UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS No: WCRO-2021-00619

September 28, 2021

Ramon Aberasturi
Regulatory Project Manager
California Delta Section
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the La Grange Sluice and Tailrace Channel Improvement Project

Dear Mr. Aberasturi:

Thank you for your letter of March 10, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the La Grange Sluice and Tailrace Channel Improvement Project (Project). This consultation was initiated April 22, 2021, and was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH for Pacific Coast salmon. Therefore, we have included the results of that review in Section 3 of this document.

Based on the best available scientific and commercial information, the biological opinion concludes that the proposed Project is not likely to jeopardize the continued existence of the federally listed as threatened California Central Valley steelhead distinct population segment (*Oncorhynchus mykiss*) or destroy or adversely modify its designated critical habitat. For the above species, NMFS has included an incidental take statement with reasonable and prudent measures and terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the Project.

Please contact Hilary Glenn, at our California Central Valley Office at (916) 200-8211, hilary.glenn@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for
California Central Valley Office

Enclosure

cc: ARN151422-WCR2021-SA00067

Electronic copy only:
Ramon Aberasturi, USACE, ramon.aberasturi@usace.army.mil
Leslie Parker, HDR, leslie.parker@hdrinc.com
Summer Pardo, HDR, summer.pardo@hdrinc.com
Michael I. Cooke, TID, micooke@tid.org

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

La Grange Sluice and Tailrace Channel Improvement Project

NMFS Consultation Number: 2021-00619

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS's Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
California Central Valley steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for California Central Valley Office

Date: September 28, 2021

TABLE OF CONTENTS

Abbreviations and Acronyms

AMMs	avoidance and minimization measures
BA	biological assessment
BMPs	best management practices
°C	Celsius
CCV	California Central Valley
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
dB	decibel
DPS	distinct population segment
DQA	Data Quality Act
EFH	essential fish habitat
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FR	Federal Register
HAPCs	Habitat Areas of Particular Concern
HDR	HDR, Inc. consultants
ILF	in-lieu fee
ITS	incidental take statement
MID	Modesto Irrigation District
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
opinion	biological opinion
PAHs	polycyclic aromatic hydrocarbons
PBF	physical or biological feature
PCE	primary constituent element
PFMC	Pacific Fishery Management Council
ppm	parts per million
RMS	root mean square
RPMs	reasonable and prudent measures
SED	Substitute Environmental Document
SWE	snow water equivalent
TID	Turlock Irrigation District
TMDL	total maximum daily loads
USACE	United States Army Corps of Engineers
USGS	United States Geologic Survey

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the National Oceanic and Atmospheric Administration (NOAA)'s Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the NMFS California Central Valley Office.

1.2. Consultation History

On April 22, 2019, HDR (consultant), on behalf of the United States Army Corps of Engineers (USACE), contacted NMFS fisheries biologist Monica Gutierrez to discuss the proposed action and identify potential concerns.

On April 26, 2019, HDR sent a preliminary description of the proposed action and supporting information, by email, to NMFS fisheries biologist Monica Gutierrez and NMFS fish passage engineer Jean Castillo.

On May 13, 2019, HDR discussed the proposed action with NMFS fish passage engineer Jean Castillo, by phone, to identify questions and concerns prior to preparation of the biological assessment (BA) in an effort to provide a more complete document to support consultation.

On May 21, 2019, NMFS fisheries biologist Monica Gutierrez and fish passage engineer Jean Castillo provided comments to HDR on the proposed action.

On March 10, 2021, NMFS received a request for formal consultation from the USACE, for:

- California Central Valley (CCV) steelhead (*Oncorhynchus mykiss)*, distinct population segment (DPS); listed threatened (71 FR 834, January 5, 2006) and its designated critical habitat (70 FR 52488, September 2, 2005).

On March 23, 2021, NMFS requested more information about specific aspects of the project and the effects of the resulting operations of the project from USACE, HDR, and Turlock Irrigation District (TID), by email.

On April 2, 2021, NMFS had a meeting with TID, the applicant, and HDR to discuss the La Grange Sluice and Tailrace Channel Improvement Project (Project) and answer questions. During the meeting NMFS requested additional information and HDR agreed to send NMFS the additional information requested.

On April 14, 2021, formal consultation was initiated and NMFS was cc'ed on a response to the additional information request from HDR to the USACE. This response contained a document (La Grange Sluice and Tailrace Channel Improvements Project Request for Additional Information Response (SPK-2020-00764) (HDR 2020)). On June, 30, 2021, NMFS asked HDR by email for clarification on a few aspects of the Project.

On July 23, 2021, TID and HDR confirmed via email that the total amount of permanent impacts to be offset with compensatory mitigation would be 0.05 acres and that TID proposes to mitigate for this loss by participating in the USACE's Sacramento in-lieu fee (ILF) program at a 3:1 ratio for a target of 0.15 acres of aquatic resource credit.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Under the MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910). The USACE is proposing to permit the Project submitted by TID.

The two main components of the proposed action are:

> (1) surfacing the sluice channel that currently conveys excess flows from La Grange Reservoir into the Tuolumne River and;
> (2) installing a diversion structure that would connect the upstream portion of the tailrace channel to the main channel of the Tuolumne River.

These components were chosen to meet the goal of minimizing the potential for pool isolation causing fish stranding, and to provide TID facilities with water management flexibility, and lower maintenance requirements during operations.

1.3.1. Sluice Channel Resurfacing

The sluice channel is a series of drop-offs and cascading pools formed out of bedrock below the TID Sluice Gate and Forebay/Penstock Intake Structure. The structure connects flows from the forebay sluice gates to the La Grange Powerhouse and its tailrace. The bottom of the tailrace channel is lined with riprap. TID is proposing to line the bottom 300 feet of the sluice channel with a concrete base fill (shotcrete or equivalent) to create a smooth, continuous surface. This would eliminate the possibility of pools to trap fish in a false migratory path and eliminate the need for future fish relocation in the area. The top 100 feet of the sluice channel would not

require fill because it is nearly vertical and inaccessible to fish and is not proposed to be modified (Figure 1). Shotcrete application would be preceded by a slow, step-wise dewatering and a fish relocation operation, as described below in the Water Management and Fish Rescue and Salvage sections of the BA (HDR 2020).

To prep the site, loose material such as boulders, rocks, and vegetation may need to be removed from the sluice channel. Once free of debris, bulldozers would reform the sluice channel to an even profile. To further smooth the channel deeper pockets would be filled in with sand and reinforced with wire mesh to hold the shotcrete. The thickness of shotcrete that would be applied to the sluice channel would vary, with a minimum thickness of 6 inches. In areas where the average thickness of shotcrete would exceed 6 inches, a slurry backfill would be applied as a base layer. Additional shotcrete would be applied to the side slopes to form the banks of the sluice channel. Along the banks, the shotcrete would be applied to a height of at least 2 feet above the water elevation associated with the maximum sluice gate flow of 700 cubic feet per second (cfs). At the base of the proposed shotcrete footprint, a 1-foot wide, 3-foot deep concrete footing would be constructed to prevent head cutting as flow passes over the downstream edges of the shotcrete and into the earthen tailrace channel. The shotcrete would be applied using spray nozzles attached to the hopper via hoses.

To resist uplift from water pressure below the shotcrete, the edge of the shotcrete lining would either be anchored into the existing rock using drilled and epoxied rebar or be keyed into locations of earthen backfill, should it be encountered. The proposed lined channel has been designed to pass 700 cfs, which is the maximum flow.

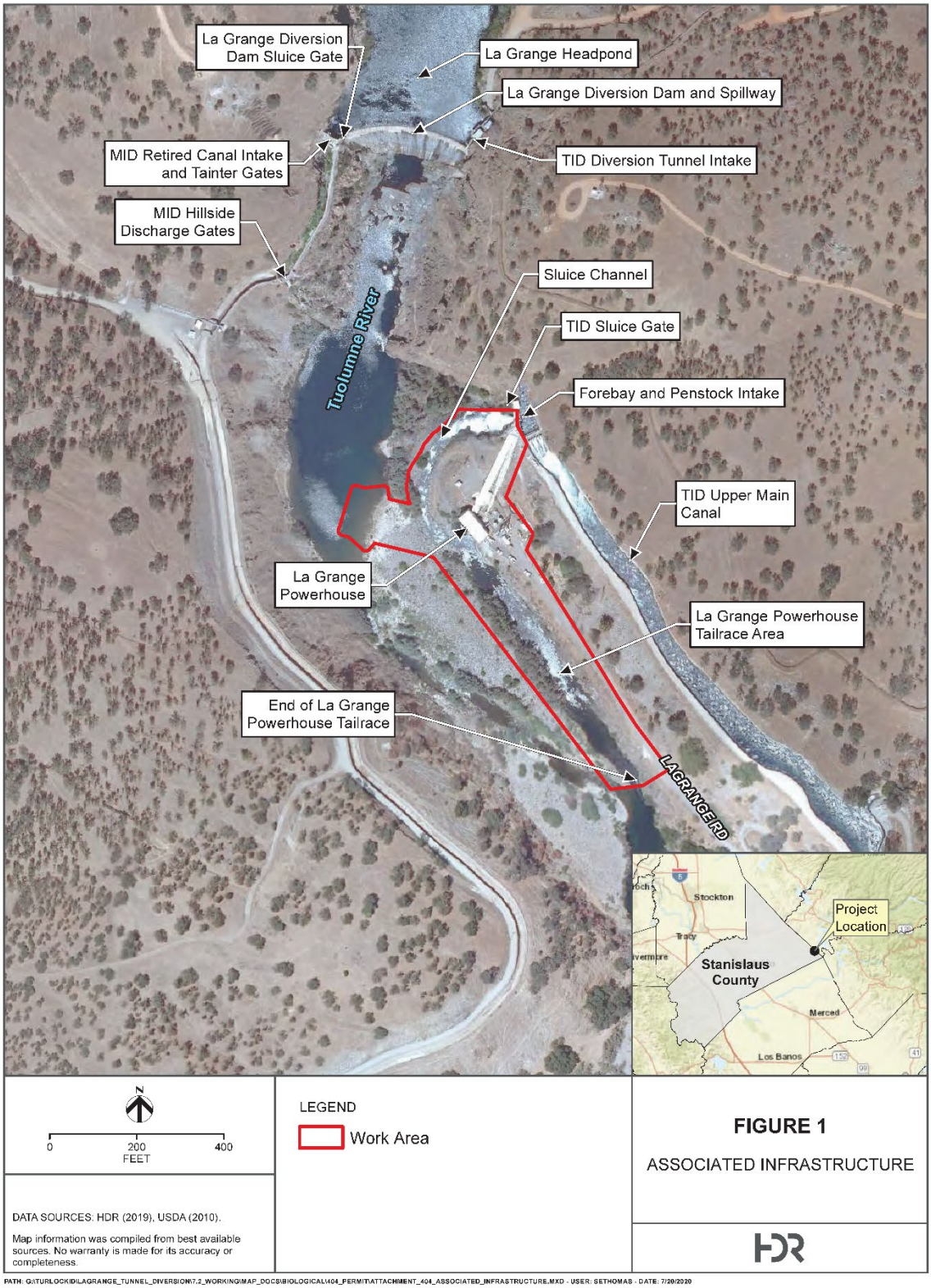

Figure 1. La Grange Diversion Dam, La Grange Reservoir, Tuolumne River, La Grange Powerhouse, and Turlock Irrigation District water management structures and associated channels (HDR 2020).

1.3.2. Installation of Diversion Structure between the Tuolumne River and Tailrace Channel

The upstream portion of the existing tailrace channel is detached from the Tuolumne River's main channel by a gravel bar, which creates a topographic highpoint of separation between the two channels (the sluice channel or through the powerhouse) until river flows exceed about 2,500 cfs. At roughly 2,500 cfs the river is inundated, the highpoint is flooded, and there is unimpeded access between the tailrace channel and the river. TID is proposing to place a gated diversion structure through the topographic highpoint between the river channel and the tailrace to convey water from the main river channel to the upper tailrace channel during tunnel dewatering and maintenance events (Figure 2).

In addition to the pipe, the diversion structure would include an inlet structure and discharge structure. The purpose of this connection would be to maintain adequate flows in the tailrace channel during times of tunnel dewatering and maintenance to sustain full connectivity with the Tuolumne River downstream, thereby minimizing the chance for fish isolation and stranding in the tailrace. To do maintenance in TID's tunnels, water needs to be completely shut off which would eliminate any flows from reaching the river through their normal path. This modification will allow TID to use Modesto Irrigation District (MID)'s Hillside discharge gates to continue to keep the river connected during maintenance (Figure 1).

The new pipe will be approximately 80 feet long, 54 inches in diameter, at a 0.7 % slope, and convey at least 50 cfs. The pipe installation would be preceded by dewatering and fish relocation in the sluice and tailrace channels. Inflatable cofferdams would be placed and filled with water at both the upstream river and downstream tailrace extents of the work area, allowing for the entire work area to be isolated from the river and dewatered. A total of 1.442 acres will be temporarily dewatered (sluice and tailrace channels), that 0.092 acres will be occupied by the upstream cofferdam, and that 0.007 acres will be occupied by the downstream cofferdam, for a total of 1.541 acres (Table 7, (HDR 2020)) in which fish relocation, cofferdam establishment, and/or dewatering will occur. Once isolated, cobble and sediment would be excavated to shape the pipe trench and to prepare the foundation for the structure. The trench dimensions would be approximately 6 feet deep by 6.5 feet wide, and 80 feet long. A 6-inch layer of sand slurry would be placed in the trench first to bed the pipe. The pipe would be placed over the bedding slurry and a final encasing slurry coat would be placed around the pipe. Native material (the cobble excavated from the mid-river bar) would be placed over the top of the slurry to bring the surface elevation back to conditions similar to the existing environment.

After the pipe is laid, the inlet and discharge structures would be moved on site using excavators. The structures would be anchored with rebar and concreted in place. A slide gate will be installed on the upstream inlet structure. The inlet structure slide gate is provided to allow flow into the tailrace when needed by TID. This gate would be closed during normal TID tunnel and powerhouse operations, but would be manually opened during times of tunnel dewatering and maintenance. The pipe ends would not be screened to avoid debris build up and impingement of fish. Fish would be allowed to travel through the pipe and into the tailrace channel when the slide gate is open or into the large pool in the Tuolumne River unimpeded, as needed.

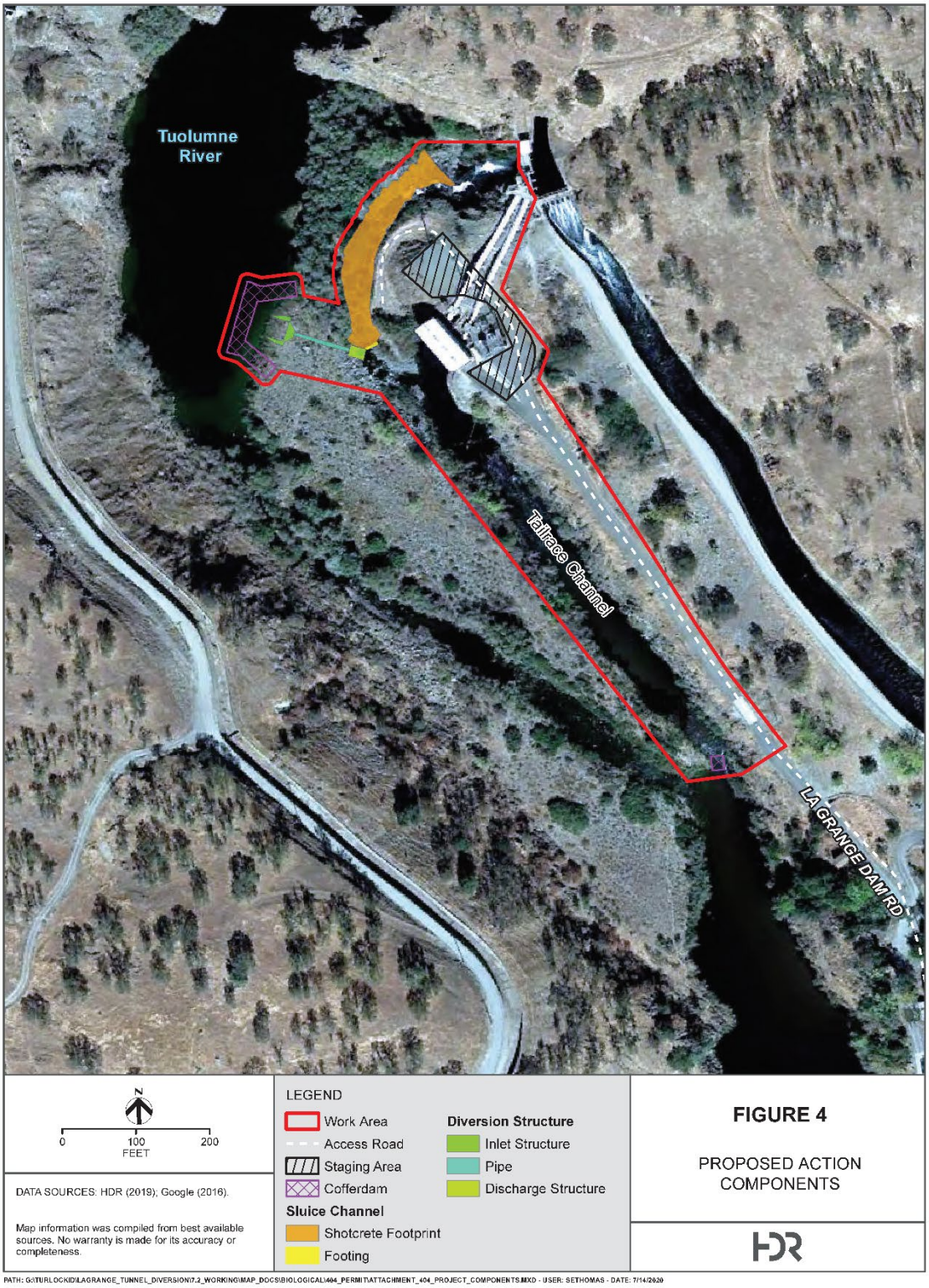

Figure 2. Components of the proposed action (HDR 2020). Permanent modifications include: the shotcrete surface (orange) and its footing (yellow), the diversion pipe (teal) and its inlet, and discharge structures (light green).

1.3.3. Fish Relocation and Salvage

Dewatering of the sluice channel, tailrace channel, and the work area within the main river channel may result in isolation and stranding of fish, including CCV steelhead. A qualified fisheries biologist would design and conduct a fish relocation and salvage effort for fish in the work areas to be isolated for construction, which would involve the capture and relocation of fish and aquatic-dependent species to suitable habitat in the Tuolumne River. In addition, a fisheries biologist would provide observation during initial dewatering activities in the temporary isolation areas to minimize the potential for isolation and stranding as water recedes. A detailed Fish Rescue and Salvage Plan (HDR 2020) would be prepared and submitted to NMFS for review at least 30 days prior to isolation of the temporary in-water work areas.

The Fish Rescue and Salvage Plan would feature three work phases: (1) clearing the general work area of fish prior to isolation, (2) clearing the isolation area of remaining fish, and (3) dewatering of the isolation area and final fish salvage. All phases of the Fish Rescue and Salvage Plan would be implemented by a fish relocation team consisting of several qualified fisheries biologists and/or technicians, each with experience in fish capture and handling.

