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.: WCR-2017-6713

JUN 25 2018

Ms. Julie Myrah
Office Chief
California Department of Transportation
District 10 Environmental
P.O. Box 2048
Stockton, California 95205

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the 7th Street Bridge over the Tuolumne River Bridge Replacement Project

Dear Ms. Myrah:

Thank you for your letter of July 15, 2016, 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 California Department of Transportation's (Caltrans), in conjunction with the County of Stanislaus's 7th Street over the Tuolumne River Bridge Replacement Project (Project).

NMFS recognizes that Caltrans has assumed the Federal Highway Administration's (FHWA) responsibilities under Federal environmental laws for this project as allowed by a Memorandum of Understanding (NEPA Assignment) with the FHWA effective December 23, 2016.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

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

NMFS' review concludes that the Project will adversely affect the EFH of Pacific Coast Salmon in the action area and has included conservation recommendations, including adoption of the ESA reasonable and prudent measures and associated terms and conditions from the BO.

Caltrans has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed written response to NMFS within 30 days of receipt of these conservation recommendations.

Please contact Neal McIntosh at (916) 930-3721, or via e-mail at neal.mcintosh@noaa.gov, if you have any questions regarding this response or require additional information.

Sincerely,

for Barry A. Thom
Regional Administrator

Enclosure: Biological Opinion

cc: To the File 151422-WCR2016-SA00210

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Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation, and Fish and Wildlife Coordination Act Recommendations

7th Street Bridge Project in Stanislaus County
Federal Aid Project Number BRLS-5938(167)

National Marine Fisheries Service Consultation Number: WCR-2016-6713

Action Agency: California Department of Transportation (Caltrans)

Affected Species and NMFS' Determinations:

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

Fishery Management Plan That Describes 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: Maria Chan
for Barry A. Thom
Regional Administrator

Date: JUN 25 2018

List of Acronyms and Abbreviations

AMMs – avoidance and minimization measures
BA – biological assessment
BMPs – best management practices
BO – biological opinion
Caltrans – California Department of Transportation
CCV – California Central Valley
CCVO – California Central Valley Office
CDFW – California Department of Fish and Wildlife
CFR – Code of Federal Regulations
CV – Central Valley
CVRWQCB – Central Valley Regional Water Quality Control Board
Delta – Sacramento-San Joaquin Delta
DPS – distinct population segment
DQA – Data Quality Act
EFH – essential fish habitat
ESA – Endangered Species Act
ESU – evolutionarily significant unit
FHWG – Fisheries Hydroacoustic Working Group
FMP – Fisheries Management Plan
FR – Federal Register
FWCA – Fish and Wildlife Coordination Act
HAPCs – habitat areas of particular concern
ILF – in-lieu fee
ITS – incidental take statement
LWM – large woody material
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NTU – nephelometric turbidity unit
OHWM – ordinary high water mark
PAHs – polycyclic aromatic hydrocarbons
PBF – physical or biological feature
PCE – primary constituent element
RM – river mile
RMS – root mean square
RPA – reasonable and prudent alternative
RSP – rock slope protection
SEL – sound exposure level
SPCC – spill prevention, control, and countermeasures
USC – United States Code
USGS – United States Geological Survey
VSP – viable salmonid population
WPCP – water pollution control program

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 (BO) 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.

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 USC 1801 et seq.) and implementing regulations at 50 CFR 600.

Because the proposed action would modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources, and enabling the Federal agency to give equal consideration with other project purposes, as required under the Fish and Wildlife Coordination Act (FWCA) (16 USC 661 et seq.).

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 through NMFS' Public Consultation Tracking System https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts. A complete record of this consultation is on file at the NMFS California Central Valley Office (CCVO).

1.2 Consultation History

- The California Department of Transportation (Caltrans) requested a species list from NMFS on January 28, 2016
- NMFS provided a species list with conservation recommendations to Caltrans on February 8, 2016.
- On July 15, 2016, the NMFS West Coast Region – CCVO received a consultation initiation request and Biological Assessment (BA) from Caltrans for the 7th Street Bridge Replacement Project in Stanislaus County. Listed species and critical habitat in the action area include California Central Valley (CCV) steelhead DPS and their critical habitat. EFH for Pacific Coast Salmon occurs within the action area.
- On February 16, 2017, NMFS, Caltrans, and Stanislaus County agreed on a modified work window.
- On August 1, 2017, NMFS requested additional information about the fish capture and relocation that will occur as part of this project.
- On August 8, 2017, NMFS received additional information about the fish capture and relocation.
- On August 8, 2017, NMFS initiated formal consultation.

