role of the Klamath River Mainstem Corridor in the Life History and Performance of Juvenile coho Salmon (Oncorhynchus kisutch). Phase 1 Report 2006-07 Winter. Prepared for Bureau of Reclamation Mid-Pacific Region, Klamath area Office, Klamath Falls, OR.

U.S. Bureau of Reclamation (USBR), 2011. Hydrology, Hydraulics, and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration, Denver, Colorado, USA. Ref. No. SRH-2011-02.

.

Appendix A

Map Book



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas
Monitoring Map Index

November 2022

N

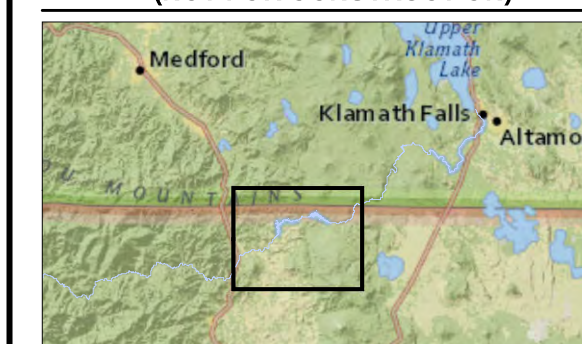
0 0.5 1 1.5 2 2.5 Miles

(At original document size of 11x17)
1:110,000

- Dam Location
- Access Road
- TMCP Monitoring Map Index
- Lower Klamath Hydroelectric Reach Reservoir
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN
(NOT FOR CONSTRUCTION)



Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022. National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN,

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

Page 1 of 23

November 2022

N

0 60 120 180 240 300 Feet

(At original document size of 11x17)
1:2,400

- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN
(NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022.
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

November 2022

N

0 60 120 180 240 300 Feet

(At original document size of 11x17)
1:2,400

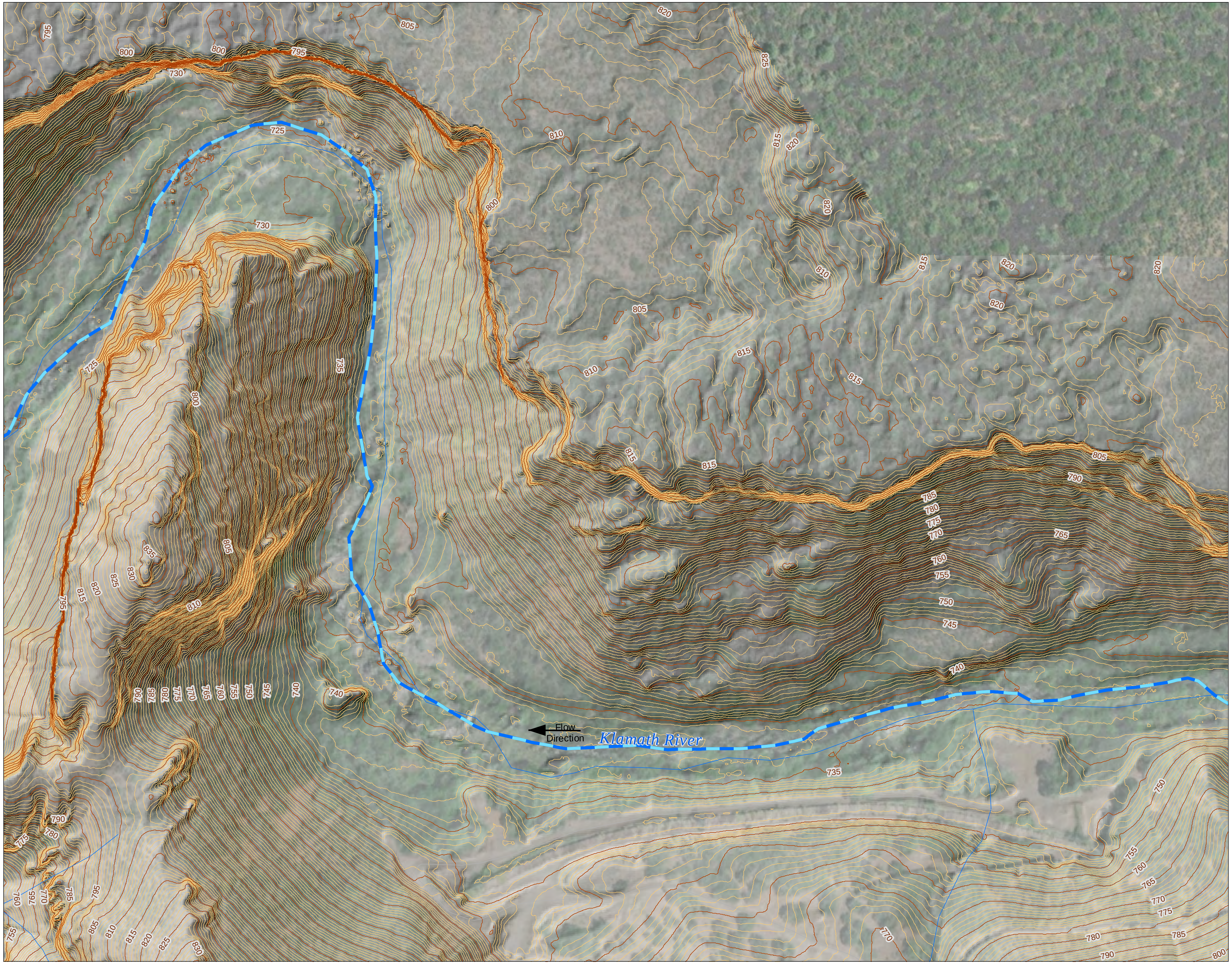
- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN
(NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