To sample the entire water column depth, biologists would sweep the work areas in the tailrace and main river channel prior to any in-water work by stacking block nets top-to-bottom and end-on-end, as needed, to push local fishes and aquatic species outside of the work area. Fish would not be handled or removed during this process to reduce the chance of added stress. In addition, potential warm water conditions would be mitigated by nudging fish and not handling them. The goal would be to clear fish from the area before any equipment enters the isolation areas. While the exact length of the block nets may vary based on conditions (for example, depth, velocity, aquatic vegetation) and professional judgment, the following characteristics would be consistent for all potential nets employed:

- individually 6 to 8 feet deep
- 5/8-inch mesh
- floats 1 foot apart on top
- 4-ounce lead weights 1 foot apart on bottom

Exclusionary barriers used to create the temporary isolation areas may vary depending on the means of implementation. For example, if it is required to construct a work pad from which to install the cofferdam, and the material for the pad would be placed in water, then the potentially affected area would be cleared of fish species and a net and/or turbidity curtain would be used to exclude fish from the area for the duration of construction.

The second phase of the Fish Rescue and Salvage Plan would take place when the primary in-water work areas have been isolated. As noted above, isolation may be achieved using turbidity curtains and/or block nets, depending on the required implementation approach. The exclusionary barrier would be installed, leaving only a small section of the barrier open to the live channel. The in-water work areas would be isolated between mid-May and September 30, which is within the agreed upon work window. Once the work areas have largely been isolated, seines and/or block nets would be used to push fish from the isolation areas without handling.

Deployment of the seines and/or block nets (collectively nets) to move fish from the isolation areas may be conducted through a variety of approaches, including the use of a raft/boat or by walking, depending on flow conditions and depth. Typically, net deployment would begin with a raft being paddled out perpendicular to the shore. One person in the raft would navigate the vessel while a second person would hold the net. An additional person would feed the net out from the shore. The nets would be deployed at the end of the isolated area opposite the opening. The nets would be deployed such that they are in contact with the exclusionary barrier on one side and the shore on the other, and would be carefully pulled from the top of the isolated area toward the opening, with the lead weights at the base of the net moving along the bottom. During this process, the biologists would make sure that there are no twists in the net and that the bag appears open, because if the net is twisted, the lead line would not be in contact with the bottom. The movement of the net from the end of the isolation area to where the barrier is open to the live channel would push fish outside of the isolation area and into the Tuolumne River.

After the areas have been swept with the nets several times, the exclusionary barriers would be closed on the river/downstream sides and the isolation areas would be sealed. In the event that block nets and/or seines are used for initial exclusion, the cofferdams may be installed inside the existing exclusion barriers. Turbidity curtains or block nets would be removed after the cofferdam encompasses the existing barriers. Portable pumps would be used to dewater the area enclosed by the cofferdams. The dewatering pumps, equipped with NMFS approved mesh size, would be used to reduce water depths within the cofferdam to a depth of approximately 1.5 to 2 feet to allow for a final fish relocation.

The third phase of the Fish Rescue and Salvage Plan would take place after the areas have been dewatered to the desired depth, usually the day after Phase II. This phase would be conducted in the early morning hours to take advantage of the coolest temperatures, using a combination of seines and dip nets. Immediately after collection, all collected fish, including native and nonnative fish, would be placed in 5-gallon buckets and/or coolers filled with river water, identified, measured, counted, and transported to a location outside of the cofferdams for release back into the Tuolumne River. Salmonids would be processed before any other fish. In the event that water temperatures become stressful (>21° Celsius (°C)) or are elevated upon arrival (19° to 20° C), a biologist would be assigned to rapidly transport fish from the work area to the release area as they are sampled without counting or identification to expedite the relocation. The biologist(s) would remain on site during the entire process of dewatering. The relocation efforts would end when few or no fish are encountered after multiple seine pass attempts.

1.3.4. Operation and Maintenance

Operation of the diversion structure would be limited to exercising the gate operator according to manufacturer recommendations during each of these dewatering events. This is typically on an annual or semi-annual basis depending on operational needs. The gated diversion inlet structure would be installed in an area of the riverbed that is inundated under flood conditions. It is anticipated that re-grading of the areas upstream of the inlet structure and downstream of the discharge structure would be required about every 20 years to restore flow capacity following extreme flood events.

No ongoing maintenance is anticipated for the surfaced sluice channel. It is assumed the sluice channel would not require major maintenance or improvement for at least 20 years. Both the diversion structure and sluice channel would be inspected for degradation on a periodic basis. Future maintenance activities requiring ground disturbance would undergo separate ESA consultation.

1.3.5. Proposed Conservation Measures

The following avoidance and minimization measures (AMMs) are proposed to reduce effects on NMFS-protected species and their habitats during construction:

- Once a contractor has been selected, a detailed plan outlining the cofferdam installation and water management process would be developed and submitted to NMFS for review 30 days prior to in-water work.

- A qualified fisheries biologist would design and implement a Fish Rescue and Salvage Plan to collect fish and other aquatic species, as needed, from the in-water work isolation areas. This plan would be submitted to NMFS for review at least 30 days prior to initiation of in-water work activities. In addition, a fisheries biologist would provide observation during initial dewatering activities in the cofferdam(s).

- Isolation of the work area via turbidity curtain and cofferdam is expected to result in short-term increases in local suspended sediment concentrations that may affect the distribution and behavior of NMFS-regulated species. To further avoid and minimize these effects on fishes during in-water work and/or cofferdam installation, site preparation and installation of the cofferdam would occur from May 15 to September 30, when NMFS-regulated species are less likely to be in the area of construction.

- The proposed action would comply with and implement the measures identified in the Central Valley Regional Water Quality Control Board Section 401 Water Quality Certification to avoid exceedance of applicable water quality standards and would include measures surrounding dewatering, erosion control, equipment fueling, and other best management practices (BMPs). Implementation of erosion control measures and BMPs for construction activities would reduce potential effects on NMFS-regulated species and habitats resulting from sedimentation and turbidity during construction.

- Isolation of the work area and dewatering may result in fish isolation and stranding, and the death of NMFS-regulated species. A portion of the exclusionary barrier would be installed first, and fishes would be given one day to volitionally leave the isolation area. Prior to placement of the remaining exclusionary barrier and commencement of construction activities, seines, and/or block nets would be used by qualified fishery biologists to relocate any remaining fishes outside of the isolation area into the river.

- A cofferdam would be installed around the construction areas. Once installed, fish would not have access to the construction sites.

- All in-water construction activities would be confined within a cofferdam and/or work isolation areas.

- All access to the work area would occur on pre-existing paved or gravel parking lot surfaces, and no road widening or improvements are proposed.

- No off-roading or removal of roadside vegetation will occur.

- All equipment, staging, and project materials will be staged on pre-existing gravel parking lots.

- Vegetation clearing will be limited to willows between the unmaintained gravel access road and the tailrace channel. Additional trimming to overhanging vegetation along the edge of the sluice channel may occur. Vegetation clearing will be accomplished by gas-powered chainsaws and weed eaters. No trees will be removed and vegetation disturbance will be kept to a minimum.

- No grading or temporary fill placement is proposed for the high bar cobble area, though a temporary sand work pad on the bank may be utilized.

- Construction mobilization and staging is proposed to begin mid-May, and active construction is proposed to occur mid-May through September 30.

- Daily inspections and cleaning of equipment that will be entering a wetted area, to ensure no leaks of fuel, oil, grease and soil will occur.

- During active construction, TID water diversion and La Grange Powerhouse facilities will be offline as flows are re-routed to the existing MID Hillside gates for discharge into the Tuolumne River, so there will be no reduction in flows released.

1.3.6. Compensatory Mitigation

To offset the 0.05 acres of permanent adverse effects on the perennial channel of the Tuolumne River and tailrace channel that would result from construction, the applicant proposes to participate in the National Fish and Wildlife Foundation (NFWF)'s Sacramento District California ILF Program. The applicant proposes to offset the 0.05 acres of permanent adverse effect at a 3:1 ratio by purchasing 0.15 acres of aquatic resource credits in the Merced/Tuolumne Rivers service area. Permanent minor effects resulting from the installation of the diversion pipe itself are not proposed to be mitigated, because the area above the pipe would retain the natural character of the streambed. Similarly, the shotcrete application in the sluice channel is proposed specifically to minimize effects to NMFS-protected species by altering the character of the channel to minimize potential fish isolation and stranding during tunnel inspection. Since this action is anticipated to minimize adverse interactions with NMFS species in future operations to the greatest extent practicable, no additional compensatory mitigation is proposed at this time to offset this impacted area.

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not cause other consequences that would not have occurred but for the proposed action.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation of critical habitat for CCV steelhead uses the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

NMFS assumes that water flow in the Tuolumne River and water management release flows will remain the same post-project as they would have under existing conditions (HDR 2020). The proposed Project clearly delineates that all flow releases that would have otherwise been required by the 1996 Federal Energy Regulatory Commission (FERC) relicensing decision (Project No. 2299 (Turlock Irrigation District and Modesto Irrigation District 2013, Federal Energy Regulatory Commission 2019)) or agreed upon for beneficial fish and wildlife uses Substitute Environmental Document (SED) Bay Delta Plan (SWRCB 2018c) into the Tuolumne River will be released as scheduled during the construction period and into the operation stage of the proposed action, albeit from a different but nearby discharge point. If construction or future operations of the proposed action were to influence and change the amount or timing of flow releases into the Tuolumne River beyond temporarily changing the discharge point of releases to the MID Hillside Gate, this opinion would be an inadequate review of potential consequences to CCV steelhead and their critical habitat in the Tuolumne River downstream of La Grange Diversion Dam and would not confer sufficient incidental take exemptions for such outcomes.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

The descriptions of the status of species in this opinion are a synopsis of the detailed information available on NMFS's West Coast Regional website. Table 1 below identifies the Federally listed species with the potential to occur in the action area and the species' associated DPS listing. More detailed information regarding the life history and geographical distribution, as well as the

Federal Register (FR) Notices, for CCV steelhead DPS and its critical habitat listing information can be found at NOAA Fisheries West Coast Region's protected species CCV steelhead page.

Table 1. Description of species, current ESA listing classifications, and summary of species status.

Species	Listing Classification and Federal Register Notice	Status Summary
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	According to the NMFS 5-year species status review (NMFS 2016a), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of becoming endangered. Most natural-origin CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

Table 2. Description of critical habitat, Listing, and Status Summary.

Critical Habitat	Designation Date and Federal Register Notice	Description
California Central Valley steelhead	September 2, 2005; 70 FR 52488	Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the legal Delta and the San Joaquin River basin upstream to the confluence of the Merced River and major tributaries up to the first impassable dam. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. PBFs considered essential to the conservation of the species include: spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas (NMFS 2014). Although the current conditions of PBFs for CCV steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

2.2.1. Climate change

One major factor affecting the rangewide status of all the listed anadromous fishes and their aquatic habitats in the Central Valley at large is climate change. Temperatures are projected to increase steadily during the century, with a general increase from about 1.6°F in the early 21st century up to almost 4.8°F in the Sierra Nevada Mountains by the late 21st century (Reclamation 2015). Increased temperatures influence the timing and magnitude patterns of the hydrograph. Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000). These changes are partly due to more precipitation falling as rain rather than snow (Dettinger et al. 2004, Stewart et al. 2004). Runoff is expected to increase during the fall and winter months, and peak runoff may shift by more than a month earlier in some watersheds (Reclamation 2015).

The magnitude of snowpack reductions is also subject to annual variability in total precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (VanRheenen et al. 2004). Factors modeled by VanRheenen et al. (2004) show that the melt season shifts to earlier in the year,

leading to a large percent reduction of spring SWE (up to 100% in shallow snowpack areas). Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen et al., 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the Central Valley, where snowpack is shallower than in the San Joaquin River watersheds to the south.

An analysis on CCV steelhead's response to climate change is not available, however one has been conducted considering Chinook salmon environmental requirements. Projected warming is expected to affect all runs of Central Valley Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, Williams (2006) questions whether any Central Valley Chinook salmon populations can persist if Northern California atmospheric temperatures warm by 5°C (9°F), as predicted by Dettinger (2005). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951 to 1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005). Although steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts (Moyle 2002). In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F).

Steelhead in the Central Valley historically consisted of both summer-run and winter-run migratory forms. Only winter-run (ocean maturing) steelhead currently are found in CCV rivers and streams as summer-runs have been extirpated (McEwan and Jackson 1996, Moyle 2002). In recent history, the summer and fall in-stream temperatures of many waterways below rim dams regularly exceeds the optimal temperatures for growth of juvenile steelhead, which range from 57 to 66°F (14 to 19 °C). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough et al. 2001). In fact, McCullough et al. (2001) recommended an optimal incubation temperature at or below 52 to 55°F (11 to 13°C). Successful smoltification in steelhead however, may be impaired by temperatures above 54°F (12°C), as reported by (Richter and Kolmes 2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but these individual may also experience decreased survival due to the higher metabolic demands and greater presence of warm-water predators. Additionally, stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations according to current climate change projections.

Besides simply facing temperature increases, and likely decreases in the overall availability of water at suitable temperatures during sensitive life stage periods on a region wide scale, there are additional effects expected to cascade through their freshwater ecosystems with severe consequences. Increases in the frequency, duration, and/or severity of droughts and heat stress caused by climate change are linked to wide-spread increases in tree mortality beyond what would be expected even in areas that are not normally-water limited (Allen et al. 2010). Widespread increases in dead trees in forested areas, as well as increases in other factors

associated with climate change, greatly increase the risk for wildfires (Abatzoglou and Williams 2016). Wildfire activity in the Western U.S. has increased, California included, with wildfires having longer durations and increasing in size, and wildfire seasons lasting longer than they did before the mid-1980s (Westerling et al. 2006, Westerling and Bryant 2007, Westerling et al. 2011). Several watersheds critical to listed salmonids in the CCV have experienced large, intense forest fires recently, such as the Camp Fire in 2018 (ABC 7 News 2018), the Creek Fire in 2020 (National Wildfire Coordinating Group 2021a), and the Dixie Fire (ongoing as of August 2021, (National Wildfire Coordinating Group 2021b)). The increased risk of extinction elevated by wildfires had already been predicted in the NMFS Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and The DPS of CCV Steelhead (NMFS 2014 Recovery Plan, (NMFS 2014)).

In summary, observed and predicted climate change effects are generally detrimental to all anadromous species in the CV as they rely on abundant cold water to spawn and rear in freshwater habitats (McClure 2011, Wade et al. 2013). Unless offset by improvements in other factors, the statuses of these species are likely to decline over time due to the decreases in the functionality of their critical habitats to support cold-water breeding and rearing. The climate change projections referenced above cover the time period between the present and approximately 2100. While the uncertainty associated with climate change projections increases with time, the direction/trend of change is relatively certain (McClure et al. 2013) and is expected to exacerbate the extinction risk of the species covered here.

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The proposed action is located in the Tuolumne River at approximately river mile 52.2 and is one mile east of the town of La Grange in Stanislaus County, California. NMFS adopts the action agency's proposed action area, including the work area (approximately 1.5 acres), plus a 200-foot area due to sound impacts the entirety of the tailrace channel, and the Tuolumne River downstream to the run located approximately 1,000 feet downstream of the confluence of the tailrace channel and the Tuolumne River (Figure 3), due to increased turbidity. Also included is the Tuolumne River upstream of the proposed action, including the MID Hillside flow release infrastructure, due to the temporary point of discharge to the river. The downstream extent of the action area was delineated because of the expected extent of construction-related sediment and increased turbidity. The action area is estimated to be approximately 21.515 acres in total.

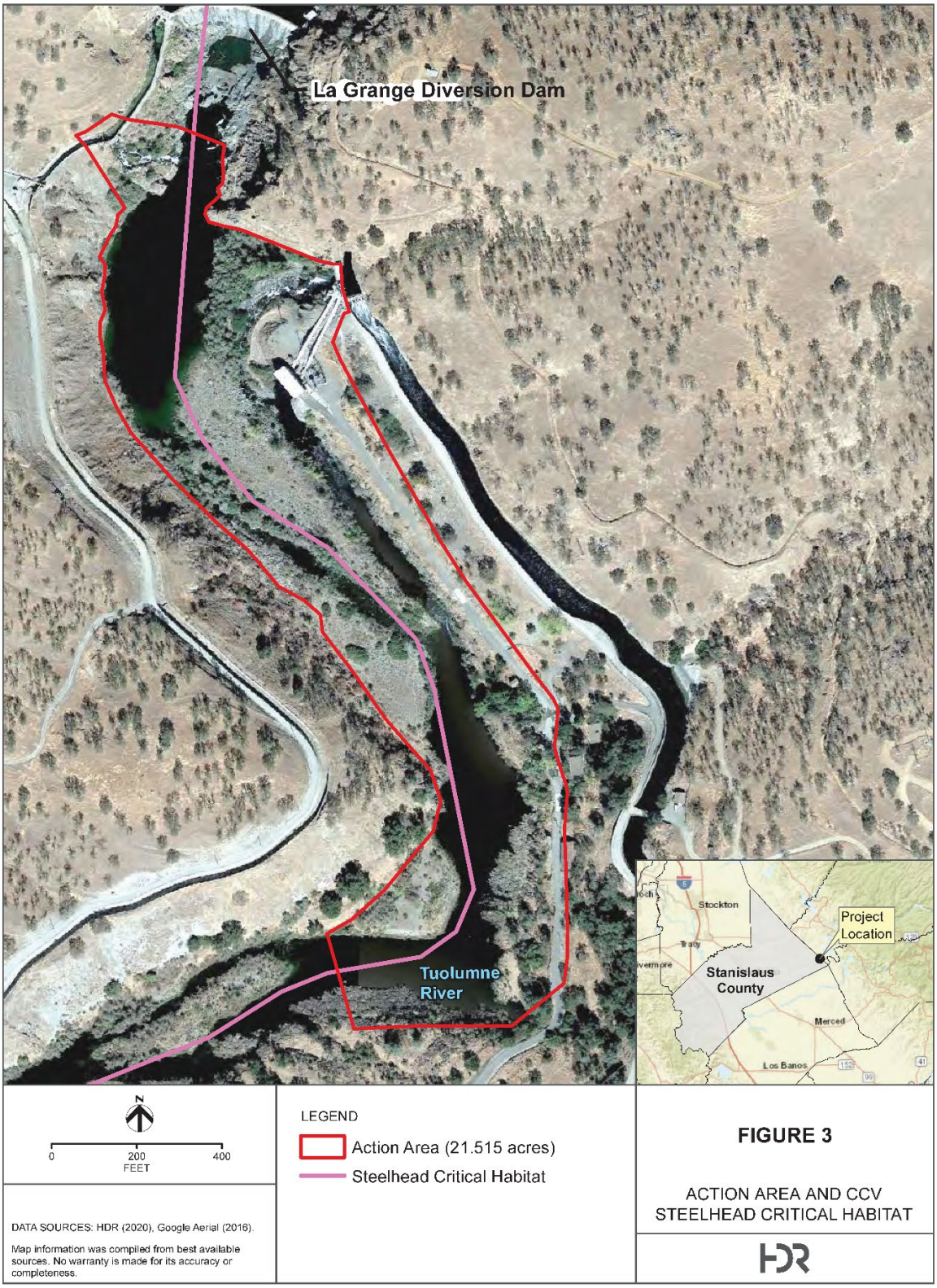

Figure 3. Action area (red boundary) of the proposed action, estimated to be approximately 21.515 acres, including the La Grange Diversion Dam, Tuolumne River, CCV steelhead designated critical habitat (pink line), and components of the proposed action (HDR 2020).