- On August 15, 2017, NMFS and Caltrans agreed to additional protection measures for pile driving and fish capture and relocation. These measures are described in the proposed action of this BO.

1.3 Proposed Federal Action

"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). Stanislaus County and the City of Modesto working in conjunction with Caltrans propose to replace the existing 7th Street Bridge over the Tuolumne River, in Modesto, California in Stanislaus County with a new bridge. This is a Federal aid project with Caltrans providing local assistance to Stanislaus County as the Federal action agency. The project will completely remove the existing structurally and hydraulically deficient bridge and replace it with a larger, safer bridge on the same alignment as the existing bridge. Work on this project is expected to begin in March 2018 and conclude in December 2019. In-water work will be conducted over two seasons from June 1 through October 15. Demolition of the existing bridge will occur during the first construction season. Construction of the new bridge will begin during the first construction season and conclude the following construction season. The existing 7th Street Bridge is composed of 14 spans with two abutments and 13 rectangular piers. The existing two-lane bridge deck is 1,165 feet long and 33 feet wide (33,445 square feet). The new bridge will be four lanes wide, composed of eight spans, supported by seven piers and two abutments. The new bridge deck will be 1,188 feet long and 86 feet wide (96,148 square feet).

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).

Under the FWCA, an action occurs whenever waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit of license (16 USC 662(a)).

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interrelated or interdependent actions associated with the Project.

1.3.1 Removal of Current Bridge

The existing bridge consists of two abutments and 13 rectangular piers that occupy approximately 5,850 square feet of the Tuolumne River floodplain and channel. The abutments for the existing bridge will be completely removed, including the footings. If the old abutment piles will interfere with the new footings or new piles they will be removed to three feet below the elevation of the bed of the river channel. For the cantilevered spans of the existing bridge above the floodplain, the midpoints of the connected spans and then the continuous top of pier locations of the existing bridge will likely be struck by excavators with concrete breakers and

hydraulic steel shears. This will cause the spans to collapse to the floodplain where they can be further broken up and removed. For the spans over the river channel, removal will likely occur in the reverse order of construction. Concrete will be removed from the steel trusses, then cranes will likely lift the spans off the piers, and the piers will be removed to at least three feet below the river channel bed elevation. Debris from the removal of concrete over the river channel will likely be caught on an underslung work platform or on a temporary work trestle. If required, the temporary work trestle will be composed of approximately 40, 12-inch diameter steel piles. Caltrans expects that the piles for the temporary trestle will be installed using an impact hammer. Two piers of the existing bridge, piers K and L, are at the edge of the river channel. Removal of piers K and L will be accomplished by placing gravel berms around each of the piers, and then using excavator-mounted hydraulic breakers to demolish the piers.

Cofferdams may be required to isolate piers K and L from the water. If used, cofferdams or other diversions will be placed so that they affect no more of the river channel than is needed to support demolition and construction activities. At no time will the entire river be blocked by water diversions, so fish passage will not be blocked. If needed, sheet piles for the cofferdams will be installed with vibratory hammers to avoid impact pile driving. If used, the cofferdam will be approximately 18 feet wide by 50 feet long. The cofferdam will require installation of approximately 40 sheet piles per pier (i.e. 40 each for Pier K and L). The total area to be dewatered will be approximately 1,800 square feet. The area behind the cofferdams will be dewatered slowly. As the area behind the cofferdams is dewatered, a fish capture and relocation of any isolated fish will occur as needed. The exact method of the fish capture and relocation will be communicated to NMFS before fish handling occurs. The most likely course of action for the fish capture and relocation will be that as water is drawn down behind the cofferdams, a NMFS approved, qualified fish biologist will dip net all fish observed. Fish will be identified, measured, put in a bucket, and transported to suitable downstream habitat. Following the fish capture and relocation, the remaining water will be pumped to a settling pond. Following removal of the piers, the sheet piles will be vibrated out and the area will be allowed to rewater slowly. Since the floodplain is typically dry, demolition over the floodplain could likely proceed during most of the year. Demolition over and in the channel would occur during the in-water work window of June 1 through October 15.