V:\1734\Active\173430065\03_data\gis_cad\gis\Mxds\RAMP\TMCP_App_A_FishPassageMonitoring_topo_series.mxd Revised: 2022-11-01 By: jcomstock



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

November 2022

N

0 60 120 180 240 300 Feet

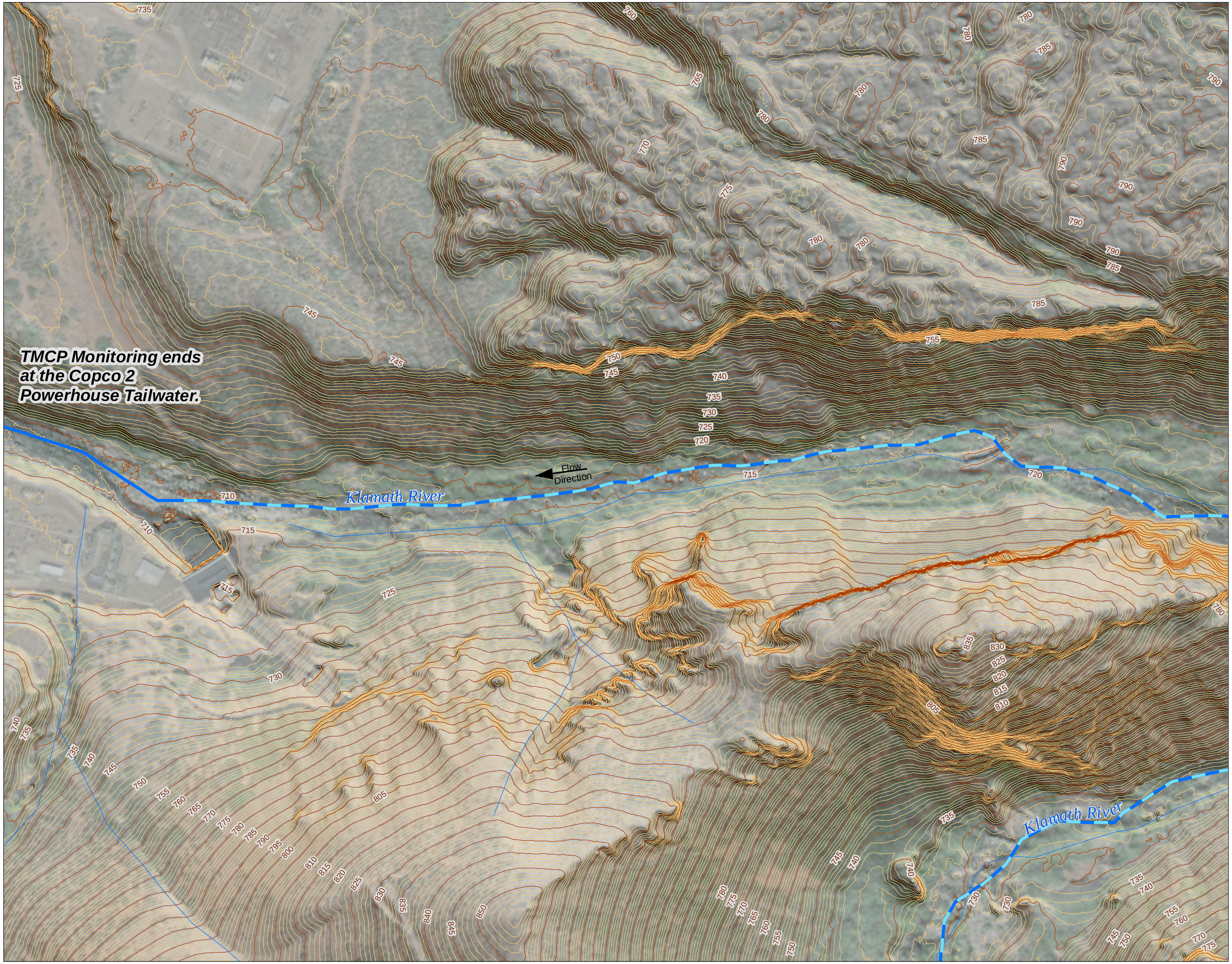
(At original document size of 11x17)
1:2,400

- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN
(NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022.
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

November 2022

N

0 60 120 180 240 300 Feet
(At original document size of 11x17)
1:2,400

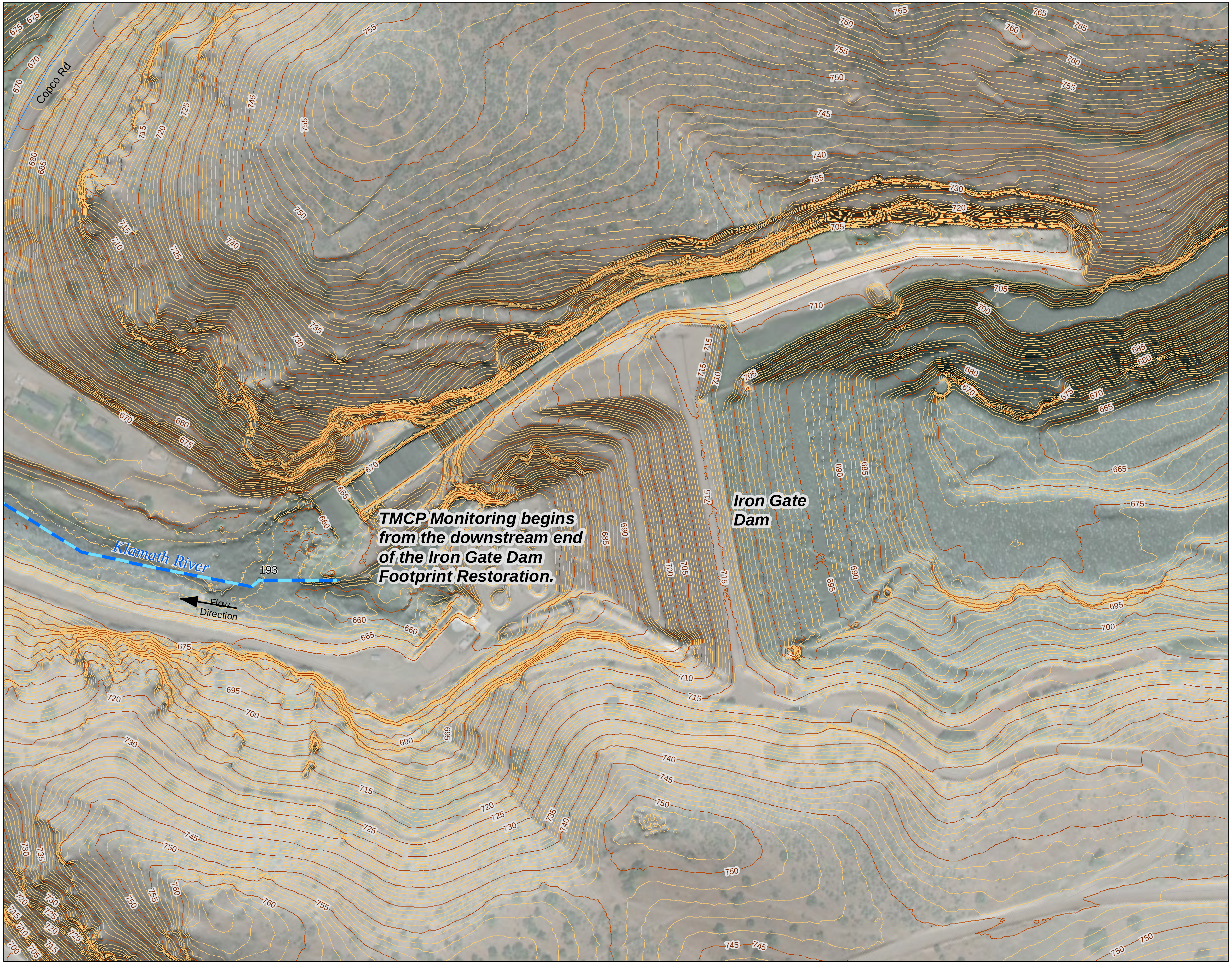
- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