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.4.1. Occurrence of CCV steelhead

The Federally listed anadromous species that use and occupy the action area are adult and juvenile CCV steelhead. There is only sparse information currently available about CCV steelhead life history timing and patterns specific to the San Joaquin River, especially concerning their use and presence in the San Joaquin River tributaries, such as the Tuolumne River. Occurrence information on CCV steelhead in the Tuolumne River will be presented here, if available, otherwise patterns seen in the other, nearby watersheds will be presented as the best available estimate of CCV steelhead presence in the action area.

It is believed that all current stocks of CCV steelhead have a winter-run timing, meaning they may migrate up rivers in the winter starting with the first pulse of notable rain runoff (Moyle et al. 1995). The life history strategies of CCV steelhead are extremely variable between individuals, and it is important to take into account that steelhead are iteroparous (i.e., can spawn more than once in their lifetime (Busby et al. 1996, Keefer et al. 2008)) and therefore may be expected to emigrate back down the system after spawning. As such, the determination of the presence or absence of steelhead includes consideration of both upstream and downstream migrating adult steelhead (kelts) in the action area.

Adult CCV steelhead historically entered freshwater from the Pacific Ocean in August (Moyle 2002) and peak migration of adults moving upriver from the Sacramento-San Joaquin River Delta into the tributaries (including Tuolumne River) occurred August through September (Figure 5; (Hallock et al. 1957)). Adult CCV steelhead usually hold in large river mainstems, like the San Joaquin River, until flows are high enough in the tributaries to complete their upstream migration (Hallock et al. 1970). The base of the La Grange Diversion Dam is furthest upstream CCV steelhead are able to access in Tuolumne River within the action area because there is no fish passage provided over La Grange Diversion Dam. In the river habitat below the dam, a large pool provides holding habitat and also spawning habitat throughout the river reach and action area. The start of spawning activities is variable but should be expected to occur December through April with peaks from January through March (Hallock et al. 1961, McEwan 2001). After spawning, any surviving steelhead kelts try to migrate back to the ocean starting in March (based on Sacramento River patterns), and have a relatively high presence in the Delta in May (Figure 4). Therefore, kelt steelhead migrating downstream may be present in the action area from March through June, again depending on flow amounts and water temperatures. Therefore,

an adult CCV steelhead could be expected to be present in the action area September through April, if rainfall and water flow patterns were typical for the locale.

After being laid and covered in a redd, eggs may incubate for over one month before hatching and progressing through the alevin stage to emerge from the redds as actively feeding fry, though exact developmental timing depends on water temperature (Moyle 2002). Steelhead juveniles typically migrate to marine waters after spending two years rearing in fresh water. Out-migrating juveniles in the Stanislaus River, the closest monitoring location to the action area, are observed January through June, with the core of their migration occurring February through the end of May (Figure 4). Larger juveniles in the process of smoltification (parr to smolt stage) have been captured further downstream until July on the Mokelumne River (Figure 4). Therefore, juveniles could be expected at all times within the action area, due to the two-year-long freshwater rearing period and the most suitably cold water temperatures being located at the base of La Grange Diversion Dam, but peak densities in juvenile CCV steelhead would be expected January through May, in relation to expected peak fry emergence timing through the peak out-migration period (observed in other San Joaquin River basin tributaries).

2.4.2. Status of CCV steelhead population in the action area

Historic Central Valley steelhead run sizes are difficult to estimate because of the overall lack of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s the steelhead run size had declined to about 40,000 (CDFW 1996). In 1996, NMFS estimated the Central Valley total run size based on dam counts, hatchery returns, and past spawning surveys was probably fewer than 10,000 fish. Central Valley steelhead were thought to be extirpated from the San Joaquin River system, until somewhat recent monitoring detected small populations of *O. mykiss* in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams in the basin previously thought to be devoid of steelhead (McEwan 2001). Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced Rivers during fall-run Chinook salmon monitoring activities, indicating that *O. mykiss* are widespread, throughout accessible streams and rivers in the Central Valley (Good et al. 2005). With such limited data (limited due to both years without actively monitoring spawning areas for steelhead presence and years where monitoring occurs but no positive observations were made), it is nearly impossible to estimate the current status of the CCV steelhead population in the Tuolumne River or the population's potential contribution and importance to the DPS's statewide abundance and sustainability within the bounds of this opinion.

The NMFS 2014 Recovery Plan considers the CCV steelhead in the Tuolumne River below La Grange Diversion Dam as a Core 2 population that faces an uncertain risk of extinction (NMFS 2014). Watersheds designated as Core 2 populations, are of secondary importance to Core 1 populations, and meet, or have the potential to meet, the biological recovery standard for moderate risk to extinction though these watersheds have lower potential to support viable populations due to either lower abundance or the amount and quality of habitat available to them. Core 2 populations also provide increased life history diversity to the DPS and are likely to provide a buffering effect against local catastrophic occurrences that could affect nearby populations. Historically the Tuolumne River population would have occupied the upper Tuolumne but due to the La Grange Diversion and New Don Pedro dams, it has been relegated to its current range designated as its critical habitat. Within the Southern Sierra Nevada Diversity

Group, the Tuolumne River below La Grange Diversion Dam population is one of only three identified Core 2 populations, with the Calaveras River below New Hogan Dam being the only Core 1 population identified for this diversity group, downstream of large dams. Therefore, while this population is important to the abundance of the CCV steelhead DPS as a whole, it appears limited at this time, and this Core 2 population does contribute to minimizing the extinction risk in the Southern Sierra Nevada diversity group by providing some amount of productivity and also by increasing the diversification of life history and genetic material.

Table 3. The temporal occurrence of (a) adult and (b) juvenile California Central Valley steelhead at locations in the Central Valley.

(a) Adult migration

Time Period and Location	Early Jan	Late Jan	Early Feb	Late Feb	Early Mar	Late Mar	Early Apr	Late Apr	Early May	Late May	Early Jun	Late Jun	Early Jul	Early Jul	Early Aug	Late Aug	Early Sep	Late Sep	Early Oct	Late Oct	Early Nov	Late Nov	Early Dec	Late Dec
[1]Sacramento R. at Fremont Weir	L	L	L	L	L	N	N	N	N	N	N	L	L	L	L	M	H	H	H	M	L	L	L	L
[2]Sacramento R. at RBDD	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	M	H	M	L	L	L	L
[3]Mill & Deer Creeks	M	M	H	M	M	L	L	L	L	L	L	L	N	N	N	N	N	N	M	H	H	L	L	L
[4]Mill Creek at Clough Dam	L	L	M	H	M	M	L	L	N	N	N	N	N	N	N	N	N	L	M	H	H	H	M	M
[5]San Joaquin River	H	H	M	M	L	L	N	N	N	N	N	N	L	L	L	L	M	M	M	M	M	M	H	H

(b) Juvenile migration

Time Period and Location	Early Jan	Late Jan	Early Feb	Late Feb	Early Mar	Late Mar	Early Apr	Late Apr	Early May	Late May	Early Jun	Late Jun	Early Jul	Early Jul	Early Aug	Late Aug	Early Sep	Late Sep	Early Oct	Late Oct	Early Nov	Late Nov	Early Dec	Late Dec
[1,2]Sacramento R. near Fremont Weir	L	L	L	L	M	M	M	M	M	M	M	M	L	L	L	L	L	L	M	M	M	M	L	L
[6]Sacramento R. at Knights Landing	H	H	H	H	M	M	M	M	L	L	L	L	N	N	N	N	N	N	N	N	L	L	L	L
[7]Mill & Deer Creeks (silvery parr/smolts)	L	L	L	L	M	H	H	H	H	H	L	L	N	N	N	N	N	N	L	L	L	L	L	L
[7]Mill & Deer Creeks (fry/parr)	L	L	L	L	L	L	M	M	H	H	H	H	N	N	N	N	N	N	M	M	M	M	M	M
[8]Chipps Island (clipped)	M	M	H	H	M	M	L	L	L	L	N	N	N	N	N	N	N	N	N	N	N	N	L	L
[8]Chipps Island (unclipped)	M	M	M	M	H	H	H	H	H	H	M	M	L	L	N	N	N	N	N	N	N	N	L	L
[9]San Joaquin R. at Mossdale	N	N	L	L	M	M	H	H	H	H	L	L	N	N	N	N	N	N	L	L	N	N	N	N
[10]Mokelumne R. (silvery parr/smolts)	L	L	M	M	M	M	H	H	H	H	M	M	M	M	N	N	N	N	N	N	N	N	N	N
[10]Mokelumne R. (fry/parr)	N	N	L	L	L	L	L	L	M	M	H	H	M	M	N	N	N	N	N	N	N	N	N	N
[11]Stanislaus R. at Caswell	L	L	M	M	H	H	M	M	M	M	L	L	N	N	N	N	N	N	N	N	N	N	N	N
[12]Sacramento R. at Hood	L	L	H	H	H	H	H	H	H	H	H	N	N	N	N	N	N	N	N	N	L	L	L	L

Sources: [1](Hallock 1957); [2](McEwan 2001); [3](Harvey 1995); [4]CDFW unpublished data; [5]CDFG Steelhead Report Card Data 2007; [6]NMFS analysis of 1998-2011 CDFW data; [7](Johnson & Merrick 2012); [8]NMFS analysis of 1998-2011 USFWS data; [9]NMFS analysis of 2003-2011 USFWS data; [10]unpublished EBMUD RST data for 2008-2013; [11]Oakdale RST data (collected by FishBio) summarized by John Hannon (Reclamation) ; [12](Schaffter 1980).

Darker shades indicate months of greatest relative abundance.
Relative Abundance: H = High M = Medium L = Low N = Not Present

2.4.3. Status of CCV steelhead critical habitat

The PBFs for CCV steelhead critical habitat in the action area include (1) freshwater spawning sites, (2) freshwater rearing sites, and (3) freshwater migration corridors for both adults and juveniles. The freshwater spawning utility within the action area is good though considered of periodic availability as the water quantity and temperature throughout the spawning sites in the action area is dependent on managed water releases from the La Grange Diversion Dam and pool/riffle formation can be variable throughout the reach. The natal freshwater rearing habitat and migration corridor in the action area is of good quality and consistent.

TID and MID mapped substrates and conducted pebble counts in portions of the action area downstream of La Grange Diversion Dam in 2016 (HDR 2020). Within the action area, the mainstem Tuolumne River channel is dominated by pool habitat (representing 74% of the total area encompassing the main channel habitats), including a plunge pool immediately downstream of the dam, a large mid-channel extension of the plunge pool adjacent to the MID Hillside release, and two small pools in the lower portion of the channel. The overall substrate in the action area was mapped predominantly as gravel-boulder-cobble (41%), sand-bedrock-cobble (30%), and boulder-gravel-cobble (11%). Three small low-gradient riffles (which the report concluded as unsuitable spawning habitat), occur in the lower portion of the main channel, along with one glide associated with the tailout of the large pool, and a bedrock outcrop separating the large extension of the pool from the plunge pool immediately below La Grange Diversion Dam.

The sluice and tailrace channels were predominantly cobble-bedded with varying proportions of gravel- and boulder-size substrates, along with some bedrock outcrops in the sluice channel. The three pebble-count samples collected within these two features exhibited a well-graded (poorly sorted) texture, with measurable sizes varying between sand (~2 millimeter (mm)) and bedrock (>4,096 mm). Substrates in the sluice channel were the coarsest measured in the action area, being composed of cobbles, boulders, and bedrock with some coarse gravel. The tailrace channel was described as being composed of cobble with varying proportions of gravel and boulder-size substrates. A minor fraction of sand was observed in the lower-most unit of the tailrace channel. The tailrace channel includes two riffles, one of which includes substrate potentially suitable potentially CCV steelhead spawning; however, the action does not proposed to alter the substrate of the tailrace channel, only the sluice channel. The TID sluice channel is described as a high-gradient step-pool that originates at the TID canal and empties into a pool at the upstream end of the tailrace channel. Estimated average width of the sluice channel is approximately 30 feet (TID and MID 2016).

The tailrace riffle with suitable spawning habitat is located just upstream of the confluence with the Tuolumne River. The second riffle rated as containing unsuitable spawning habitat for CCV steelhead is located downstream of the powerhouse plunge pool. This riffle is characterized by highly embedded and consolidated angular rock. The tailrace channel also includes one run habitat in the lower portion of the channel. The upper portion of the tailrace channel includes a single plunge pool with turbulent flow from the powerhouse discharge, along with a glide associated with the tailout of this pool. Estimated average width of habitats in the tailrace channel is approximately 50 feet.

As previously indicated, the base of the La Grange Diversion Dam is the furthest upstream extent CCV steelhead can current access in the Tuolumne River watershed. The critical habitat within the action area also has the highest probability of maintaining suitable water temperatures in the Tuolumne River despite warm ambient air temperatures; without the dam CCV steelhead would hold and spawn far upstream of this location in cooler air and water temperatures. Optimal adult holding temperatures are reported to range between 46 to 52 °F (CDFW 1991b) while preferred water temperatures for spawning activities range cooler from 30 to 52 °F (CDFW 2000). Steelhead eggs can survive at water temperatures from 35.6 to 59 °F (Myrick and Cech 2001) but have the highest survival rates at water temperatures 44.6 to 50.0 °F. According to the California Data Exchange website, there are no stations that are currently collecting water temperature measurements in the Tuolumne River below the La Grange Diversion Dam reasonable close to the action area, but the limited past water temperature readings show that water temperatures remained suitable for CCV steelhead within the action area the over the vast majority of the available observation period. Therefore, the critical habitat within the action area is extremely valuable to the CCV steelhead population in the Tuolumne River, as it provides holding, spawning, egg incubation, and larval development habitat of the best possible quality and is also currently accessible to the population.

All young-of-the-year to less than 2-year-old juvenile steelhead require cool, clear, fast-flowing permanent streams with riffles, invertebrate prey, and escapement cover (Moyle 2002), which critical habitat in the Tuolumne River within the action area offers. The floodplain habitat further downstream, beyond the action area, also offers rearing habitat; optimal water temperatures for growth of steelhead are estimated at 59 to 64.4 °F (Moyle 2002). The TID and MID (2016) report also mapped available riparian vegetation within the action area. Fragmented patches of narrow bands of riparian vegetation were recorded as present along both the tailrace channel and the mainstem Tuolumne River downstream of the large plunge pool at the base of the La Grange Diversion Dam. In addition, riparian vegetation had established along higher-elevation gravel bars in the mainstem Tuolumne River, which are typically dry during non-spill periods at La Grange Diversion Dam. The rearing habitat offered by this section of the Tuolumne River is also considered in good quality and of value to the population but since the amount of rearing habitat is not as limited in this watershed as the available spawning habitat, the overall relative value of the rearing habitat within the action area is somewhat lesser in comparison.

2.4.4. Tuolumne River water resources and management

The action area is located in the Upper Tuolumne watershed (Hydrologic Unit Code 180400091401). The Tuolumne River derives much of its flow from snowmelt from the Sierra Nevada. The Tuolumne River is a major tributary of the San Joaquin River and runs for approximately 150 miles.

Flows in this area are regulated by the upstream New Don Pedro Dam. Using estimates of natural flow, Don Pedro Reservoir and La Grange Headpond would normally receive about 88 % of their inflow from January through July ((HDR 2020), Figure 5). However, because of upstream regulation, the pattern of inflow does not reflect a typical snow-melt driven hydrograph (highest flows begin after spring thaw and sustain into or through summer months). The altered hydrograph does provide current benefits to fish and aquatic resources in the lower Tuolumne

River, but should more closely resemble a natural hydrograph for maximum benefits to the habitat.

Flows from Don Pedro Reservoir that are not intended to be diverted at the La Grange Diversion Dam for water supply purposes pass downstream through either the powerhouse, one of four flow conduits, or pass over the La Grange Diversion Dam spillway. In normal to above-normal water years, the minimum instream river flow is 250 cfs, as measured at the La Grange United States Geologic Survey (USGS) gaging station located approximately 0.5 river miles below the La Grange Diversion Dam. In below-normal water years, the minimum instream river flow is 50 to 75 cfs.

Mean monthly flows in the lower Tuolumne River from 1970 to 2016 are shown in Figure 6. Records for this location are available from the USGS National Water Information System website for October 1970 to November 2016. The period of record shown is adapted from the La Grange Hydroelectric Project Final License Application (FERC No. 2299-082 and 14581-002, (Federal Energy Regulatory Commission 2019)). Review of aerial imagery on Google Earth (2019) showed that the in-river island separating the tailrace channel from the main channel at the western end of the survey area is periodically submerged during high flow events in the Tuolumne River. River flows not needed to support irrigation are passed through the sluice and tailrace channels into the Tuolumne River. The sluice channel typically has a flow between 5 and 10 cfs. The TID Main Canal also exit into the forebay, which diverts water from the Tuolumne River into TID's irrigation system.

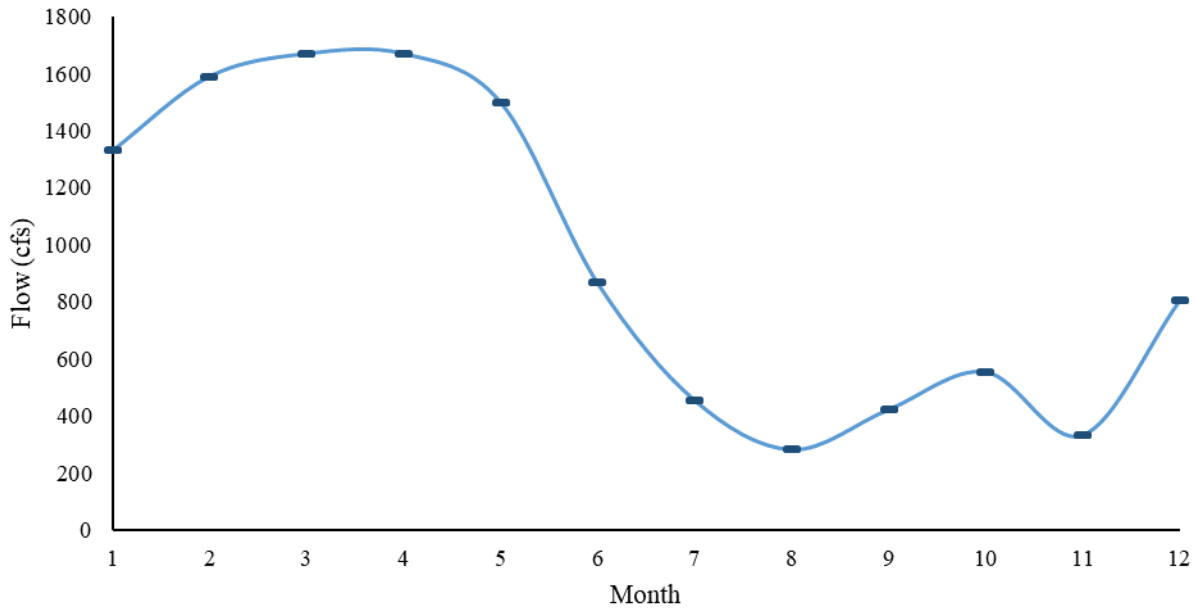

Figure 4. Mean monthly flow in the Tuolumne River below La Grange Diversion Dam 1970 through 2016, from USGS gauge 11289650 (HDR 2020).