If cofferdams will be used, the area to be coffered will be surveyed for salmon or steelhead redds. It is unlikely that redds will be present in the proposed action area, but if they are, the applicant will notify NMFS immediately for advice on how to proceed. Fish salvage efforts will be conducted during coffering and dewatering activities under the direction of a fisheries biologist. Fish salvage will be performed following isolation of the area by sheet piles or gravel berms and will occur according to methods described by NMFS (2000) and the California Department of Fish and Wildlife (CDFW) scientific collection permit held by the attending fisheries biologist.

1.3.2 Construction of New Bridge

The new bridge will be constructed along the same alignment as the existing bridge. The abutments for the new bridge are proposed to be supported by cast-in-drilled-hole (CIDH) pilings. CIDH pilings are large diameter concrete piles that are cast in place into holes drilled to

the design depth with an auger. The hole is drilled, a reinforcing cage is lowered into the hole, and the hole is filled with concrete. In the event of an unstable hole, a dense biodegradable fluid ("slurry") or a steel casing may be used in the hole to keep it open. Excavation for the footings of the abutments will occur first, then the CIDH pilings will be installed, then concrete footings are formed around and atop the piles. To prevent scour, rock slope protection (RSP) will be placed on the sides and in front of the new abutments. Since construction of the abutments will be conducted away from the low-flow channel, work is not expected to occur within flowing water so coffering is not expected to be required. Abutment 1 will require 125 cubic yards (1,010 square feet) of RSP and abutment 2 will require 135 cubic yards (1,140 square feet) of RSP for a total of 260 cubic yards (2,150 square feet) for both abutments.

Each of the seven new bridge piers will be composed of two seven-foot diameter CIDH piles. The new bridge piers will occupy approximately 539 square feet of the Tuolumne River floodplain and river channel. Piers 2 and 3 of the new bridge are close to the river channel. It is likely that the CIDH piles for Piers 2 and 3 will be constructed out of the water. However, cofferdams or gravel berms may be required to isolate the work areas. If cofferdams are used, the area inside the dewatered cofferdam will be filled with clean, washed gravel to allow access for pile construction equipment. If cofferdams are used, the area to be dewatered will be approximately the same footprint of the area to be dewatered for the removal of the old piers K and L as described above, approximately 1,800 square feet.

Type-2 one-way flare columns will be constructed using steel column forms that will be placed on top of the CIDH piles and guyed for stability. Concrete pier caps will be built on top of the columns to support bridge spans. The pier caps will be rectangular-shaped and constructed using ground-supported falsework.

Following the construction of the pier caps, eight spans of precast, pre-stressed girders will be installed. The girders will be conveyed to the new bridge site on trailers that will drive onto the floodplain. Large cranes, also positioned on the floodplain, will set the precast girders atop the pier caps. Installation of the girders could potentially occur year round since the cranes are mobile and could likely be used from the floodplain except during periods of flooding.

After placement of the girders, smaller cranes will be used to lift forms and reinforcement for the concrete deck onto the top of the girders. Concrete pump trucks positioned at various locations on the floodplain will pump concrete for the deck. Standard best management practices (BMPs) for the use of concrete will be employed to prevent concrete from entering the river.

A temporary work trestle will likely be installed to allow access of cranes to install precast girders and deliver material across the river during construction of the arch span. The trestle will be installed downstream of the new bridge location. The trestle will be supported by approximately 40, 12-inch diameter steel piles. The trestle for the bridge construction is a separate trestle from the trestle that may be required for the removal of the old bridge. Both temporary trestles will require approximately 40, 12-inch steel piles. Many of the trestle piles will be driven into the floodplain, so pile driving for those piles will not occur in water. Some piles may be required within the active channel. Attenuation via wood block or bubble curtain

will be employed to reduce the effects of pile driving on listed fish species. The trestle may be left in place through the winter months.