V:\1734\Active\173430065\03_data\gis_cad\gis\Mxds\RAMP\TMCP_App_A_FishPassageMonitoring_topo_series.mxd Revised: 2022-11-01 By: jcomstock



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

Page 5 of 23

November 2022

N

0 60 120 180 240 300 Feet
(At original document size of 11x17)
1:2,400

- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022.
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

V:\1734\Active\173430065\03_data\gis_cad\gis\Mxds\RAMP\TMCP_App_A_FishPassageMonitoring_topo_series.mxd Revised: 2022-11-01 By: jcomstock

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

November 2022

N

0 60 120 180 240 300 Feet

(At original document size of 11x17)
1:2,400

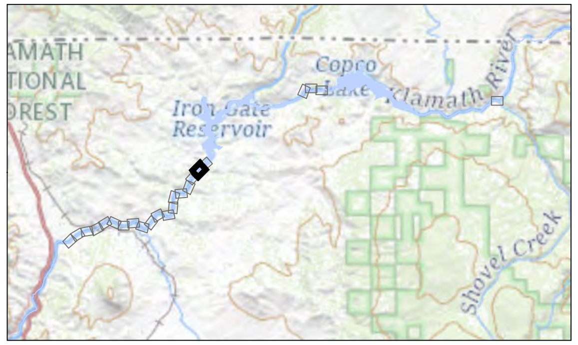
- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:

TMCP - Tributary-Mainstem Connectivity Plan

* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

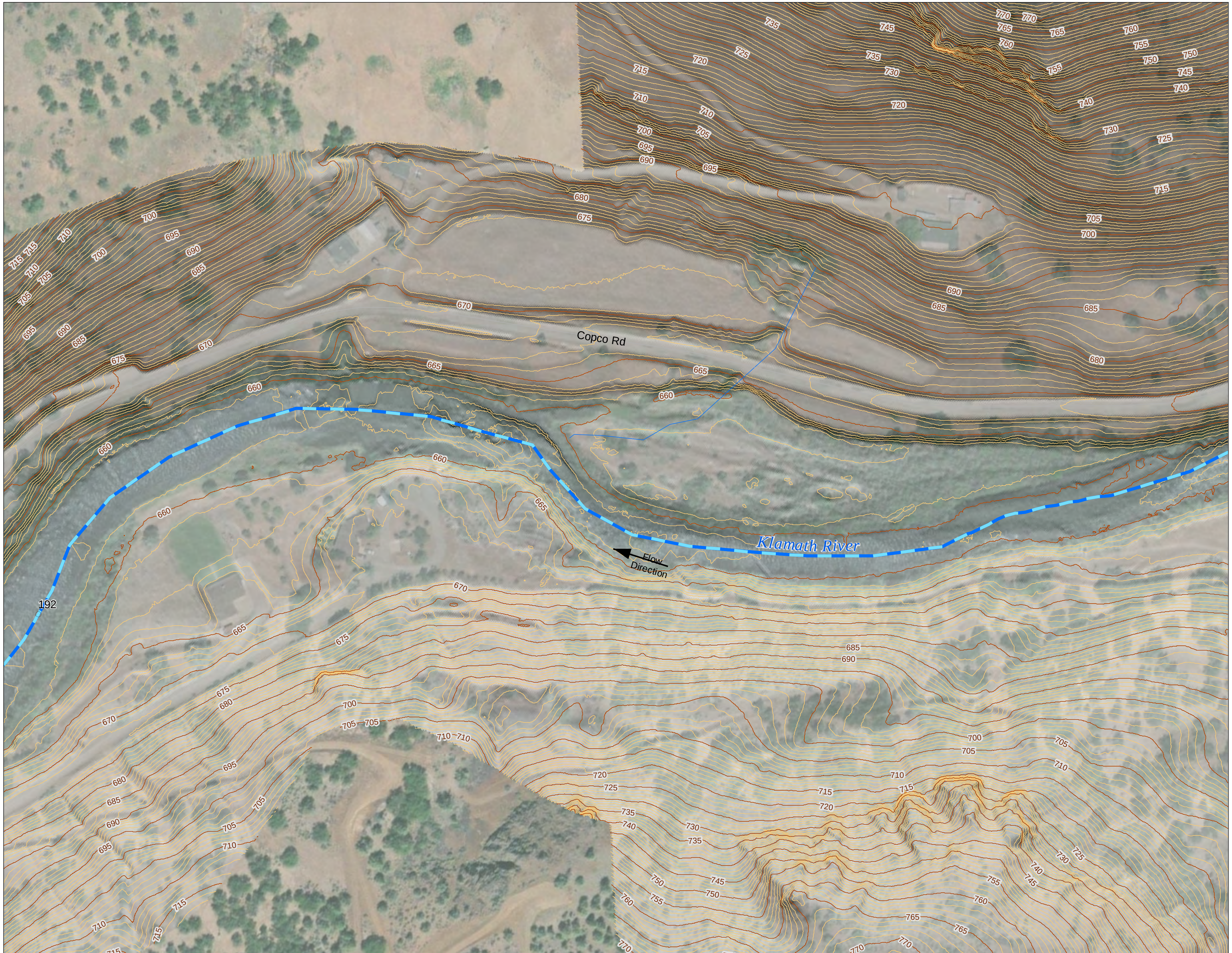


Notes

1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US

2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.