As previously referenced, the FERC 1996 order amending the Don Pedro Project license required the incorporation of certain lower Tuolumne River instream flow provisions, as

contained in the 1995 settlement agreement between TID and MID, the City and County of San Francisco, resource agencies, and environmental groups. The revised continuous instream flows in the lower Tuolumne River range from 50 to 300 cfs, depending on water year hydrology and time of year. The FERC-required flows also specify certain pulse flows, the amount of which also varies with water-year type. The current downstream flow schedule is shown in Table 3. Outside of the flood water spill season (approximately December through June), these flows typically account for 95 % of the surface water passed downstream of the La Grange Diversion Dam. Don Pedro Reservoir releases may be routed through the powerhouse, and into the tailrace channel.

2.4.5. Water quality conditions

On October 3, 2017, the California State Water Board listed the Tuolumne River on the Clean Water Act Section 303(d) list of impaired waterbodies (SWRCB 2017b, c). USEPA approved the California 303(d) list on April 6, 2018. Don Pedro Reservoir is impaired for mercury. The Tuolumne River, from Don Pedro Reservoir to the San Joaquin River, has been identified as being impaired by chlorpyrifos, diazinon, Group A pesticides, mercury, temperature, and toxicity. Section 303(d) of the Clean Water Act requires total maximum daily loads (TMDLs) to be developed for impaired waterbodies. TMDLs are written plans that define the maximum amount of a pollutant that a waterbody can receive without exceeding water quality standards and establish load allocations for point and nonpoint sources of pollution. The 2018 Integrated Report recommended to not delist the Tuolumne River in the action area from the 303(d) list for mercury impairment (SWRCB 2017b). The line of evidence supporting this decision were many fish tissue samples of trophic level 4 fish (sport fish that prey on other fishes) caught in the Tuolumne River taken over time that often exceeded the U.S. EPA water quality criteria of 0.20 parts per million (ppm) for concentrations of methylmercury in sport fish tissue to be protective of human health (SWRCB 2018d).

Mercury is a potent neurotoxicant that is toxic to humans, wildlife, and fish. Mercury pollution negatively impacts the beneficial uses of many waters throughout the state. Fish collected from the Tuolumne River and New Don Pedro Reservoir have fish tissue mercury concentrations that exceed safety thresholds to protect fish health, as well as exceed water quality objectives for the protection of human and wildlife consumers of fish. Although mercury occurs naturally in the environment, the reservoir operations upstream exacerbate fish mercury concentrations. The proposed Statewide Mercury Control Program for Reservoirs has identified multiple mechanisms for how reservoir operations can adversely influence mercury bioaccumulation. For example, when reservoir operations decrease flow releases and therefore increase water temperatures which increase methylmercury production and support non-native warm water fish, reduce primary and secondary productivity, reduce inputs from ocean-derived nutrients, and change water chemistry (SWRCB 2017a). The probable effect concentration of elemental mercury in sediments is 1.06 ppm or milligram mercury per kilogram of sampled sediment (MacDonald et al. 2000), meaning that sediments that contain over this amount are predictive for adverse toxic effects from mercury in associated freshwater ecosystems.

Table 4. Lower Tuolumne River Flow Release Schedule (from FERC 1996 order, (Federal Energy Regulatory Commission 2019)).

Schedule	Units	# Days	Critical and Below	Median Critical[a]	Interm. CD[a]	Median Dry	Interm. Dry-BN	Median BN	Interm. BN-AN[b]	Median AN	Interm. AN-W	Median Wet/Max
Occurrence	percent	—	6.4%	8.0%	6.1%	10.8%	9.1%	10.3%	15.5%	5.1%	15.4%	13.3%
October 1–15	cfs	15	100	100	150	150	180	200	300	300	300	300
	acre-feet	—	2,975	2,975	4,463	4,463	5,355	5,950	8,926	8,926	8,926	8,926
Attraction pulse	acre-feet	—	none	none	none	none	1,676	1,736	5,950	5,950	5,950	5,950
October 16–May 31	cfs	228	150	150	150	150	180	175	300	300	300	300
	acre-feet	—	67,835	67,835	67,835	67,835	81,402	79,140	135,669	135,669	135,669	135,669
Outmigration pulse flow	acre-feet	—	11,091	20,091	32,619	37,060	35,920	60,027	89,882	89,882	89,882	89,882
June 1–September 30	cfs	122	50	50	50	75	75	75	250	250	250	250
	acre-feet	—	12,099	12,099	12,099	18,149	18,149	18,149	60,496	60,496	60,496	60,496
Volume	acre-feet	365	94,000	103,000	117,016	127,507	142,502	165,003	300,923	300,923	300,923	300,923

[a] Critically dry

[b] Between a median critical water year and an intermediate below-normal (BN) above-normal (AN) water year, the precise volume of flow to be released by the MID and TID each fish flow year is to be determined using accepted methods of interpolation between index values.

2.4.6. Conservation and restoration efforts

There are many efforts by Federal, state, nonprofit, and multi-authority agencies to restore the Tuolumne River basin back to its natural physical state and biological functionality. In the 2014 Recovery Plan, NMFS established recovery criteria for the CCV steelhead DPS, including the Core 2 population of the Tuolumne River discussed in this opinion. Recovery is the process by which listed species and their ecosystems are restored to the point that the protections provided by the ESA are no longer necessary to ensure their continued existence. Recovering anadromous species in the Central Valley is challenging due to California's large and expanding human population, the associated amount and extent of water use and manipulation, and the continuous development of natural areas for agricultural production and housing (NMFS 2014).

The foremost goal of CCV steelhead this region is to have at least two robust (Core 1) populations in the Southern Sierra Diversity Group (NMFS 2014). To achieve this goal, many recovery actions need to be completed and these actions require restoring the marine, estuarine, and freshwater systems upon which these species depend. Regarding the Tuolumne River specifically, NMFS has identified a series of actions/efforts that must be completed for the populations associated with the watershed to persist and thrive. These are identified in full in the 2014 Recovery Plan (NMFS 2014), and include:

- A passage program to get anadromous fishes above La Grange and Don Pedro dams, including a reintroduction program. This Core 2 population would be the source of individuals and/or supplemental genetic material for such a reintroduction program.

- Managing water releases from La Grange and New Don Pedro dams so that suitable water flows and water temperatures are provided for all downstream life stages of steelhead.

- Implementing studies to determine whether pulse flows in the Tuolumne River are beneficial to adult steelhead immigration or juvenile steelhead emigration, and if so, what pulse flow regime is most beneficial.

- Restoration and conservation projects that increase the availability and quality of spawning and rearing habitat in the Tuolumne River.

- Working with partners to acquire more dedicated, instream water flow in the Tuolumne River and potentially modifying current operational plans of upstream dams so that available flows can be reallocated for the benefit of salmonids.

- Implementing floodplain and side channel projects that improve river function and increase the habitat diversity in the Tuolumne River.

- Restoring the riparian habitat to promote shading and habitat diversity in the Tuolumne River.

- Updating the 2006 Water Quality Control Plan for the Bay-Delta so that flow conditions are improved for steelhead in the Tuolumne River.

- Implementing projects that minimize juvenile predation at weirs, diversion dams, and related structures in the Tuolumne River and improving instream refuge cover to minimize predatory opportunities.

- Prioritizing installing screens on lower Tuolumne River diversions based on the diversion's level of entrainment and identifying those with high benefit to cost ratios.

- Improving water quality in the basin by developing a baseline water quality program throughout the watershed to identify potential candidate pollutants for the Clean Water Act 303(d) list and completing TMDL objectives for all pollutants already 303(d) listed.

- Increasing monitoring and enforcement so that water quality criteria established in the Central Valley Water Quality Control Plan are met for all pollutants.

In 2018, the update to the Bay-Delta Plan: Amendments and Substitute Environmental Document for the Lower San Joaquin River and Southern Delta attempted to address some of these recovery actions, in particular those pertaining to habitat needs and water flow aspects (SWRCB 2018b). Also, the final Substitute Environmental Document of the Bay Delta plan recommends increasing flows released into the Tuolumne River from an estimated current of 21% to 30 to 50% of unimpaired flow, returning more flow into the river (SWRCB 2018c). During the public comment period, NMFS recommended 50 to 60% unimpaired flows be adopted to be fully protective of fish, and NMFS recommended a year-round flow schedule be used to better address fish needs, though these recommendations were not adopted (NMFS 2016b).

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

2.5.1. Consequences to individual fish

2.5.1.1. General construction activities

General construction considerations encompass work on site that is necessary to construct the proposed Project and include activities such as general site preparation; stockpiling of materials; vegetation clearing and grubbing; the operation of heavy machinery, vehicles, and tools nearby waterways; the installation of any required falsework; BMP implementation; and earthwork and excavation. In the case of the shotcrete installation for this project, construction may also entail drilling into the bedrock to install rebar, or the rebar may be epoxied onto the rock, to anchor the edge of the shotcrete lining.

Most general construction activities have the potential to introduce noise, vibration, artificial light, and other physical disturbances into the immediate environment in and around the construction zone, including the aquatic environment, that can result in the harassment of fish by disrupting or delaying their normal behaviors and use of areas, and in extreme cases causing injury or mortality. These outcomes to fish could occur immediately or later in time. The potential magnitude of effects depends on a number of factors, including type and intensity of disturbance, the proximity of disturbance-generating activities to the water body, the timing of the activities relative to the use and occurrence of the sensitive species in question, the life stages of the species affected, and the frequency and duration of disturbance periods.

Noise, Light, and Vibration

Fish may exhibit avoidance behavior near construction activities that displace them from locations they would normally occupy due to the noise and vibration generated by the operation of construction machinery or movement of soils and rocks during earthwork periods. Depending on the innate behavior that is being disrupted, the effects could vary. An example of an immediate adverse effect to individuals would be cessation or alteration of migratory behavior. For juvenile fish, this response may also include alteration of behaviors that are essential to their maturation and survival, such as feeding or sheltering.

General construction disturbance may increase fish physiological stress and increase risk of mortality. Juvenile fish vacating protective habitat due to disturbance may experience increased predation rates and decreased survival rates compared to those left undisturbed. In the action area, the Tuolumne River below La Grange Diversion Dam hosts many pools where adults may be holding, and disturbing adults from these cold water pools would force them downstream into pools with less suitable water conditions, resulting in elevated physiological stress due to increased water temperatures and decreases in dissolved oxygen levels. In extreme cases, general construction-related effects may also include debris and/or equipment falling into channels hosting fish. Such instances could cause physical injury or death if a fish was struck or crushed, or cause the fish to significantly alter their behavior and increase stress.

The applicants have proposed to adhere to specific seasonal work windows for in-water and near-water construction activities. They are as follows:

<u>Proposed work window:</u>

- Near-water mobilization and staging: begin mid-May
- Active construction, including in-water construction: mid-May through September 30

<u>Proposed daily work hours:</u>

- Monday through Friday
- 6 a.m. through 6 p.m.
- No nighttime work or nighttime overhead lighting

Additionally, the applicants propose to complete all work within one season with a target to avoid in-water work during the wet season (roughly October to May). The Project is estimated to take 9 weeks total, including the fish relocation, for a total of 45 working days.

In section 2.4.1., it was established that adult CCV steelhead may be expected to occur in the action area starting sometime in the month of September but their presence relies on rainfall or flow release patterns that support their up-migration early in the fall season. Considering kelt down-migration timing out of the action area, kelts could persist until late April through early May. Abundance numbers would be expected to be extremely low as fish surviving spawning to become kelts only make up a small proportion of spawners within a season, perhaps as much as 17% (Keefer et al. 2008, Evans et al. 2014, Schrader et al. 2014, Matala et al. 2016), and persisting in freshwater so long after spawning is not typical behavior. As such, the proposed work window does not completely avoid adult presence in the action area but the Project will occur during peak summer months when adult fish are most likely to be absent. It is anticipated that adult CCV steelhead would be exposed to the first two weeks of construction activities until the end of May and during the tail end of the work window during the month of September, if rainfall or flow releases are amenable to adult migration.

Adult CCV steelhead would not be expected to begin creating redds in the tailrace channel or downstream until December, therefore there is no anticipated exposure to egg-through-fry life stages. All offspring from redds created in the spawning season preceding construction would be expected to emerge by May, before construction is proposed to begin. And because the Project is projected to be completed within one summer season and active construction activities are not expected to overlap with egg laying or incubation periods, there is no risk to egg, larval, alevin, or fry life stages from to construction activities.

Unlike adult and egg-to-fry life stages, juvenile CCV steelhead (parr and smolt) from preceding spawning seasons would be expected to occur in the action area at any time due to their prolonged rearing time in freshwater habitat, approximately two years in duration. As this is the furthest upstream fish can reach and the locality closest to flow releases in the Tuolumne River of suitable low temperatures, there is a high probability that over summering juveniles will be nearby the construction location in the riffle or margin of pools, especially if the watershed is in a dry or critically dry water year designation. As the severity of the dry water year increases, the wetted habitat of suitably cool water temperatures will constrict closer to the base of the La Grange Diversion Dam as released flows cannot suitably cool long stretches of the Tuolumne River. In such a scenario, the outcome of disturbance from project activities driving juveniles away from suitably cold water could be extremely negative to the brood year success of that generation.

The proposed daily work hour restrictions are likely to somewhat minimize adverse construction disturbance effects on fish migration and behavior during crepuscular periods and at night. Research suggests that adult CCV steelhead show the greatest amount of upstream movement in river mainstems from early dawn until approximately 0800 hours, and show somewhat more movement nocturnally compared to mid-morning and evening hours (Keefer et al. 2012). In winter months, tagged steelhead juveniles released in an ‘upper river’ stretch during a multi-year study were observed to progress downstream somewhat more at night compared to daylight hours, with 63% of detections occurring at nighttime hours (Chapman et al. 2012). The results of

this study are somewhat informative to this situation, but only marginally because there were no observations of juveniles undergoing summer holding patterns, and because even their 'upper river' habitat was the mainstream of a much larger river and not a higher tributary like the Tuolumne River. However, it can be inferred that juvenile CCV steelhead show some degree of preference for movement at night, likely due to the decreased probability of predation. The proposed daily work schedule of 6 a.m. to 6 p.m. in summer months will overlap with morning and evening crepuscular periods in which fish are likely to show movement but leaves the majority of the nighttime period available for disturbance free movement patterns. Both juvenile fish and piscivorous fish are attracted to lit areas at night, which could result in mortality of juvenile fish (Lehman et al. 2019). The fact that there will be no night work avoids the creation of nightly predation events due to artificial lighting being used near or over the waterway.

In summary, adherence to the seasonal and daily work windows, is expected to greatly decrease the exposure of adult and juvenile CCV steelhead to effects associated with construction activities. Those exposed would be subject to harm and harassment due to general construction activities, occurring through disruption of normal fish behaviors and their use of the aquatic habitats near the construction zone. Equipment operation, construction noise and vibration during daylight hours, cobble and rock excavation, cofferdam installation, and general human presence in and near waterways is expected to elicit these responses. Given the overlap between construction of the proposed action and expected low fish presence of adult CCV steelhead in September, adult individuals are expected to avoid the action area. For juveniles, there is a moderate risk to individuals due to general construction disturbance. Individuals that would otherwise be present in the action area may be deterred from their normal occupancy patterns delaying their migration or holding timing, and may experience elevated stress levels due to active construction associated with the Project. Acute injury or mortality from construction activity is expected to be minimal because extensive fish relocation is proposed prior to all in-water work in the isolated pool or excavation areas.

Turbidity

Construction activity near or in waterways will disturb streambed materials which is likely to mobilize fine particles into the water column and cause turbidity plumes into the downstream area. Elevated turbidity is expected to have adverse effects on rearing CCV steelhead present in the action area during the proposed construction windows if not properly contained within control measures or within a cofferdam. For salmonids specifically, high sedimentation and turbidity levels have shown to decrease juvenile growth and survival as a result of reduced prey detection and availability, and individual physical injury rates increase in high turbidity due to increased activity in association with gill fouling and even peer aggression (Bash et al. 2001). In a lab study using juvenile steelhead and coho salmon, Sigler et al. (1984) found that individuals prefer to occupy water between 57 and 77 nephelometric turbidity units (NTU) when given a choice. This result suggests that juvenile salmonids may avoid waters of very low turbidities (i.e., clear waters) but also those with higher turbidities. Information presented by Gregory (1993) found that juvenile Chinook salmon decrease predator avoidance behaviors at increased turbidities; juvenile salmonids in general may avoid clear waters where they are easily visible to predators but since they experience negative physiological effects in muddy waters, they may be most successful overall in slightly cloudy waters.

Elevated turbidity would be expected to occur during cofferdam installation and dewatering, during the excavation of the mid-river cobble bar to place the diversion pipe and screens, during the replacement of cobble over the diversion pipe, during vegetation removal close the water's edge, and during preparation of the sluice channel for shotcrete (removing or excavating loose rock and bedrock). Vegetation clearing will be done manually, involving mostly cutting and trimming. Roots will be left intact to the extent possible. These tactics reduce the mobilization of soil associated with vegetation clearing. Turbidity curtains are also proposed to be used to minimize the extent of turbid waters created by these activities. Given that fish relocation will occur prior to activities anticipated to create turbidity plumes, and that turbidity curtains and cofferdams will be used to prevent turbid water from moving downstream, it is anticipated that fish will either be removed from or voluntarily vacate areas that are expected to experience the highest levels of turbidity. Though extensive fish relocations will occur before dewatering within cofferdams, a small number of juvenile CCV steelhead are expected to evade capture and would be subject to high levels of turbidity plumes. It is unlikely that construction activities will alter the natural range of in-river turbidities to a degree that would adversely affect the juvenile CCV steelhead using the action area outside of the dewatering areas, therefore effects associated with elevated turbidities are expected to be minimal.

2.5.1.2. Water quality from construction, equipment operations, staging, and storage

All activities that involve construction near, in, or over water, including work in dry or dried channels, have some potential to deliver contaminants to surface waters, likely in liquid (leaks, drips, and spills) or particulate forms (friction dust/brake dust, exhaust, and fugitive dust with legacy contamination). Contaminants originating from construction areas can also be delivered to surface waters through stormwater discharges if not properly managed onsite. Contaminants may also enter the aquatic environment through disturbance, resuspension, or discharge of contaminated soil and sediments from construction sites. Introduced or contamination originating from resuspension would be expected to be temporary in nature, persisting as long as stormwater discharges continue or as long as construction is ongoing.