1.3.3 Avoidance and Minimization Measures

Caltrans included the following avoidance and minimization measures (AMMs) for this project:

1.1.1.1 Measures for Operating Equipment in the Action Area

- AMM-1: Equipment will be operated during the least sensitive diurnal, seasonal, and meteorological periods relative to the potential effects on ESA-listed salmon and steelhead, and their habitat, to the extent feasible.

- AMM-2: Equipment will be inspected on a daily basis for leaks and completely cleaned of any external petroleum products, hydraulic fluid, coolants, and other deleterious materials prior to operating the equipment.

- AMM-3: A Spill Prevention, Control, and Countermeasures (SPCC) Plan will be developed to provide consistent, appropriate responses to spills that may be reasonably be expected with implementation of the project. The SPCC Plan will be kept on-site during construction and the appropriate materials and equipment will also be on-site during construction to ensure the SPCC Plan can be implemented. Personnel will be knowledgeable in the use and deployment of the materials and equipment so response to an accidental spill will be timely.

- AMM-4: Maintenance and fueling of construction equipment and vehicles will not occur within 150 feet of the flowing water of the Tuolumne River.

- AMM-5: Maintenance and construction activities will be avoided at night to the extent practicable. When night work cannot be avoided, disturbance of sensitive species and managed habitats (including EFH) will be avoided and minimized by restricting substantial use of temporary lighting to the least sensitive seasonal and meteorological windows. Lights on work areas will be shielded and focused to minimize fugitive lighting.

1.1.1.2 Measures for Managing/Controlling Materials in the Action Area

Implement AMM-3 and the following:

- AMM-6: Debris from demolition and construction activities will be disposed of off-site at an approved location where it cannot enter surface waters.

- AMM-7: An underslung work platform, temporary work trestle or similar structure will be installed to keep bridge debris and construction, maintenance, and repair materials from falling into the river during demolition and construction.

- AMM-8: Temporary sediment basins, if installed, will be cleaned of sediment and the site restored to pre-construction contours (elevations, profile, and gradient) and function post-construction.

1.1.1.3 Measures for Staging and Storing Equipment and Materials in the Action Area
Implement AMM-3 and the following:

- AMM-9: Construction staging and storage areas will be located a minimum of 150 feet from the flowing water of the Tuolumne River and from sensitive plant communities such as native riparian vegetation.

- AMM-10: Excavated material will not be stored or stockpiled in the channel. Any excavated material that will not be placed back in the channel or on the bank after construction will be end-hauled to an approved disposal site.

- AMM-11: Gravel and instream woody material (IWM) excavated from the channel that is temporarily stockpiled for reuse in the channel will be stored in a manner that prevents mixing with river flows. The removal of IWM should be minimized to the maximum extent practicable while maintaining design flows in the Action Area. Where appropriate, removed IWM should be anchored back into place to enhance habitat complexity and increase habitat value for salmonids.

1.1.1.4 Measures for Working in and Near Flowing Water
Implement AMM-3 and the following:

- AMM-12: "Wet–work" area(s) will be isolated from flowing water using cofferdams, gravel berms, or other methods approved by permitting agencies. Seasonal in-water work areas will be specified by regulatory agencies during project permitting, but are assumed to be June 1 through October 31.

- AMM-13: Cofferdams or other diversions will affect no more of the river channel than is necessary to support completion of the maintenance or construction activity. Immediately upon completion of in-channel work, temporary fills, cofferdams, diversions, and other in-channel structures that will not remain in the river (i.e., materials other than clean, spawning-sized gravel) will be removed in a manner that minimizes disturbance to the aquatic environment.

- AMM-14: All structures and imported materials placed in the river channel or on the banks during construction that are not designed to withstand high flows will be removed before such flows occur.

- AMM-15: Temporary fills, cofferdams, and diversions that are left in stream channels will be composed of washed, rounded, spawning-sized gravel between 0.4 to 4 inches in diameter; gravel in contact with flowing water will be left in place, modified (i.e., manually spread out using had tools if necessary) to ensure adequate passage for all life stages of fish present at the Action Area, and then allowed to disperse naturally by high winter flows; materials placed above the OHWM must be clean washed rock or contained to prevent material conveyance to the stream or mixing with clean gravel.