3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

November 2022

N

0 60 120 180 240 300 Feet

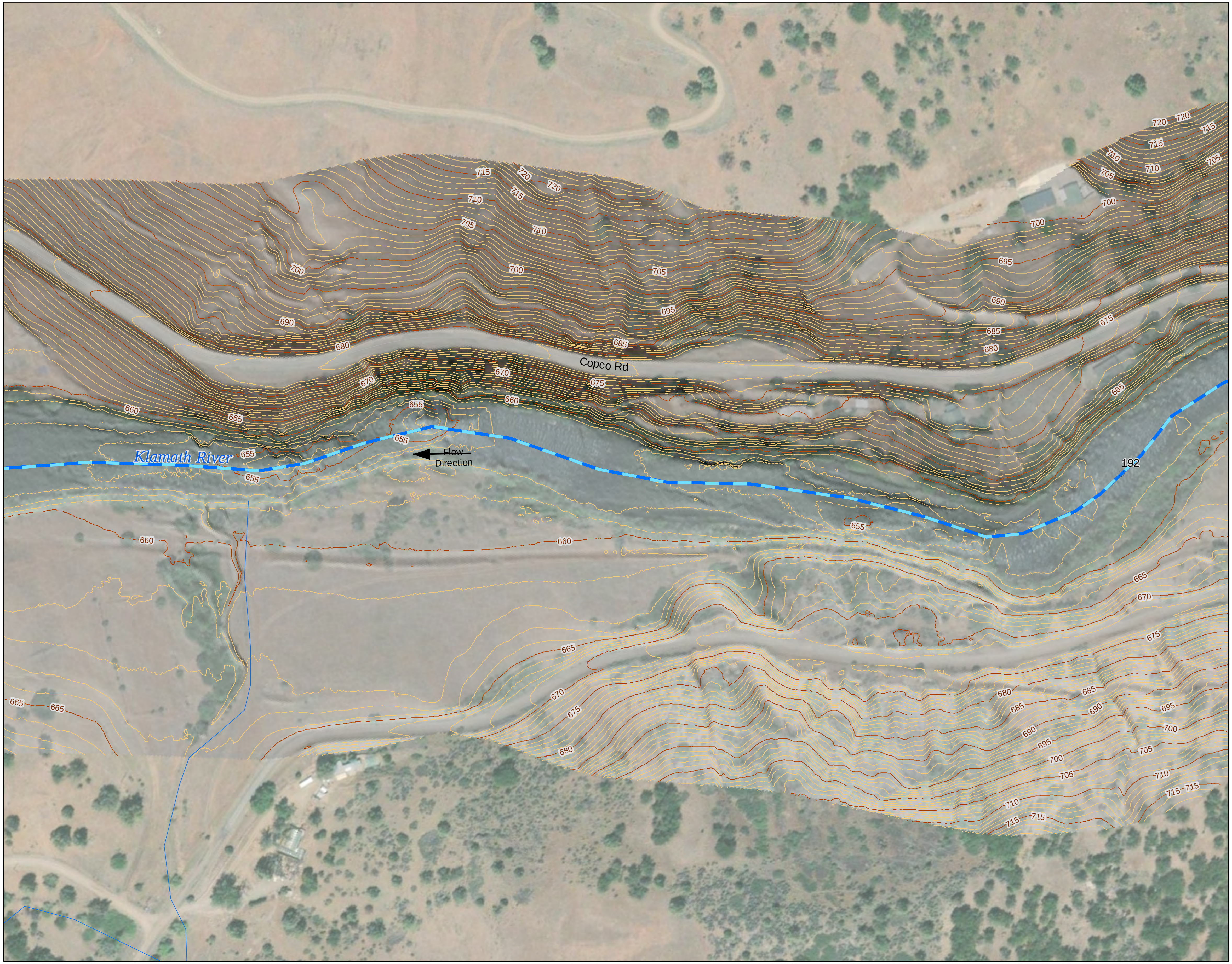
(At original document size of 11x17)
1:2,400

- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN
(NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022.
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Fish Passage Monitoring Areas

Page 8 of 23

November 2022

0 60 120 180 240 300 Feet
(At original document size of 11x17)
1:2,400

- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at*:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
  - Cottonwood Creek RM 185.1

Definitions:
TMCP - Tributary-Mainstem Connectivity Plan
* Monitoring extends 150 feet upstream in the tributary from the confluence.

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Notes
1. Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US
2. Data Sources: Klamath River Hydrology: Developed by AECOM with https://nhd.usgs.gov/NHD_High_Resolution.html National Hydrography Dataset; Special Species Plants: CDM Hill surveys April and July 2019; BLM surveys. Eagle data: RES; All other nest data: CDM Hill 2018 and 2019 surveys; Restoration Zones: AECOM 2017.
3. Background: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed June, 2022.
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community