The operation of construction equipment/heavy machinery is likely to deposit trace amounts of heavy metals throughout the construction area (Paul and Meyer 2001). Heavy metals, even in trace amounts, have been shown to alter juvenile salmonid behavior through disruptions of various physiological mechanisms including sensory dampening, endocrine disruption, neurological dysfunction, and metabolic disruption (Scott and Sloman 2004). Oil-based products used in combustion engines for both fuel and mechanical lubrication contain polycyclic aromatic hydrocarbons (PAHs), which have been known to bio-accumulate in other fish taxa and cause carcinogenic, mutagenic, and cytotoxic effects to fish (Johnson et al. 2002, Incardona et al. 2009, Hicken et al. 2011). Studies have shown that increased exposure of salmonids to PAHs also results in reduced immunosuppression and therefore increases their susceptibility to pathogens (Arkoosh et al. 1998, Arkoosh and Collier 2002). Resuspension of contaminated sediments may also have adverse effects on fish that encounter sediment plumes or come into contact with deposited or newly exposed sediment. Exposure to contaminated sediments, either through direct exposure (e.g., swimming through plumes of re-suspended sediment) or foraging on contaminated food sources, could harm juvenile CCV steelhead.

Though these substances can kill fish or elicit sub-lethal effects when introduced into waterways in sufficient concentrations, effects from hazardous materials from the proposed construction are expected to be minimal and only occur if a piece of equipment has some sort of failure. The proposed AMMs and BMPs require that the stockpiling of materials, staging of equipment, and most equipment operation will be conducted from existing paved surfaces above the sluice and tailrace channels, which minimizes the probability that leaked chemical contaminants will enter the Tuolumne River and instead will be contained on the paved surface. While the BMPs are in place to ensure refueling of construction equipment does not occur within 50 feet of the Tuolumne River, this small distance does not exclude the possibility that refueling could be done on the mid-channel gravel bar and still be within the confines of this BMP. Equipment that will be entering a wetted area will be inspected daily to prevent fuel, oil, grease and soil from coming in contact with water. If a leak occurs proper BMPs would be installed immediately and the equipment would be removed immediately. Erosion control BMPs will be installed prior to the initiation of construction activities and only be removed after all construction is complete. Even with these measures, it is possible that some amount of construction contamination will enter the Tuolumne River and cause sub-lethal responses in any CCV steelhead present but these effects are expected to be minimal if they happen at all.

Furthermore, the excavation of cobble from the mid-river bar carries the potential to remobilize mercury contained in sediments interspersed in the removed material. While the FERC relicensing application for Don Pedro and La Grange Hydro Electric (P-2299-082), includes mercury monitoring and minimization measures in the water quality certification (SWRCB 2021), these concerns and measures were not included in the BA for the proposed action, but are examined in this opinion. Inorganic mercury in sediments mobilized into aquatic environments is converted into organic methylmercury by microbes (Alpers et al. 2005). Methylmercury can then bioaccumulate up the food web into fish tissue. In fishes, highly toxic methylmercury can affect biochemical processes, damage cells and tissue, cause immunosuppression, and reduce reproductive capability (Fong et al. 2016). While transfer of methylmercury up the food web to eventually pose negative consequences to juvenile CCV steelhead would occur later in time and the severity would be variable depending on water temperature, water flow, and the amount of inorganic mercury ultimately mobilized by the excavation of cobble in the mid-river bar, without appropriate monitoring and containment measures in place, it is reasonably certain that these outcomes will occur. Only juvenile CCV steelhead would be expected to feed in the action area; adults usually stop feeding once they travel beyond the limits of salinity in the Delta. Therefore, in the action area, adverse effects to feeding and rearing CCV steelhead juveniles from mercury mobilization due to cobble excavation would be expected for a short time while the disturbed area finds equilibrium post construction.

2.5.1.3. Cofferdam installation, flow redirection, dewatering, and rewetting

During the work windows, cofferdams will be installed on the mid-river bar to isolate the diversion pipe entry and at the beginning and end of the tailrace channel. The cofferdams will be made using inflatable bags and sealed using sandbags. Since the flow from the TID forebay sluice gates will be halted, water in the sluice channel will be dewatered naturally due to the grade of the sluice channel and any remaining pools will then be dewatered via screened pumps, if necessary, after fish relocation proceedings take place there. The tailrace channel will also be dewatered following fish relocation, in between the cofferdams, to allow passage of equipment

over the lower cofferdam to access the mid-river cobble bar. After installation of the cofferdam around the area to be excavated for the inlet side of the diversion pipe, that area will also be dewatered so that work and excavation can occur in a dry work area.

The cofferdam placement in the upper tailrace channel will not change flow patterns in the action area much since the TID releases will have ceased. Flow releases that would have normally gone through the powerhouse before discharge into the Tuolumne River will instead be directed through the MID Hillside gates, so total river volume and flow from managed releases will not change in duration or magnitude to the proposed action. Without flow releases, the powerhouse will be out of service and not convey water into the tailrace channel for the duration of construction. The shift of flow from the powerhouse and tailrace channel should reduce the number of fish congregating at the base of the tailrace channel and instead attract them to the opposite river bank to the discharge point of the MID Hillside gates.

Though extensive fish relocations will occur before dewatering within cofferdams, a small number of juvenile CCV steelhead are expected to evade capture and would be subject to direct interactions of water pumping or dry conditions, resulting in death. The water pumped out from the cofferdams will be discharged directly into the Tuolumne River adjacent to the site. Without the use of a turbidity curtain or infiltration basin to contain the dewatered discharge, elevated turbidity can be assumed as a negative impact for fishes downstream of the discharge point. As discussed in section 2.5.1.1 above, waters measured above 80 NTUs are likely to be avoided by juvenile CCV steelhead. Higher turbidity levels would be expected to cause stress and reduced growth and survival rates. However, CCV steelhead avoidance of the location where pumped water is discharged would only persist as long as water is being discharged back to the river and will gradually dissipate as discharges cease. As fish would have adjacent habitat to move to, effects of the discharge would be minimal.

Portions of the Tuolumne River habitat within the action area will be temporarily unavailable for adult and juvenile CCV steelhead use while the cofferdams remain in place. While juvenile steelhead would be unable to rear or feed in habitat isolated due to the cofferdam placement, the relative amount of area removed from their access would be relatively negligible compared to the habitat that would still be available within the action area. Impacts to adults and juveniles CCV steelhead associated with cofferdams are temporary as the stream flow and streambed access would be restored following the completion of construction and removal of the cofferdams.

Water will be released back into to dried areas once the construction is complete and the new structures have been tested. While rewetting the area some increased turbidity is expected. It is likely that fish will avoid the newly wetted area until the kicked up sediment settles and the river reaches equilibrium. Some turbidity is also expected downstream of the rewetted area.

2.5.1.4. Fish capture, handling, and relocation associated with dewatering

Prior to any potential fish relocation or fish handling associated with cofferdam placement and dewatering activities, the applicants have proposed to prepare a detailed Fish Rescue and Salvage Plan and submit it to NMFS for review at least 30 days prior to isolating the work areas. Doing so enables coordination with NMFS, and staff may be available to respond to the activities in a timely manner to help minimize effects to fish through appropriate capture and handling

procedures. Due to the work window timing, it is expected that the number of CCV steelhead encountered will be low and will primarily be juveniles, as overlap with adults would be expected at the end of the work season but not the beginning when the fish relocation would take place.

Qualified biologists would sweep the work areas in the tailrace and main river channel prior to any in-water work by stacking block nets top-to-bottom and end-on-end, as needed, to push local fishes and aquatic species outside of the work area. Driving fish out slowly of the area to be isolated will be less harmful and less stressful than direct capture, handling, and relocation, and are preferred when possible. Then the isolation areas will be cleared using seine nets, again with the focus of pushing or driving fish away from the areas rather than capture and handling them clear the area. Several sweeps will be made to increase the probability that the majority of fish will vacate the area before dewater pumps are used. There is a very low chance that a few individual juveniles would remain within the isolation areas despite best efforts and potentially be exposed to impingement on the intake screen (with NMFS approved mesh size) of the dewatering pumps, or be stranded during dewatering. Dewatering would continue until water depths were 1.5 to 2 feet, for the final stage of the fish relocation.

In the third stage of the fish relocation, the reduced isolated pools will be fished by qualified biologists using seines and dip nets with the objective of collecting all fish remaining within the confines of the cofferdams. This stage will take place during early morning hours when air temperatures are the coolest. Captured fish will be identified, measured, and counted, and transported to a location outside of the cofferdams for release back into the Tuolumne River just downstream of the isolated areas. Salmonids will be processed first but native and nonnative fish will be placed in 5-gallon buckets or coolers together filled with river water. If water temperatures are >19°C upon arrival and commencement of fish relocation activities, personnel will be assigned to rapidly transport fish from the work area to the release area as they are sampled without counting or identification to minimize physiological stress and reduce the probability of juvenile CCV steelhead dying from these activities. Fish relocation activities would cease when fish are no longer captured after multiple seine pass attempts.

2.5.1.5. Cofferdam Installation

Juvenile CCV steelhead are expected to become entrapped during cofferdam installation. During the fish relocation and salvage process, entrapped juvenile CCV steelhead would likely experience increased stress levels, shock, and suffer mild injuries during capture and handling, even if seasoned fisheries biologists perform the fish relocation with appropriate equipment under ideal conditions. Some juveniles may be killed during capture, handling, or transport, while others may be disoriented at release, leaving them more susceptible to predation. Furthermore, handling fish is likely to inflict small wounds that may become infected. It is also possible that some juveniles will avoid the capture methods and die while hiding due to asphyxiation, extremely elevated turbidity or elevated temperatures, desiccation, or receive fatal wounds in the dewatering/fish capture process. It is expected that most individuals will volitionally vacate the isolation areas during the first phase of the fish relocation when staff attempt to drive fish out of the tailrace channel or isolate part of the Tuolumne River for cofferdam installation. Though individual juveniles will experience increased stress through these early stages, this outcome is preferable to capture and handling of juveniles to relocate

them outside of the work area. Although, this component of the proposed project is expected to minimize stress, injury, and mortality of juvenile steelhead during construction, installation of cofferdams, and dewatering, we do expect some level of impacts, injury, and mortality.

Curing new concrete/shotcrete

The pouring of new concrete and/or shotcrete may negatively affect water quality by increasing the pH of water in contact with curing surfaces, until it dissipates over time as the concrete cures. pH changes in water can affect fish to varying degrees through direct damage to gills, eyes, and skin, and interfere with fishes' ability to dispose of metabolic wastes (ammonia) through their gills (Washington Department of Fish and Wildlife 2009). In addition, alkali may leak from freshly cast concrete for some time after curing if in contact with water, up to several days to months depending on the water in the water-cement ratio of the mix (CTC & Associates 2015).

Because the installation/casting and curing of concrete/shotcrete will be done "in-the-dry," the potential that the curing concrete will adversely affect water quality and fish health is greatly reduced. New concrete is expected to mature and be practically inert within six months after casting, but since flows and contact of the new surfaces with water will commence before six months of curing is complete, the curing surfaces may cause a small amount of altered pH in water in close proximity. However, the relatively larger amount of river volume expected when the concrete is in the last stages of maturing and is in contact with increased Tuolumne River flow from the fall through the winter months, is expected to dampen any potential harmful changes in the pH of stream water from contact down to immeasurable differences due to volumetric dilution. Once the concrete is completely cured and chemically inert, potential pH changes are expected to cease. Therefore, adverse effects to CCV steelhead from chemical changes from new concrete are expected to be temporary and minimal.

2.5.1.6. Permanent Structure

By introducing a hard structure to the middle of the Tuolumne River channel, it is expected that changes in flow dynamics will degrade juvenile rearing habitat and adult spawning and holding habitat. Artificial structures also act as fish aggregation devices which make juveniles susceptible to predation and prohibit the growth of beneficial riparian habitat. The placement of the diversion structure, including its inlet/discharge structures, concrete footing, and pipe is therefore expected to have permanent adverse effects to a small proportion of the Tuolumne River population, as fish would have adjacent habitat to utilize.

2.5.2. Consequences to critical habitat

2.5.2.1. Sluice surface preparation, sand pad placement, cobble excavation, and vegetation removal

This section will analyze the consequences of these temporary alterations on the functionality of the critical habitat impacted by these activities. The preparation for installing shotcrete and the diversion pipe will require clearing of loose rock from the sluice channel, sand pad placement on the mid-river gravel bar so that heavy machinery has a stable work area, and excavation of cobble from the mid-river bar down 6 feet so that the diversion pipe can be installed. Riparian

vegetation will also be trimmed and cleared so that the machinery can cross the tailrace channel to reach the mid-river bar.

While the sluice channel runs from above to below the ordinary high water mark and bankfull river height that defines designated critical habitat boundaries of the Tuolumne River for CCV steelhead, it is a man-made feature with hydrology fully dependent on flow management from the La Grange Diversion Dam facilities. This feature would not exist but for the La Grange Diversion Dam and it was created for the purpose of protection against reductions in downstream flow that could otherwise result during unforced outages of the powerhouse, and it is one of several facilities that provide FERC-required flows into the Tuolumne River. Loose rock within the sluice channel may have eventually entered the Tuolumne River, but at the larger sizes of freshly broken bedrock, the loose rocks to be removed would not be expected to contribute to available spawning gravel this far up into the Tuolumne. At most these rocks could provide some heterogeneity on the river margin and bottom topography and potentially serve as a hiding or resting area if they had entered the active river channel. When contained in the sluice channel itself, these rocks would not normally be accessible to steelhead, as only the highest flood flows provide fish sufficient access to the sluice channel. Therefore, removing rock from the sluice channel is not expected to impact the functionality of critical habitat downstream of the sluice channel.

Creation of a sand pad on the mid-river bar is also not anticipated to adversely affect critical habitat function, even if left after construction is complete. The mid-river bar is normally exposed where the sand pad would be placed, and only during elevated flows (>2,500 cfs) would water be expected to run over the cobble bar. During such a flood flow, the movement of a relatively small amount of added sand is not expected to have measureable effects on the composition of Tuolumne River sediment in the action area. It is expected that the sand pad will have completely mobilized and dispersed downstream after one significant flood event.

From recent observations (1998 onward, available Google Earth historical imagery), the cobble bar is a semi-permanent feature that divides the Tuolumne River main channel and the tailrace channel and creates a highpoint. It also forms the edge of the large pool below the base of the La Grange Diversion Dam in which steelhead hold and use as thermal refugia. Removing cobble via excavation to place the diversion pipe may disrupt the integrity of the matrix of cobble of the bar and cause it to destabilize during high flows. This may still occur after the excavated sediment and cobble is used to backfill around the diversion pipe and inlet structures. Given the overall size of the mid-river bar, it is unlikely that the proposed excavation will cause erosion of the entire bar but it may induce an unforeseen amount of variability and cause the bar to change in shape or extent. Too much variability in this structure may lead to increased sediment deposition downstream as the bar restructures itself. This may cause some currently available spawning habitat to become unusable until the river sediment reorganizes under varying winter and spring flows. However, in-river habitat by its nature is dynamic, and even desirable in the long-term to ensure heterogeneity in gravel sizes and composition is maintained. Therefore, excavation of cobble from the mid-river bar is expected to have temporary adverse effects to the functionality of spawning habitat PFBs, but these effects will not persist beyond a few rainy seasons following Project completion and because rivers are naturally dynamic these effects are expected to be minimal.

Decreases in riparian vegetation are normally expected to cumulatively decrease the survivorship of juvenile steelhead that use the area (Bjornn and Reiser 1991). Changes in vegetative cover can influence the macroinvertebrate prey assemblage, through alterations in shading, water temperatures, and nutrient inputs, to one less supportive of juvenile growth (Meehan et al. 1977). Removal of riverine vegetation will also reduce the natural cover that was previously available on site and reduce the general habitat complexity that would otherwise be beneficial to rearing steelhead's growth, survival, and eventual migration out of freshwater. The vegetation to be trimmed down is a band of smaller willows. As the entire plant will be trimmed to the roots and not completely removed, the removal of the upper foliage is expected to result in short-term reduction in quality for rearing and migratory PBFs (1-3 years for regrowth).

2.5.2.2. Placement of shotcrete and permanent structures in the Tuolumne River

There is a small portion of the sluice channel below the ordinary high water mark that is within CCV designated critical habitat. This small portion of the sluice channel will have a permanent adverse effect on critical habitat. Because the sluice channel is not a natural feature, has a high gradient, and is composed of small pools out of smooth rock with some loose larger rocks, it does not offer much value as habitat to CCV steelhead. In the past, after high water events, some fish became stranded in these pools and required relocating them to ensure their survival. Filling in the created pools and smoothing the overall sluice channel surface is expected to eliminate the potential for CCV steelhead to become isolated and trapped in the sluice channel, regardless if flow reductions are in response to receding flood flows or temporary suspension of flows for TID maintenance or inspection purposes. Therefore the placement of shotcrete and smoothing of the sluice channel surface is not expected to negatively affect the functionality of CCV steelhead designated critical habitat in the action area.

The diversion structure to be placed into the mid-river bar is an artificial element that will exist in perpetuity in the landscape within the wetted channel. While the pipe itself will only be used temporarily for short periods, it will physically occupy riparian and streambed habitat so that it is available for use on demand. For a majority of the year, it is expected that most of the diversion structure will be above the water line and only during periods of flood flows or a wetter than average water year would it interact with stream flow dynamics. This structure will create a new source of water turbulence, and is expected that water velocities around the structure may change the sediment composition and deposition or erosion rates normally associated with the mid-river bar (Oregon Water Resources Research Institute 1995). By introducing a hard structure to the middle of the Tuolumne River channel, it is expected that changes in flow dynamics will degrade PBFs associated with juvenile rearing habitat and adult spawning and holding habitat. The placement of the diversion structure, including its inlet/discharge structures, concrete footing, and pipe is therefore expected to be a permanent adverse effect on the critical habitat available in the Tuolumne River.

There is also probability that flood events will dislodge the diversion structure due to anticipated erosion and scour around the structure. The applicants expect that re-grading the areas upstream of the inlet structure and downstream of the discharge structure would be required about every 20 years to restore flow capacity following extreme flood events. If the diversion structure is partially or wholly dislodged, any future activities requiring ground disturbance for diversion structure repair, retrieval, or replacement would need to undergo ESA consultation separately.

2.5.2.3. Future dewatering associated with TID operations and inspections

The purpose of the proposed action is to enable TID to temporarily suspend flow releases from the forebay so that their La Grange diversion tunnel and forebay can be dewatered to be inspected and maintained without causing repeated fish stranding events. Operation of the diversion structure would be limited to exercising the gate operator according to manufacturer recommendations during each of these dewatering events. This is typically on an annual or semi-annual basis depending on inspection and maintenance needs.

The minimum continuous flow into the sluice channel is 5 cfs for powerhouse operation though often the flow amount is much greater in order to meet FERC licensing minimum flow standards for the Tuolumne River and Bay-Delta agreements (SWRCB 2018b, c, Federal Energy Regulatory Commission 2019, HDR 2020). Whenever flow through TID infrastructure must be suspended, these flows will be passed into the Tuolumne River through MID facility on the opposite bank, as what will occur during the construction season of the proposed action. Therefore, there will be no decrease in amount of river flow that would have otherwise been discharged into the Tuolumne River, and the released water should be of the same quality (temperature, dissolve oxygen, etc.) because of the close and equal proximity of MID infrastructure to that of TID infrastructure. Additionally, the change in flow release location is intended to be temporary, only during inspection and maintenance activities.

Whenever TID release flows are temporarily suspended, the gates of the installed diversion pipe will be opened. Their opening will allow flow between the large pool in the Tuolumne River below La Grange Diversion Dam and the tailrace channel below the powerhouse, and passage for fish between these two areas.