- AMM-16: The extent of dewatering will be limited to the minimum footprint (within coffered areas) necessary to support construction activities.

- AMM-17: A wood block or bubble curtain would be installed (prior to the driving of piles) to further reduce the effects of noise and vibration to fish associated with pile-driving activities when such activities occur in the water.

- AMM-18: The contractor will monitor turbidity levels in the river during construction and implement a plan that avoids unacceptable sedimentation and turbidity.

- AMM-19: Water pumped from areas isolated from surface water to allow construction to occur in the dry will be discharged to an upland area providing overland flow and infiltration before returning to the stream. Upland areas may include sediment basins of sufficient size to allow infiltration rather than overflow or adjacent dry gravel/sand bars if the water is clean and no visible plume of sediment is created downstream of the discharge. Other measures may be used to settle and filter water such as Baker tanks.

- AMM-20: A NMFS-approved fish biologist will be onsite to observe de-watering activities and to capture/rescue any fish that are observed in an isolated area during dewatering activities.

- AMM-21: Drilling will be conducted in dry river channel areas, to the extent practicable. If drilling must occur where water is present, the work area will be isolated from live water prior to work.

- AMM-22: When geotechnical drilling takes place within the river channel, including gravel beds and bars, drilling mud will be bentonite without additives; initial drilling through gravel will be accomplished using clean water as a lubricant; after contact with bedrock or consolidated material, drilling mud (i.e., bentonite clay) may be used. All drilling fluids and materials will be self-contained and removed from the site after use; drilling will be conducted inside a casing so that all spoils are recoverable in a collection structure.

- AMM-23: Stream width, depth, velocity, and slope that provide upstream and downstream passage of adult and juvenile fish will be preserved according to current NMFS and CDFW guidelines and criteria or as developed in cooperation with NMFS and CDFW to accommodate site-specific conditions.

- AMM-24: Stream flow through new and replacement culverts and bridges, and over existing stream gradient control structures, must meet the velocity, depth, and other passage criteria for salmonid streams as described by the current NMFS and CDFW guidelines or as developed in cooperation with NMFS and CDFW to accommodate site-specific conditions.

- AMM-25: Rock slope protection (RSP), sheet piles, and other erosion control materials will be pre-washed to remove sediment and/or contaminants.

- AMM-26: Temporary material storage piles (e.g., RSP) will not be placed in the 100-year floodplain during the rainy season (October 15 through May 31), unless material can be relocated within 12 hours before the onset of a storm.

- AMM-27: When concrete is poured to construct bridge footings or other infrastructure in the vicinity of flowing water, work must be conducted to prevent contact of wet concrete with water (e.g., within a cofferdam). Concrete or concrete slurry will not come into direct contact with flowing water.

1.1.1.5 Measures for Working in and Near the Riparian Corridor

Implement AMM-3 and the following:

- AMM-28: Environmentally Sensitive Areas will be fenced to prevent encroachment of equipment and personnel into riparian areas, stream channels and banks, and other sensitive habitats.

- AMM-29: Trees as identified in any special contract provisions or as directed by the Project Engineer will be preserved. Hazard trees greater than 24 inches in diameter at breast height (DBH) will be removed only under the supervision of the Project Biologist. Trees will be felled in such a manner as not to injure standing trees and other plants to the extent practicable.

- AMM-30: Where vegetation removal is temporary to support construction activities, native species will be re-established that are adapted to the project location and that contribute to a diverse community of woody and herbaceous plants.

- AMM-31: Disturbance and removal of aquatic vegetation will be minimized. The limits of disturbance will be identified; native vegetation, stream channel substrate, and IWM disturbed outside these limits should be replaced if damaged. The minimum amount of wood, sediment and gravel, and other natural debris will be removed using hand tools, where feasible, only as necessary to maintain and protect culvert and bridge function, ensure suitable fish passage conditions, and minimize disturbance of the streambed.

- AMM-32: Soil compaction will be minimized by using equipment that can reach over sensitive areas and that minimizes the pressure exerted on the ground. Where soil compaction is unintended, compacted soils will be loosened after heavy construction activities are complete.

- AMM-33: IWM subject to damage or removal will be retained and replaced on site after project completion as long as such action would not jeopardize infrastructure or private property or create a liability. IWM not replaced on-site will be stored or offered to other entities for use in other mitigation/restoration projects where feasible.