This connection will help maintain adequate flows (at least 50 cfs, (HDR 2020)) in the tailrace channel while flows are otherwise turned off for maintenance. This will ensure that the salmonid spawning habitat within the tailrace channel remains available and wetted during these periods. The inlet and discharge ends at the diversion pipe and would not be screened so fish and debris should not be impinged onto the end. Thus, fish will be able to pass through the diversion pipe without being blocked when the inlet side is open. Because the installation of the diversion pipe will ensure that the tailrace channel will not experience reduced flows during maintenance activities, there is no reduction of habitat availability or function, as long as the diversion structure is used in conjunction with these activities and conveys at least 50 cfs of flows properly, as designed. Therefore, future TID operations associated temporary flow suspension to enable inspection and maintenance activities in their diversion tunnel and forebay is not expected to reduce the functionality or value of CCV designated critical habitat within the action area.

2.5.2.4. Compensatory Mitigation

The USACE and its applicant, TID, have proposed to offset permanent adverse effects to designated critical habitat (permanent occupation of the diversion structure and the base of the sluice channel in designated critical habitat) using a compensatory mitigation purchase at a 3:1 ratio (offset acreage: impact acreage). They estimate the total acreage permanently adversely effected to be 0.05 acres of CCV steelhead designated critical habitat and have an offset goal of 0.15 acres of compensatory mitigation. There are no NMFS-approved mitigation banks that offer

steelhead or other appropriate habitat type credits that also include the action area of the project within their service areas. However, the action area is part of the area served by NFWF's Sacramento District California ILF Program.

To acknowledge that the existing, good quality habitat used by CCV steelhead will be degraded by permanent structures due to this project, TID proposes to participate in the Sacramento District California ILF program. From the TID's ILF payment for 0.15 acres of CCV steelhead habitat, a restoration project will be implemented that will result in increases to the habitat required by CCV steelhead. All restoration projects funded by the ILF program must have an enabling instrument, which ensures that the funds generated by each fee payment will be tracked comprehensively and allocated to the appropriate credit type. The prospectus of USACE's Sacramento District ILF to implement projects on the behalf of NMFS jurisdictional species was originally approved by NMFS leadership on October 3, 2014 (NMFS 2014b), and most recently with amendments on February 12, 2018 (NMFS 2018). Additionally, ILF payments made towards a particular restoration project, are sent to either a program account to implement the restoration action or kept in a separate account for any long-term management and maintenance needs of the ILF project site, established by the program sponsor and according to stipulations in the enabling instrument. Therefore, payment of ILFs towards the implementation of a project which improves habitat conditions for the CCV steelhead DPS is expected to provide benefits for the population, also in perpetuity.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Human population growth adjacent to the action area will increase pressure on listed anadromous species and their habitats, as a larger human population will require construction of new roadways, electric power generation facilities, utilities, schools, hospitals, and commercial and industrial facilities, and increase demand on available freshwater supply. California Department of Finance estimates that 561,951 people currently live in the county. By 2040, projections show that the county's population will increase to 655,915, which is a net increase of approximately 17% from 2021 (California Department of Finance 2021).

Urbanization associated with human population growth primarily results in the conversion of agricultural, range, or natural lands to developed lands for housing, commercial, or governmental purposes. Urbanization effects on natural areas include habitat loss, degradation, and fragmentation, which leads to declines in overall habitat functionality. The loss of habitat occurs incrementally as urbans areas grow outward. The quality of remaining habitat at the edge of urban areas is degraded by pets (e.g., dogs and cats); the increased presence of humans; invasive species; and increased noise, light, and non-point source pollution. Development associated with urbanization can alter or block wildlife movement, impair typical behavioral patterns, and reduce food resource availability. Habitat loss and degradation can result in the reduction of food

resources and breeding opportunities, which can then decrease survivability and make local populations more vulnerable to stochastic events.

Urban and suburban environments also affects an area's hydrology, water quantity, and water quality. Development leads to the rerouting, straightening, and hardening of creeks, streams, and rivers. The hardening of previously pervious land cover types can increase peak flows during storm events and cause erosion. Development also brings an increase in non-point source pollutants such as trash, oil, gasoline, 6-PPD in tire wear particles from automobile traffic (Tian et al. 2021), and chemical fertilizers and pesticides in addition to often over-utilizing available surface water resources. All of these outcomes, can reasonably expected to have negative outcomes for the CCV steelhead DPS.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1. Status of CCV steelhead DPS and designated critical habitat

The 2016 status review (NMFS 2016a) concluded that overall, the status of CCV steelhead DPS appears to have changed little since the 2011 status review when the technical review team concluded that the DPS was in danger of becoming endangered. Furthermore, there is still a general lack of data on the status of wild populations. The Central Valley population of steelhead still faces the loss of the majority of the historical spawning and rearing habitat due to dams and other passage impediments, as well as the other factors previously described for their decline. The new video counts at Ward Dam show that Mill Creek likely supports one of the best wild steelhead populations in the Central Valley, though at much reduced levels from the 1950's and 60's. Restoration efforts in Clear Creek continue to benefit CCV steelhead. However, the catch of unmarked (wild) steelhead at Chipps Island is still less than 5 % of the total smolt catch, which indicates that natural production of steelhead throughout the Central Valley remains at very low levels. Despite the positive trend on Clear Creek and encouraging signs from Mill Creek, all other concerns raised in the previous status review remain.

Designated Critical Habitat: Critical habitat has been designated in the action area for CCV steelhead. PBFs affected for CCV steelhead critical habitat is listed in Section 2.5.2. Though designated critical habitat for CCV steelhead DPS has been degraded, the habitat remaining is considered highly valuable..

2.7.2. Status of Environmental Baseline and Cumulative Effects

CCV steelhead occur and use the action area and it is the furthest accessible reach in the Tuolumne River for vital life history processes like holding, spawning, egg incubation, and rearing, albeit at very low numbers of steelhead. Within the action area, the PBFs of their designated critical habitat associated with spawning, rearing, and migration are all of good to fair quality as this portion of the Tuolumne River has mostly:

- maintained a natural riparian corridor,
- suffers little developed or impervious surface cover below the La Grange Diversion Dam infrastructure,
- somewhat retained its ability to braid and meander,
- hosts a combination of pools, runs, riffles, and glides,
- has variable riparian vegetation and minimal riprap placement on the banks, and
- consistently maintains acceptable water temperatures and dissolved oxygen content due to managed water releases.

While the Tuolumne River hydrograph no longer demonstrates a typical snow-melt driven pattern, the minimum flows and flow release timing required by FERC ensure flows are released to maintain downstream fish populations (HDR 2020). The final SED of the Bay Delta plan recommends increasing flows released into the Tuolumne River from an estimated current of 21% to 30 to 50% of unimpaired flow (SWRCB 2018c), returning more flow into the river, which would be beneficial to CCV steelhead. The Tuolumne River is also considered impaired for several pollutants (SWRCB 2018d), with mercury being the most concerning impairment within the action area.

However, there are multiple efforts by a host of agencies to restore the Tuolumne River itself and the fish and wildlife populations that depend on it. The Tuolumne River population of CCV steelhead is considered a Core 2 population that helps defray the extinction risk of the Southern Sierra Diversity Group (NMFS 2014). The Tuolumne River has been identified as a watershed in which an above dam passage or reintroduction program could occur and CCV steelhead captured in the Tuolumne River could be used in or supplement the genetic material of this reintroduction effort.

2.7.3. Summary of Project Effects on CCV steelhead

These effects are related to the immediate acute effects of the construction activities to individual fish for the installation of the in-river diversion structure and applying shotcrete to the sluice channel during the May 15 through September 30 construction work window.

Adults: It is anticipated that some overlap between adult steelhead and construction activities will occur in the month of September, especially if precipitation patterns and/or flow releases

support early adult upstream migration. Adult steelhead typically enter the San Joaquin River in September in low numbers and their numbers would be expected to increase towards the end of the month. Adults holding in the large pool adjacent to the work areas will be exposed to construction related noise and activities throughout working hours (6 a.m. to 6 p.m.). They will be exposed to low levels of contaminates coming from the operation, maintenance, and fueling of equipment and machinery used during construction. Although direct injury is unlikely, behavioral avoidance will cause fish to drop back downstream as the pools nearby construction are the furthest extent upstream fish can currently access. Fish often respond to construction activities by quickly swimming away from the construction sites, resulting in the majority escaping direct physical injury but as the pools directly below the La Grange Diversion Dam have the best available water quality and temperature, these reactions would send them into less suitable, warmer waters downstream. The probability of an individual fish being present during construction actions in the affected river reaches increases after mid-September. For the small proportion of the Tuolumne River population that will be exposed to construction contaminants effects include internal sublethal responses and reduced physiological fitness.

Juveniles: Expected exposure of parr steelhead to the effects of the active construction activities during the work window, are due to the extended freshwater residency undertaken by juvenile steelhead that includes oversummering in tributaries. Juveniles are expected to be encountered during the fish capture and relocation process associated with dewatering the sluice channel, the cofferdams around the construction area of the inlet of the diversion pipe, and in the tailrace channel. During the fish relocation, juveniles will experience elevated physiological stress from entrapment, capture, and handling, and potentially be injured or even killed during the immediate process. Even after release, a small proportion of juveniles are expected to perish due to contracting infections through cuts from the capture and handling process or by being easily predated upon due to being disoriented when released back to the river. However, effects of removing juveniles from dewatered areas is preferable to leaving them in place, and also minimizes direct interaction between construction activities in the isolated work areas and juvenile steelhead through the construction period.

Juveniles are generally expected to swim away and relocate downstream when disturbed by noise and vibration. Because the action does not propose to work at night or on weekends, there will be ‘quiet periods’ throughout the summer in which parr can move undisturbed and behave normally. Low numbers of parr are expected to vacate areas of the Tuolumne River experiencing elevated levels of turbidity due to direct discharge of waters from cofferdams. Unlike adults, juveniles can uptake methylmercury from food sources if cobble excavation mobilizes inorganic mercury into the food web, because juveniles are expected to feed while in the action area, which will cause a host of sublethal but serious outcomes to affect individuals. Sublethal effects related to construction contaminants are also expected to inflict internal sublethal responses and reduce physiological fitness. Reduced growth and increased mortality through predation would be considered a secondary consequence of the proposed project.

Long-term Impacts to Individuals: There are no long-term adverse effects associated with the proposed action beyond the new permanent structures. Future flows into the Tuolumne River will not be altered due to future TID operations involving inspection and maintenance activities. Permanent structure effects will be offset through purchase of ILF credits. Only the discharge location is proposed to be temporarily changed during the work period, and since the MID

infrastructure to redirect flow releases currently exists, no further action is needed to enable this switch. The MID Hillside discharge point is located near the current discharge location of the sluice/tailrace channel that water conditions (like temperature and dissolved oxygen), such that changes in the Tuolumne River are not expected. The resurfacing of the sluice channel prevents the creation of pools in which steelhead could strand and so future fish relocations will not be needed, increasing survival. The diversion structure will be opened temporarily and support flow into the tailrace channel, ensuring water flow and conditions are maintained there during maintenance activities. Therefore, no exposure is expected during future inspection and maintenance activities for the TID diversion tunnels, as designed by the proposed Project to avoid interactions and adverse outcomes to CCV steelhead in using the action area.

2.7.4. Summary of Project Effects on CCV steelhead Critical Habitat

The relevant PBFs of the designated critical habitat for CCV steelhead are spawning and rearing habitat. The excavation of cobble from the mid-river bar is expected to temporarily disrupt the current sediment distribution nearby, and will induce the bar and surrounding sediment to reorganize when next experiencing above average flows. This will cause spawning areas currently hosting gravel appropriately sized for steelhead uses to shift, move, and be unavailable for several flood seasons. However, as the cobble is not proposed to be removed from the area, it is not expect that these effects will be persistent in the long term as the same amount of gravel in the action area will remain the same, and such gravel will resort into useable beds and riffles again. As some willows will be trimmed, shading and leaf litter input from this vegetation would not be available due to project actions. However, these adverse effects would be minimal, as the amount of willows to be trimmed is limited to a small amount, and the deficits would be temporary, as the willows are expected to regrow within 2 years of project completion.

However, the Project does have permanent adverse effects on critical habitat. While the diversion structure (diversion pipe, gates, inlets and outlets) is needed to maintain habitat functionality in the tailrace channel by passing flows of Tuolumne River water during temporary periods of inspection and maintenance activities, it is still a hard, artificial structure that will be installed in the mid-river bar and permanently occupying previously unaltered river bottom, in perpetuity. It is expected to alter water flow dynamics and induce scour around the structure, somewhat degrading spawning and holding PBFs locally.

Impact to CCV steelhead DPS: The majority of the currently existing populations of the CCV steelhead DPS originate in the Sacramento River basin (Northwestern California, Northern Sierra Nevada, and the Basalt and Porous Lava diversity groups). Steelhead from the Southern Sierra Nevada diversity group are expected to be present in the action area, and thus will be affected by the Project's actions. The Tuolumne River's population is considered a Core 2 population that supports the diversity group but is not considered an abundant population. Since no mortality of adult steelhead is expected from direct exposure to the action's construction activities and any adverse effects are expected to be limited and primarily due to harassment of fish by noise and activity, the proposed action is not expected to affect the overall CCV steelhead DPS' ability to recover.

The majority of juvenile (parr) CCV steelhead present in the action area during construction activities will be herded out of the work zone, then a small proportion would be captured, and

relocated. A very small number is expected to die during or immediately after release (due to predation, infection, or stress/shock). Juveniles not directly encountered by the fish relocation will also be exposed to noise and elevated levels of turbidity which may cause them to relocate (non-lethal take, harassment), or hide (expected death due to stranding). Juveniles are also expected to be exposed to low-levels of construction-related contamination and are expected ingest increased levels of methylmercury following cobble disturbance, causing non-lethal response by lowering these individuals' growth and physiological health. However, as juvenile steelhead are expected to have low survivorship probabilities through each life stage to smolt stage before ocean entry even under ideal conditions (Evans et al. 2014, Melnychuk et al. 2014), the small numbers of anticipated exposure is not expected to measurably change the broodyear success of CCV steelhead from the Tuolumne River. Currently, one of the Tuolumne River's most important contribution to the CCV steelhead DPS is as a supply of wild, diverse genetic material, and the limited number of juveniles exposed to effects of this project is not expected to reduce this capacity, as not all juveniles from the Tuolumne River from the broodyear are anticipated to be affected. Therefore, adverse effects associated with the proposed action is not expected to reduce appreciably the likelihood of both the survival and recovery of the CCV steelhead DPS.

By offsetting the 0.05 acres occupied by the diversion structure with ILF payments for 0.15 acres, a greater amount of CCV steelhead habitat will be restored, enhanced, and/or preserved in perpetuity compared to before the proposed Project. A NFWF project site has not yet been identified but this is expected to produce beneficial outcomes for the CCV steelhead habitat area ultimately selected. In combination with the anticipated adverse effects identified above, the proposed Project is not expected to appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and designated critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the CCV steelhead DPS or destroy or adversely modify its designated critical habitat.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be

prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

NMFS anticipates incidental take of CCV steelhead in the action area through the implementation of the proposed Project. Because of the proposed timing of the work window for the construction phase of the Project, actual numbers of fish adversely affected by the construction actions are expected to be low. A few adult CCV steelhead are expected to be present during the month of September since this is early in their upstream migration period, and their current low escapement estimates in the Tuolumne River. Juveniles are expected to be more numerous as a greater portion of the work window overlaps with their use of waterways in the action area.

However, while individual fish will be present in the action area, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) as a result of the proposed action. This is due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of habitat disturbance of 2.104 acres, which includes the factors causing fish to relocate to other locations downstream, the amount of area from which juvenile fish would be captured, those factors which kill, or cause sublethal physiological ailments, and factors which would temporarily reduce the growth and fitness of individuals using the habitat within the action area.

The behavioral modifications of fish responses that result from the habitat disturbance are described below. NMFS anticipates incidental take will occur during construction and will be limited to the following forms:

1. Incidental take will occur in the form of harm and harassment of holding CCV steelhead adults in the month of September and over-summer rearing CCV steelhead parr. The harassment will originate from construction noise and vibration throughout the work window, starting mid-May until September 30, Monday through Friday, 6 a.m. to 6 p.m. for one season. If noise and vibration levels rise higher than normal background river levels, those CCV steelhead present in the Tuolumne River during construction would alter their behaviors and move away from locations adjacent to the active construction area to some point downstream. Also, because individual fish are difficult to monitor, their individual reactions to the harassment will likely remain undetected, and each fish

may react differently. It is more robust to estimate take through the area or distance which the underwater noise and vibrations could travel, which is 2.104 acres. Take will be considered exceeded if noise and vibrations are above normal background levels further than 2.104 acres away from the construction site.

2. Incidental take will occur in the form of harassment, pursuit, trapping, capturing, handling, wounding, and unintentionally killing parr CCV steelhead during work area isolation, cofferdam dewatering, and fish relocation efforts. These activities are likely to stress, shock, and injure them, resulting in immediate or delayed death, or susceptibility to predation. The number of parr CCV steelhead to be entrapped by cofferdams, driven or captured by nets, handled, and transported for release is expected to be low, but the total number affected will not be known because the primary effort will be to herd fish out of areas to be dewatered or isolated. However, the total amount of area to be isolated, dewatered, and fished for parr is known and limited. The BA estimates that a total of 1.442 acres will be temporarily fished and dewatered (sluice and tailrace channels) and 0.662 acres will be temporarily disturbed, for a total of 2.104 acres (Table 7, (HDR 2020)) in which fish relocation, cofferdam establishment, and/or dewatering will occur. In association with fish relocation activities, it is typically assumed that no more than 3% of captured and handled fish will experience immediate mortality during fish relocation if experienced fish biologists perform the fish relocation and protocols designed to improve fish survival are followed. The amount of incidental take associated with these activities is proportional to the amount of area fished; if more area were fished, isolated, or dewatered, the likelihood of encountering additional steelhead parr increases. Increasing the acreages associated with dewatering, cofferdam establishment, and fish relocation for this project to more than 1.541 acres total will be considered exceeding the expected incidental take levels of this surrogate. Additionally, if more than 3% of total number of CCV steelhead captured and handled in these processes immediately perish or show evidence of fresh external wounds, incidental take will be considered exceeded.

3. Incidental take will occur in the form of harassment to parr CCV steelhead outside of the 1.541 acres described above as water is pumped from behind cofferdams back into the Tuolumne River. The most appropriate threshold for incidental take consisting of fish disturbance and sub-lethal effects associated with elevated turbidity is an ecological surrogate of the amount of increase in turbidity generated by dewatering discharge. Increased turbidity is expected to cause harm and harass parr through elevated stress levels and disruption of normal habitat use locally when in-water readings exceed 80 NTUs. These responses are linked to decreased growth, survivorship, and overall reduced fitness as described for underwater noise avoidance, up to respiratory distress and reduced gill function. NMFS cannot estimate how many parr steelhead may be affected by elevated turbidity plumes for the reasons outlined in previous incidental take estimates, and also because the turbidity will naturally dissipate but is variable depending on river flow dynamics, leading to more uncertainty. The degree to which juvenile steelhead display adverse reactions (avoidance) to turbidity plumes, however, is relational, so limiting the maximum amount of allowable turbidity in-river will limit negative outcomes for fish. However, the effect area partially overlaps with the disturbance distance surrogate established for incidental take #1. Therefore, water downstream of construction activities are expected to remain under 80 NTUs beyond 30

meters from either the inlet cofferdam or downstream tailrace channel cofferdam. Exceeding 80 NTUs within the identified distances will be considered as exceeding the expected incidental take levels.

4. Incidental take will occur in the form of harm to rearing CCV steelhead as legacy mercury is mobilized due to excavation of cobble from the mid-river bar in the Tuolumne River. CCV steelhead are expected to feed throughout the action area and those that ingest methylmercury would experience sublethal effects like immunosuppression, resulting in reduced growth and reduce individual survivorship probability. NMFS cannot estimate the number of CCV juveniles that may ingest methylmercury within the action area due to project actions, for aforementioned reasons, and also because the transfer of methylmercury up the food web to fish predators is variable and dependent on water flow, water temperature, and bacterial/foodweb activity at the time of inorganic mercury mobilization, and most importantly, on the final amount of inorganic mercury ultimately mobilized into the aquatic environment. The likelihood of adverse aquatic ecosystem outcomes, and outcomes to rearing steelhead, can be predicted with reasonable certainty relative to the amount of elemental mercury in disturbed sediments. Therefore, using the MacDonald et al. (2000) probable effect concentration for mercury in sediments of 1.06 ppm and the State of California's threshold for use of mercury provisions while disturbing areas with elevated mercury concentrations of 1 ppm, such as mine tailings, the sediments and cobble excavated from the mid-river bar is expected to remain at (or below) 1 ppm or 1 milligram per kilogram of inorganic mercury. If these materials contain more than 1 ppm inorganic mercury, incidental take would be exceeded.

5. Incidental take will occur in the form of harm to CCV steelhead through temporary adverse habitat changes in association with the installation of the diversion structure in the mid-river bar. Its installation necessitates excavation of the cobble to construct and place the diversion pipe and inlet/outlet, which is expected to somewhat destabilize the permanent bar feature in the river. NMFS cannot estimate the temporary reduction of habitat functionality and subsequent reductions in growth, survivorship, or fitness that may occur as outcomes associated with destabilized cobble movement. However, the probability that the bar will reorganize loosened cobble, even if replaced, is expected to increase with the amount of cobble excavated from the bar. The BA estimates that approximately 400 cubic yards of cobble must be excavated from the mid-river bar to install the diversion pipe structure. Exceeding the estimated cubic yardage will be considered exceeding incidental take.

6. Incidental take will occur in the form of harm to CCV steelhead through temporary adverse habitat changes in association with riparian vegetation removal. The most appropriate measurement of harm to CCV steelhead using the riparian zone within the action area is a surrogate of the total amount of area affected by degradation of habitat from vegetation trimming. The removed branches and foliage would have otherwise supported the macroinvertebrate prey of juvenile steelhead and provided limited amounts of shade and habitat cover relative to their occupation in the overall available habitat, which will result in reduced growth and fitness. From aerial work images provided in the BA (Figure 8 of the BA) and area estimations using Google Earth, no more than 0.3 acres of CCV steelhead designated critical habitat will experience vegetation trimming.

Trimming vegetation on more than a total of 0.3 acres of CCV steelhead critical habitat will be considered exceeding incidental take. The proposed project describes retaining the roots of the vegetation to ensure trimmed plants regrow onsite, therefore removal of the roots of riparian vegetation will also be considered exceeding incidental take.

7. Incidental take will occur in the form of harm to CCV steelhead through permanent adverse habitat alterations in association permanent occupation of hard artificial structures in designated critical habitat. The persistence of a diversion structure in the channel is expected to change the river flow dynamics locally by becoming a source of water turbulence and scour when interacting with river flows, degrading the rearing, spawning, and migration PBFs in the action area, as long as the structure remains in the designated critical habitat. Degradation of critical habitat PBFs will result in reduced growth and fitness of juveniles, and reduced fitness of adults. At this time it is difficult to predict the severity of outcomes for critical habitat PBFs, but the likelihood of severe consequences is relative to the size of the structure. The applicant estimates that no more than 0.05 acres of CCV steelhead designated critical habitat will experience direct, permanent, adverse effects. Increasing the amount of CCV steelhead designated critical habitat occupied by artificial structures beyond 0.05 acres will be considered exceeding incidental take.

2.9.2. Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. Measures shall be taken by USACE, its applicant TID, and their contractors to minimize the extent of take of CCV steelhead caused by the proposed action, related to the consequences of the proposed action as discussed in this opinion.

2. Measures shall be taken by USACE, its applicant TID, and their contractors to reduce the extent of harm and alteration to the designated critical habitat of CCV steelhead, related to the consequences of the proposed action as discussed in this opinion.

3. The USACE, its applicant TID, or its contractors, shall prepare and provide NMFS with updates, reports, and plans pertinent to monitoring the impacts to and amount of incidental take of listed species under NMFS jurisdiction, or their ecological surrogates, in the action area.

2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:

    a. The USACE or its applicant TID shall ensure that, through the terms of the issued permits, all contractors and personnel involved with this action will be educated and informed of the Terms and Conditions of this biological opinion and the avoidance and minimization measures described in the project description.

    b. All proposed and required conservation measures, AMMs, and BMPs shall be adaptively managed with coordination with NMFS staff as they pertain to protecting CCV steelhead throughout the life of the project to ensure their effectiveness. If measures are suspected of not performing as intended or are observed causing greater than expected harm to CCV steelhead, NMFS shall be contacted and the issue discussed until a resolution of the issue is determined and recorded via NMFS technical assistance. The issue shall be resolved and the resolution measure implemented within one week from notification date.

    c. During the dewatering, cofferdam and isolation barrier installation, and fish relocation activities (i.e., "fish rescue"), the enclosed areas shall be checked for CCV steelhead, according to the recommendations of the lead qualified on-site biologist, but also considering the following:

        i. NMFS staff shall be notified of any planned fish relocation or salvage activities at least two business days before such activities begin, so that staff can advise these efforts or make a field visit to observe, if deemed necessary.

        ii. Persons performing salmonid captures and handling shall be qualified and experienced juvenile salmonid handlers, and be familiar with the fishing equipment to be used.

        iii. All gear (nets, seines, buckets, waders, boats, boots, gloves, etc.) to be used in contact with Tuolumne River water shall follow California Department of Fish and Wildlife (CDFW) biological sterilization and disinfection standards prior to use so that pathogens, parasites, chemicals, or nonnative biological organisms are not introduced into the ecosystem (CDFW 2016).

        iv. If water temperatures in the areas to be dewatered or fished are elevated above >21°C (69.8°F), dewatering and fish relocation activities shall not proceed. Dewatering and fish relocation shall only proceed if water temperatures are 20.9°C (69.6°F) or less.

v. If daytime air temperature highs are predicted to be more than 29.4°C (85°F) during the fish relocation, shade shall be provided to cover the fish processing area to minimize heat transfer into water holding containers. At these air temperatures, insulated coolers shall be used in preference of buckets to maintain water temperatures.

vi. Water holding fish shall be maintained within +/- 2 °C of the temperature of the waterbody the fish were captured from; water holding fish shall not exceed 23 °C (73.4 °F) at any time.

vii. All salmonids shall be held in buckets separate from other types of fishes and be a priority for releasing first and separately from other groups, as possible.

viii. Fish shall be held in buckets at low densities, where there is enough room to swim freely, to avoid the effects of overcrowding and further stress on fish.

ix. Salmonids shall not be held in containers for more than 30 minutes total.

x. CCV steelhead that die during capture and handling shall be placed on ice or frozen until transfer to NMFS or another NMFS-associated entity can occur.

d. Outside of the initial fish relocation, if any steelhead or salmon is injured or killed within the action area in relation to project activities, the construction shall cease and NMFS staff shall be contacted within 24 hours to assign species identity. This does not apply to the initial fish relocation activities that preceded all other construction activities because a low amount of immediate mortality is expected in conjunction with that set of actions and is part of the incidental take already considered for the project.

i. If dead, the fish shall be recovered and placed on ice or frozen until transfer to NMFS can occur or another NMFS-associated entity.

ii. If injured, the fish shall be gently handled only to take a photograph to enable later species assignment. Then it shall be immediately released back into the waterbody it was taken in, preferably in a shaded area with overhanging or in-water vegetation. However, the injured individual shall not be pursued if it proceeds to exit the immediate area under its own volition before being photographed.

iii. Construction shall cease until coordination with NMFS can take place and technical assistance can determine whether the death was related to construction activities or not, and if the death was construction-related but not included in the incidental take identified in Section 2.9.1.

e. A qualified technician shall conduct water quality monitoring consistent with the Clean Water Act Section 401 Permit for the project (WDID#5B50CR00098).

i. Technical Certification Conditions section 5 subheading b:

a. Activities shall not cause turbidity increases in surface water to exceed:

1. Where natural turbidity is less than 1 NTU controllable factors shall not cause downstream turbidity to exceed 2 NTUs;

2. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent;

3. Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs; and

4. Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent

ii. The turbidity measurement equipment shall be calibrated daily to ensure accurate readings.

iii. Turbidity measurements shall be taken and recorded at least once per hour while discharge of pumped water into the Tuolumne River is occurring. An estimate of approximate distance in meters downstream the turbidity reading occurred from the cofferdam location shall also be recorded.

iv. A turbidity curtain shall be used to control and settle discharged water if the turbidity surrogate is anticipated to be exceeded 30 meters downstream of the cofferdam location, as informed by the real-time turbidity readings.

f. In-water sound should be monitored roughly 2.104 acres downstream from the construction area. Measurements should be taken at least three times during in-water construction activities and included with the report to NMFS outlined below.

g. The USACE, TID, or their contractors shall take steps to minimize or avoid the introduction of construction-related contamination to the Tuolumne River.

i. Measures consistent with Clean Water Act Section 401 Permit for the project (WDID#5B50CR00098) will be implemented onsite to minimize the probability of introducing construction pollution into waterways and to reduce the amount ultimately discharged, should an accidental or uncontrolled discharge occur.

a. Erosion BMPs shall be installed as proposed and monitored for integrity and effectiveness until the project is complete and they are removed.

ii. Accidental spill containment and clean-up materials shall be present at the work location and be accessible to construction crews at all times, to ensure rapid response to events. Materials and available amounts shall be adequate for the machinery and chemicals expected onsite.

iii. Equipment shall be checked for leaks and maintained regularly to ensure proper function before entering water channels or traveling over water channels.

Equipment to be used stationary for long periods shall have drip pans or absorbent pads placed underneath to catch any and all leaks, especially while operating on the mid-river bar.

iv. Equipment shall be cleaned prior to entering the riverbed. Wash water, if used, shall be properly disposed of and not discharged into the Tuolumne River, unless treated through an infiltration basin or some other commensurate measure.

v. Refueling, lubrication, and other equipment maintenance activities shall not occur on the mid-river cobble bar. Such activities shall only occur on existing gravel or paved surfaces outside of the ordinary high water mark of the Tuolumne River.

a. Containment shall be used during these activities to capture drips, leaks, or small spills, and such materials must be cleaned up and contained for disposal immediately.

vi. Material used for fill should be cleaned prior to use in the action area.

vii. If contamination is observed on the sand pad created on the mid-river cobble bar (e.g., drips, leaks, or discoloration) after the equipment is removed and construction complete, contaminated sand shall be removed from the bar and disposed of properly offsite.

viii. Should an accidental spill or discharge greater than 10 millimeters into the Tuolumne River occur, NMFS shall be contacted within 24 hours with information regarding the event, including type of spill or breach, event duration, estimates on the amount and concentration of materials discharged, description of the immediate response taken by the contractor onsite, and the proposed long-term resolution to avoid such events. Environmental samples shall be taken and documentation made to track the efficacy of containment and clean-up efforts.

h. At least one sediment sample shall be taken to measure the concentrations of inorganic mercury in the excavated mid-river cobble bar materials.

i. The sample(s) of available fine material shall be taken from the lowest excavation point.

ii. The excavated material may be mostly cobble, which is sized too large for a typical sample. In such cases, provisions shall be made to wash a set amount of cobble, filtered down to a standard sample amount that can be tested to determine the inorganic mercury concentration at a ppm level, if finer material cannot reasonably be collected.

iii. The sample shall be sent out and evaluated in a timely manner so that the mercury risk can be known before excavated cobble is replaced into the bar and mercury is mobilized into the aquatic environment.

iv. If mercury concentration is found to be over 1 ppm, the State of California mercury provisions (SWRCB 2018a) shall be observed onsite, and either:

a. the excavated cobble shall be washed before replacement into the bar and the wash water and removed mercury shall be properly disposed offsite, or

b. the mercury contaminated cobble shall be removed completely and replaced in-kind with the same amount and size cobble from a clean source.

i. NMFS shall be contacted within 24 hours for technical assistance after direct observation that exceedance of an ecological surrogate has occurred, or is suspected of being exceeded.

j. During construction, cofferdams and isolated areas shall be checked daily by biological monitors for pooled water and fish presence. If fish are discovered, construction activities shall halt and fish relocation and relocation activities shall commence immediately until all fish are captured or several passes of nets do not result in fish. If a steelhead or salmonid is encountered during these proceedings, NMFS shall be contacted immediately for technical assistance. Construction activities shall only begin again after cofferdams and isolation barriers are readjusted so that additional fish relocations are not required and NMFS confirms that incidental take levels were not exceeded.

2. The following terms and conditions implement reasonable and prudent measure 2:

a. Riparian vegetation removal shall be minimized to the extent practicable, except for nonnative plant species, which shall be completely removed when encountered. For larger native plants, trimming of branches to enable site access shall be used in preference over complete clearing and native plants should remain as intact as possible to promote regrowth.

b. Riparian vegetation not planned for removal shall be clearly marked to ensure those resources are avoided and preserved in the landscape. Markings/tags shall be removed after construction is complete.

c. Temporary construction materials and BMPs shall consist of natural biodegradable materials whenever possible and the use of plastic (such as monofilament and Visqueen) shall be minimized to the extent practicable. All materials intended for temporary use onsite shall be removed within 30 days post construction/project completion or at least seven days before the first anticipated rainfall to reduce pollution and trash entering the waterways.

d. During the operation stage (post-construction), both inlet and outlet ends of the diversion structure shall be checked and cleared of any accumulated debris before gates are opened. Woody materials found during this process shall be returned to the wetted channel of the Tuolumne River downstream of the inlet of the diversion structure. Unnatural materials (plastics, trash) shall be removed and disposed of properly.

e. Any visible damage to or changes of the riffles downstream of the construction area shall be recorded with photos and measured with measuring tapes, and reported to NMFS immediately.

3. The following terms and conditions implement reasonable and prudent measure 3:

a. A report on the initial fish relocation efforts and results shall be submitted to NMFS within 30 days of conclusion of the activities, indicating the number of salmonids that were handled, the number injured or killed, the transport water quality readings, total time in transport, and the location they were released into (a simple schematic map will suffice).

b. A final construction report shall be submitted by December 31st after the completion of construction. This report shall include:

i. Construction start and end dates, and number of days worked.

ii. The flow release amounts through the MID Hillside Gate through the construction time period.

iii. The final total number of salmonids and CCV steelhead observed, captured, or handled throughout the entirety of construction, including a summary of the initial fish relocation, including a tally of CCV steelhead injured or killed during project activities.

iv. Estimate of the amount of riparian vegetation severely trimmed (total acreage) and the species composition affected. General plant group is sufficient (e.g., willow, oak, cottonwood, nonnative, etc.).

v. Summary report of any leaks, spills, or accidental discharges of construction-related materials to the Tuolumne River.

vi. Estimated amount of time shotcrete and concrete cured in dry conditions before flows were released.

vii. The record of the turbidity readings during discharge, with measurement locations.

viii. The record of in-water sound measurements taken roughly 2.104 acres downstream of the construction area.

ix. Lab report of inorganic mercury concentrations from the mid-river cobble bar excavation at a ppm level, and final estimate of total cobble excavated to place the diversion structure, and whether any new, clean cobble was placed to supplement removed material.

x. Photos of the completed sluice channel and diversion structure.

c. Updates and reports required by these terms and conditions shall be sent to:

ccvo.consultationrequests@noaa.gov (**primary and preferred contact**)

or

California Central Valley Office – c/o Monica Gutierrez
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814
Monica.gutierrez@noaa.gov

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

- Willow sticks from the vegetation trimming should be replanted in the disturbed area and replaced cobble around the diversion structure to provide future cover for fish near the diversion structure and possibly enhance the stability of the cobble matrix near the structure when under flow. Doing so would help restore the functionality and value of CCV critical habitat adjacent to the diversion structure.

- The USACE and its applicant TID should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local land management groups to identify opportunities for cooperative analysis, monitoring, and funding to support salmonid and watershed restoration projects and recovery action projects in the action area and beyond, especially projects involving fish passage, or reintroduction of salmonids, above dams into historical habitat extents. Doing so would aid restoration of the functionality of existing critical habitats in general, and improve the resiliency and probability of recovery of CCV steelhead in the region.

2.11. Reinitiation of Consultation

This concludes formal consultation for the La Grange Sluice and Tailrace Channel Improvement Project.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the

action. An example of when reinitiation of consultation will likely be warranted under 50 CFR 402.16 is if USACE, TID, or their contractors do not adhere to the work window as proposed.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast salmon (PFMC 2014, 2016) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by PFMC managed salmon within the USGS 4th field hydrologic units identified by the fishery management plan (PFMC 2014). This designation includes the Tuolumne River below La Grange Dam (HUC 18040009) for all runs of Chinook salmon that are managed by the PFMC (fall-run, and late fall-run).

The Pacific Coast salmon fishery management plan also identifies Habitat Areas of Particular Concern (HAPCs): complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation. The HAPCs for complex channel and floodplain habitat, spawning habitat, and thermal refugia are expected to be either directly or indirectly adversely affected by the proposed action. These HAPCs are currently degraded habitat within the action area due to numerous instream structures for water storage, hydroelectricity, and flood control, as well as from extensive agricultural land use downstream of the action area and urbanization in the lower portion of the action area.

3.2. Adverse Effects on Essential Fish Habitat

Effects to the HAPCs for complex channel and spawning habitats are discussed in the context of effects to CCV steelhead critical habitat PBFs as designated under the ESA and described in section 2.5. A list of adverse effects to this EFH HAPCs is included in this EFH consultation, which are expected to be similar to the impacts affecting critical habitat, including; dam operation, habitat degradation and inaccessibility, sediment and turbidity and in-channel disturbances.