- AMM-34: Vegetation disturbance will be minimized by locating temporary work areas to avoid patches of native aquatic vegetation, substantial IWM, and spawning gravel. Where vegetation removal is temporary to support construction activities, native species will be re-established that are specific to the project location and that comprise a diverse community of aquatic plants.

- AMM-35: Where river bed material is removed temporarily to facilitate construction, it will be stored adjacent to the site, then placed back in the channel post-construction at approximately pre-project depth and gradient.

- AMM-36: Existing roadways will be used for temporary access roads whenever reasonable and safe. The number of access and egress points and total area affected by vehicle operation will be minimized; disturbed areas will be located to reduce damage to existing native aquatic vegetation, substantial large woody debris, and spawning gravel.

- AMM-37: Modified or disturbed portions of streams, banks, and riparian areas will be restored as nearly as possible to natural and stable contours (elevations, profile, and gradient). At project completion, the riverbank toe will not extend farther into the active channel than the existing riverbank toe location.

- AMM-38: The extent of bank and channel armoring (e.g., RSP) will be limited to the minimum necessary to protect essential infrastructure. Threatened infrastructure will be relocated to maintain or reestablish natural stream sediment processes to the extent feasible.

- AMM-39: Bank stabilization will incorporate bioengineering solutions consistent with site-specific engineering requirements. Where RSP is necessary, native riparian vegetation and/or IWM may be incorporated into the RSP.

1.1.1.6 Measure Implementation and Compliance

- AMM-40: Stanislaus County shall retain a qualified biologist with expertise in the areas of anadromous salmonid biology, including handling, collecting, and relocating salmonids, salmonid/habitat relationships, and biological monitoring of salmonids. Stanislaus County shall ensure that all biologists working on the project will be qualified to conduct fish collections in a manner which minimizes potential risks to salmonids. The qualified biologist should be approved by NMFS.

- AMM-41: If individuals of sensitive aquatic species may be present and subject to potential injury or mortality from construction activities, a qualified biologist will conduct a preconstruction visual survey (i.e., bank observations).

- AMM-42: When sensitive aquatic species are present in the Action Area and it is determined that they could be injured or killed by construction activities, a qualified project biologist will identify appropriate methods for capture, handling, exclusion, and relocation of individuals or resources that could be affected. Where such resources cannot be feasibly

captured, handled, excluded, or relocated (e.g., salmonid redds), actions that could injure or kill individual organisms or harm resources will be avoided or delayed until the species leaves the affected area or the organism reaches a stage that can be captured, handled, excluded, or relocated.

- AMM-43: The project biologist will conduct, monitor, and supervise all capture, handling, exclusion, and relocation activities; ensure that sufficient personnel are available for safe and efficient collection of listed species; and ensure that proper training of personnel has been conducted in identification and safe capture and handling of sensitive aquatic species.

- AMM-44: Electrofishing may be used when other standard fish capture methods are likely to be ineffective or other methods fail to remove all fish from the site; the project biologist must have appropriate training and experience in electrofishing techniques and all electrofishing must be conducted according to the NMFS (2000) Guidelines for Electrofishing.

- AMM-45: Individual organisms will be relocated the shortest distance possible to habitat unaffected by construction activities. Within occupied habitat, capture, handling, exclusion, and relocation activities will be completed no earlier than 48 hours before construction begins to minimize the probability that listed species will recolonize the affected areas.

- AMM-46: Within temporarily drained stream channel areas, salvage activities will be initiated before or at the same time as stream area draining and completed within a time frame necessary to avoid injury and mortality of sensitive aquatic species.

- AMM-47: For projects that involve in-water activities, the project biologist will continuously monitor in-water activities (e.g., placement of cofferdams, dewatering of isolated areas) for the purpose of removing and relocating any listed species that were not detected or could not be removed and relocated prior to construction. The project biologist will be present at the work site until all sensitive species to be removed from a project site have been removed and relocated.

- AMM-48: The project biologist will maintain detailed records of the species, numbers, life stages, and size classes of listed species observed, collected, relocated, injured, and killed, as well as recording the date and time of each activity or observation.