Habitat degradation and inaccessibility:

- Reduced water quality and quantity (flow and temperature) due to the long-term operations and maintenance of TID facilities
- Habitat degradation from routine and non-routine maintenance activities, such as placement of riprap and loss of riparian vegetation, and stream bank erosion
- Reduced shelter from predators
- Reduction/change in aquatic macroinvertebrate production
- Reduced habitat complexity

Sediment and turbidity:

- Degraded water quality
- Reduction/change in aquatic macroinvertebrate production

In-channel disturbance:

- Channel disturbance from in-water construction
- Temporary de-watering or re-routing of water for construction and non-routine maintenance activities

The proposed action would result in 0.05 acre of permanent adverse effects, 0.661 acre of temporary disturbed effects, and 1.442 acre of temporary dewatered effects on Chinook salmon EFH.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

Habitat degradation and inaccessibility

- Limit maintenance to in water work windows for salmon in the area
- Restore rearing, spawning, and floodplain habitat downstream of the action area
- Monitor regrowth of willows and other native disturbed native vegetation in the action area

Sediment and turbidity:

- A qualified biologist shall use a held-hand turbidity monitor to conduct water quality monitoring during all in-water activities to ensure the turbidity control measures are functioning as intended. If an in-river turbidity plume is created and conditions within the plume exceed take limits (80 NTUs) for Covered Species, TID, or its consultants, shall coordinate with NMFS within 24 hours after an event that exceeds the given water turbidity surrogate, to discuss ways to reduce turbidity back down to acceptable levels.

In-channel disturbance:

- BMPs shall be implemented to reduce or eliminate the potential for hazardous contaminants to enter the water or stream channel.
- All avoidance and minimization measures identified in section 4.5 of the Biological Assessment should be followed

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

3.4. Statutory Response Requirements

As required by section 305(b)(4)(B) of the MSA, USACE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS's EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The USACE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS's EFH Conservation Recommendations (50 CFR 600.920(l)).

4. Data Quality Act Documentation and Pre-Dissemination Review

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are USACE. Other interested users could include HDR and TID. Individual copies of this opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. REFERENCES

Abatzoglou, J. T. and A. P. Williams. 2016. Impact of Anthropogenic Climate Change on Wildfire across Western Us Forests. Proceedings of the National Academy of Sciences USA 113(42):11770-11775.

ABC 7 News. 2018. Camp Fire Timeline of Terror: The Evacuation of Butte County's Paradise from Beginning to End. https://abc7news.com/timeline-of-terror-the-evacuation-of-paradise-from-beginning-to-end/4850913/.

Allen, C. D., A. K. Macalady, H. Chenchouni, D. Bachelet, N. McDowell, M. Vennetier, T. Kitzberger, A. Rigling, D. D. Breshears, E. H. Hogg, P. Gonzalez, R. Fensham, Z. Zhang, J. Castro, N. Demidova, J.-H. Lim, G. Allard, S. W. Running, A. Semerci, and N. Cobb. 2010. A Global Overview of Drought and Heat-Induced Tree Mortality Reveals Emerging Climate Change Risks for Forests. Forest Ecology and Management 259(4):660-684.

Alpers, C. N., M. P. Hunerlach, J. T. May, and R. L. Hothem. 2005. Mercury Contamintation from Historical Gold Mining in California. United States Geological Survey. U.S. Department of the Interior, Sacramento, California.

Arkoosh, M. R., E. Casillas, E. Clemons, A. N. Kagley, R. Olson, P. Reno, and J. E. Stein. 1998. Effect of Pollution on Fish Diseases: Potential Impacts on Salmonid Populations. Journal of Aquatic Animal Health 10:182-190.

Arkoosh, M. R. and T. K. Collier. 2002. Ecological Risk Assessment Paradigm for Salmon: Analyzing Immune Function to Evaluate Risk. Human and Ecological Risk Assessment: An International Journal 8(2):265-276.

Bash, J., C. Berman, and S. Bolton. 2001. Final Research Report. Research Project T1803, Task 42: Effects of Turbidity and Suspended Solids on Salmonids. Washington State Transportation Commission, Department of Transportation, in cooperation with U. S. Department of Transportation Federal Highway Administration.

Bjornn, T. C. and D. W. Reiser. 1991. Chapter 4. Habitat Requirements of Salmonids in Streams. Pages 83-138 *in* Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarinso. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NMFS-NWFSC-27.

California Department of Finance. 2021. Projections. P-2 (County Population Projections (2010-2060): P-2a Total Population for California and Counties (.xlsx). https://www.dof.ca.gov/forecasting/demographics/projections/. 8/8/2021.

CDFW. 2016. California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Regions). California Department of Fish and Wildlife.

Chapman, E. D., A. R. Hearn, C. J. Michel, A. J. Ammann, S. T. Lindley, and M. J. Thomas. 2012. Diel Movements of out-Migrating Chinook Salmon (*Oncorhynchus tshwaytscha*) and Steelhead Trout (*Oncorhynchus mykiss*) Smolts in the Sacramento/San Joaquin Watershed. Environmental Biology of Fishes 96(2-3):273-286.

Cohen, S. J., K. A. Miller, A. F. Hamlet, and W. Avis. 2000. Climate Change and Resource Management in the Columbia River Basin. Water International 25(2):253-272.

CTC & Associates. 2015. Preliminary Investigation: Determining the Appropriate Amount of Time to Isolate Portland Cement Concrete from Receiving Waters. Caltrans Division of Research, Innovation, and System Information.

Dettinger, M. D. 2005. From Climate-Change Spaghetti to Climate-Change Distributions for 21st Century California. San Francisco Estuary and Watershed Science 3(1):Article 4.

Dettinger, M. D. and D. R. Cayan. 1995. Large-Scale Atmospheric Forcing of Recent Trends toward Early Snowmelt Runoff in California. Journal of Climate 8(3):606-623.

Dettinger, M. D., D. R. Cayan, M. K. Meyer, and A. E. Jeton. 2004. Simulated Hydrologic Responses to Climate Variations and Change in the Merced, Carson, and American River Basins, Sierra Nevada, California, 1900–2099. Climatic Change 62(1-3):283-317.

Evans, A. F., N. J. Hostetter, K. Collis, D. D. Roby, and F. J. Loge. 2014. Relationship between Juvenile Fish Condition and Survival to Adulthood in Steelhead. Transactions of the American Fisheries Society 143(4):899-909.

Federal Energy Regulatory Commission. 2019. Draft Environmental Impact Statement for Hydropower Licenses: Don Pedro Hydroelectric Project - Ferc Project No. 2299-082, La Grange Hydroelectric Project - Ferc Project No. 14581-002, California. Office of Energy Projects and Division of Hydropower Licensing, pp. 794.

Fong, S., S. Louie, I. Werner, and R. E. Connon. 2016. Contaminant Effects on California Bay–Delta Species and Human Health. San Francisco Estuary and Watershed Science 14(4).

Good, T. P., R. S. Waples, and P. Adams. 2005. Updated Status of Federally Listed Esus of West Coast Salmon and Steelhead. U.S. Department of Commerce, pp. 598 p.

Gregory, R. S. 1993. Effect of Turbidity on the Predator Avoidance Behaviour of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 50(2):241-246.

Hallock, R. J., R. F. Elwell, and D. H. Fry. 1970. Migrations of Adult King Salmon, *Oncorhynchus tshawytscha*, in the San Joaquin Delta. Bulletin 151, pp. 92.

Hallock, R. J., D. H. Fry, and D. A. LaFaunce. 1957. The Use of Wire Fyke Traps to Estimate the Runs of Adult Salmon and Steelhead in the Sacramento River. California Fish and Game Quarterly 43(4):271-298.

Hallock, R. J., W. F. Van Woert, and L. Shapovalov. 1961. An Evaluation of Stocking Hatchery-Reared Steelhead Rainbow Trout (*Salmo gairdnerii gairdnerii*) in the Sacramento River System. Fish Bulletin No. 114. State of California, Department of Fish and Game.

HDR, I. 2020. National Marine Fisheries Service Biological Assessment: La Grange Sluice and Tailrace Channel Improvement Project. Prepared for the Turlock Irrigation District,, Stanislaus County, California.

Hicken, C. E., T. L. Linbo, D. H. Baldwin, M. L. Willis, M. S. Myers, L. Holland, M. Larsen, M. S. Stekoll, S. D. Rice, T. K. Collier, N. L. Scholz, and J. P. Incardona. 2011. Sublethal Exposure to Crude Oil During Embryonic Development Alters Cardiac Morphology and Reduces Aerobic Capacity in Adult Fish. Proceedings of the National Academy of Sciences USA 108(17):7086-7090.

Incardona, J. P., M. G. Carls, H. L. Day, C. A. Sloan, J. L. Bolton, T. K. Collier, and N. L. Scholz. 2009. Cardiac Arrhythmia Is the Primary Response of Embryonic Pacific Herring (*Clupea pallasi*) Exposed to Crude Oil During Weathering. Environ Sci Technol 43(1):201-207.

Johnson, L. L., T. K. Collier, and J. E. Stein. 2002. An Analysis in Support of Sediment Quality Thresholds for Polycyclic Aromatic Hydrocarbons (PAHs) to Protect Estuarine Fish. Aquatic Conservation: Marine and Freshwater Ecosystems 12(5):517-538.

Keefer, M. L., C. C. Caudill, C. A. Peery, and M. L. Moser. 2012. Context-Dependent Diel Behavior of Upstream-Migrating Anadromous Fishes. Environmental Biology of Fishes 96(6):691-700.

Keefer, M. L., R. H. Wertheimer, A. F. Evans, C. T. Boggs, and C. A. Peery. 2008. Iteroparity in Columbia River Summer-Run Steelhead (*Oncorhynchus mykiss*): Implications for Conservation. Canadian Journal of Fisheries and Aquatic Sciences 65(12):2592-2605.

Lehman, B., M. Gary, N. Demetras, and C. Michel. 2019. Where Predators and Prey Meet: Anthropogenic Contact Points between Fishes in a Freshwater Estuary. San Francisco Estuary and Watershed Science 17(4).

MacDonald, D. D., C. G. Ingersoll, and T. A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology 39(1):20-31.

Matala, A. P., D. R. Hatch, S. Everett, M. W. Ackerman, B. Bowersox, M. Campbell, and S. Narum. 2016. What Goes up Does Not Come Down: The Stock Composition and Demographic Characteristics of Upstream Migrating Steelhead Differ from Post-spawn Emigrating Kelts. ICES Journal of Marine Science: Journal du Conseil 73(10):2595-2605.

McClure, M. 2011. Status Review Update for Pacific Salmon and Steelhead Listed under the Esa: Pacific Northwest. Climate Change. In M.J. Ford (Ed.), pp. 281.

McClure, M. M., M. Alexander, D. Borggaard, D. Boughton, L. Crozier, R. Griffis, J. C. Jorgensen, S. T. Lindley, J. Nye, M. J. Rowland, E. E. Seney, A. Snover, C. Toole, and V. A. N. H. K. 2013. Incorporating Climate Science in Applications of the US Endangered Species Act for Aquatic Species. Conservation Biology 27(6):1222-1233.

McCullough, D. A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids - Issue Paper 5., pp.

McEwan, D. 2001. Central Valley Steelhead. Pages 1-44 *in* Contributions to the Biology of Central Valley Salmonids, R. L. Brown, editor. CDFW Sacramento, CA, Fish Bulletin.

McEwan, D. and T. A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Department of Fish and Game.

Meehan, W. R., F. J. Swanson, and J. R. Sedell. 1977. Influences of Riparian Vegetation on Aquatic Ecosystems with Particular Reference to Salmonid Fishes and Their Food Supply. Oregon State University, Symposium on the Importance, Preservation, and Management of the Riparian Habitat.

Melnychuk, M. C., J. Korman, S. Hausch, D. W. Welch, D. J. F. McCubbing, C. J. Walters, and J. Grant. 2014. Marine Survival Difference between Wild and Hatchery-Reared Steelhead Trout Determined During Early Downstream Migration. Canadian Journal of Fisheries and Aquatic Sciences 71(6):831-846.

Michel, C. J., A. J. Ammann, S. T. Lindley, P. T. Sandstrom, E. D. Chapman, M. J. Thomas, G. P. Singer, A. P. Klimley, R. B. MacFarlane, and M. Bradford. 2015. Chinook Salmon Outmigration Survival in Wet and Dry Years in California's Sacramento River. Canadian Journal of Fisheries and Aquatic Sciences 72(11):1749-1759.

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

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. Fish Species of Special Concern in California. Report Contract# 2128IF, California Department of Fish and Game, Rancho Cordova.

National Wildfire Coordinating Group. 2021a. Inciweb Incident Information System: Creek Fire. https://inciweb.nwcg.gov/incident/7147/. 8/6/2021.

National Wildfire Coordinating Group. 2021b. Inciweb Incident Information System: Dixie Fire (CA). https://inciweb.nwcg.gov/incident/7690/. 8/6/2021.

NMFS. 2014a. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the

Distinct Population Segment of California Central Valley Steelhead. National Marine Fisheries Service. West Coast Region, pp. 427.

NMFS. 2014b. Sacramento District California In-Lieu Fee Enabling Instrument. Signed by Will Stelle, Regional Administrator for the National Marine Fisheries Service, West Coast Region. October 3, 2014. pp. 41.

NMFS. 2016a. 5-Year Review: Summary and Evaluation of California Central Valley Steelhead Distinct Population Segment. National Marine Fisheries Service. West Coast Region.

NMFS. 2016b. Response to the State Water Resources Control Board's Draft Revised Substitute Environmental Document Phase 1, 2016 Bay-Delta Plan. Letter Dated December 22, 2016. National Marine Fisheries Service. West Coast Region, pp. 22.

NMFS. 2018. Amendment No. 3 to in-Lieu Fee Enabling Instrument Sacramento District California, In-Lieu Fee Program. Signed by Barry Thom, Regional Administrator for the National Marine Fisheries Service, West Coast Region. February 12, 2018. pp. 2.

Oregon Water Resources Research Institute. 1995. Gravel Disturbance Impacts on Salmon Habitat and Stream Health. Volume I: Summary Report. Oregon State University, For the Oregon Division of State Lands.

Paul, M. J. and J. L. Meyer. 2001. Streams in the Urban Landscape. Annual Review of Ecology and Systematics 32:333-365.

PFMC. 2014. Appendix a to the Pacific Coast Salmon Fishery Management Plan as Modified by Amendment 18 to the Pacific Coast Salmon Plan: Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. 219pp.

PFMC. 2016. Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California as Amended through Amendment 19. 91pp.

Reclamation. 2015. Sacramento and San Joaquin Basins Study, Report to Congress 2015.

Richter, A. and S. A. Kolmes. 2005. Maximum Temperature Limits for Chinook, Coho, and Chum Salmon, and Steelhead Trout in the Pacific Northwest. Reviews in Fisheries Science 13(1):23-49.

Schrader, W. C., M. W. Ackerman, T. Copeland, C. Stiefel, M. R. Campbell, M. P. Corsi, K. K. Wright, and P. Kennedy. 2014. Wild Adult Steelhead and Chinook Salmon Abundance and Composition at Lower Granite Dam, Spawn Year 2012, 2012 Annual Report. Idfc Report Number 14-16. Idaho Department of Fish and Game, Boise, Idaho.

Scott, G. R. and K. A. Sloman. 2004. The Effects of Environmental Pollutants on Complex Fish Behaviour: Integrating Behavioural and Physiological Indicators of Toxicity. Aquatic Toxicology 68(4):369-392.

Sigler, J. W., T. C. Bjornn, and F. H. Everest. 1984. Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon. Transactions of the American Fisheries Society 113:142-150.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2004. Changes in Snowmelt Runoff Timing in Western North America under a 'Business as Usual' Climate Change Scenario. Climatic Change 62:217-232.

Stillwater Sciences. 2016. Salmonid Habitat Mapping Technical Memorandum: La Grange Hydroelectric Project Ferc No. 14581. Prepared for Turlock Irrigation District and Modesto Irrigation District.

SWRCB. 2017a. Draft Staff Report for Scientific Peer Review for the Amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California, Mercury Reservoir Provisions - Mercury Tmdl and Implementation Program for Reservoirs. Statewide Mercury Control Program for Reservoirs. Sacramento, California.

SWRCB. 2017b. Final California 2014 and 2016 Integrated Report Clean Water Act Sections 303(D) and 305(B). Supporting Information Region Board 5 -Central Valley Region Tuolumne River, Lower (Don Pedro Reservoir to San Joaquin River).

SWRCB. 2017c. Staff Report: 2014 and 2016 California Integrated Report Clean Water Act Sections 303(D) and 305(B). State Water Resources Control Board,.

SWRCB. 2018a. Appendix A: Final Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California - Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions. State Water Resources Control Board, pp. 23.

SWRCB. 2018b. Bay-Delta Plan Update: Amendments and Substitute Environmental Document (Sed) for Lower San Joaquin River and Southern Delta Adoption and Approval of Plan Amendments and Final Sed. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2018_sed/. 8/6/2021.

SWRCB. 2018c. Fact Sheet for the Proposed Final Amendments and Final Substitute Environmental Document for Lower San Joaquin River Flow Objectives and Southern Delta Salinity Objectives.

SWRCB. 2018d. Final California 2018 Integrated Report (303(D)/305(B) Report). Supporting Information Region Board 5 -Central Valley Region Tuolumne River, Lower (Don Pedro Reservoir to San Joaquin River). State Water Resources Control Board, State of California,.

SWRCB. 2021. Water Quality Certification for Federal Permit or License, in the Matter of Water Quality Certification for Turlock Irrigation District and Modesto Irrigation District Don Pedro Hydroelectric Project and La Grange Hydroelectric Project Federal Energy

Regulatory Commission Projects Nos. 2299 and 14581, Tuolumne River and Tributaries, Stanislaus and Tuolumne Counties. State Water Resources Control Board, pp. 113.

Tian, Z., H. Zhao, K. T. Peter, M. Gonzalez, J. Wetzel, C. Wu, X. Hu, J. Prat, E. Mudrock, R. Hettinger, A. E. Cortina, R. G. Biswas, F. V. C. Kock, R. Soong, A. Jenne, B. Du, F. Hou, H. He, R. Lundeen, A. Gilbreath, R. Sutton, N. L. Scholz, J. W. Davis, M. C. Dodd, A. Simpson, J. K. McIntyre, and E. P. Kolodziej. 2021. A Ubiquitous Tire Rubber-Derived Chemical Induces Acute Mortality in Coho Salmon. Science 371(6525):185-189.

Turlock Irrigation District and Modesto Irrigation District. 2013. Don Pedro Project Ferc No. 2299 Draft License Application. Exhibit F - General Design Drawings (Public).

VanRheenen, N. T., A. W. Wood, R. N. Palmer, and D. P. Lettenmaier. 2004. Potential Implications of Pcm Climate Change Scenarios for Sacramento–San Joaquin River Basin Hydrology and Water Resources. Climatic Change 62(1-3):257-281.

Wade, A. A., T. J. Beechie, E. Fleishman, N. J. Mantua, H. Wu, J. S. Kimball, D. M. Stoms, and J. A. Stanford. 2013. Steelhead Vulnerability to Climate Change in the Pacific Northwest. Journal of Applied Ecology 50(5):1093-1104.

Washington Department of Fish and Wildlife. 2009. Section 7.6 Direct and Indirect Effects: Water Quality Modifications. pp. 66.

Westerling, A. L. and B. P. Bryant. 2007. Climate Change and Wildfire in California. Climatic Change 87(S1):231-249.

Westerling, A. L., B. P. Bryant, H. K. Preisler, T. P. Holmes, H. G. Hidalgo, T. Das, and S. R. Shrestha. 2011. Climate Change and Growth Scenarios for California Wildfire. Climatic Change 109(S1):445-463.

Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. Science 313(5789):940-943.

Williams, J. G. 2006. Central Valley Salmon: A Perspective on Chinook and Steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science 4(3):Article 2