- AMM-49**:** Before construction activities begin, the project environmental coordinator or biologist will discuss the implementation of the required BMPs with the maintenance crew or construction resident engineer and contractor, and identify and document environmentally sensitive areas and potential occurrence of listed species.

- AMM-50: Before construction activities begin, the project environmental coordinator or biologist will conduct a NMFS-approved worker awareness training session for all construction personnel that describes the listed species and their habitat requirements, the

specific measures being taken to protect individuals of listed species in the project area, and the boundaries within which project activities will be restricted. Written documentation of training should be submitted to NMFS within 30 days of the completion of training.

- AMM-51: Stanislaus County will designate a biological monitor to monitor on-site compliance with all project BMPs and any unanticipated effects on listed species. Non-compliance with BMPs and unanticipated effects on listed species will be reported to the resident engineer or maintenance supervisor immediately. When non-compliance is reported, the resident engineer or maintenance supervisor will implement corrective actions immediately to meet all BMPs; where unanticipated effects on listed species cannot be immediately resolved, the resident engineer or maintenance supervisor will stop work that is causing the unanticipated effect until the unanticipated effects are resolved.

Additional AMMs that were not included in the BA, but that were agreed upon or clarified on August 15, 2017, and include:

- Pile driving will not occur at night in order to provide time for fish to migrate through the area without being exposed to acoustic effects.

- If a fish capture/relocation is required it will be carried out by a qualified fisheries biologist.
    - Fish will be handled with extreme care to minimize stress.
    - Fish will be kept in cool, shaded, aerated water.
    - Fish will be protected from excessive noise, excessive handling, temperature variation, jostling, or overcrowding while they are in captivity during relocation.
    - Fish will only be removed from water when ready for release.
    - Juvenile salmonids will be separated from older salmonids and other potential aquatic predators.

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 provides 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 non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This BO includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that 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 BO relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designation of critical habitat for CCV steelhead uses the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace 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.

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This BO 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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. This BO also examines the condition of critical habitat throughout the designated area, evaluates the value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that value for the conservation of the species.

In 2016, NMFS completed a status review of 28 species of Pacific salmon, steelhead and eulachon, including CCV steelhead, and concluded that the species' status should remain as previously listed (81 FR 33468). The 2016 status review for CCV steelhead found that, although the listing should remain unchanged, the status of this population has suffered in 2014 and 2015 from the unprecedented California drought (NMFS 2016a). The previous status review of the CCV steelhead DPS (NMFS 2011) found that the status of the population appeared to have worsened since the 2005 status review (Good *et al.* 2005), when it was considered to be in danger of extinction.

The description of the status of species and conditions of the designated critical habitat in this BO are a synopsis of the detailed information available on NMFS' West Coast Regional website. Table 1 below includes the federally listed species evolutionarily significant units (ESUs) or DPSs and designated critical habitat that occur in the action area and may be affected by the proposed action.

http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/steelhead/california_central_valley/california_central_valley_steelhead.html

Table 1. ESA listing history.

Species	Scientific Name	Original Final Listing Status	Current Final Listing Status	Critical Habitat Designated
California Central Valley steelhead DPS	*Oncorhynchus mykiss*	3/19/1998 63 FR 13347 Threatened	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488

2.2.1 California Central Valley Steelhead

Detailed information regarding DPS listing history, DPS life history, and viable salmonid population (VSP) parameters can be found in the NMFS 2014 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon, Central Valley Spring-Run Chinook Salmon, and the Distinct Population Segment of California Central Valley Steelhead (Recovery Plan) (NMFS 2014).

Summary of CCV Steelhead DPS Viability

All indications are that natural-origin CCV steelhead have continued to decrease in abundance and in the proportion of naturally spawned fish to hatchery produced fish (Good *et al.* 2005, NMFS 2016a); the long-term abundance trend remains negative. Hatchery production and returns are dominant over natural-origin fish, and one of the four Central Valley hatcheries is dominated by Eel/Mad River origin steelhead stock. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin-clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts captured in monitoring studies has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin basin continue to show an overall very low abundance, and fluctuating return rates (NMFS 2016a). Lindley *et al.* (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley *et al.* (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The widespread distribution of natural-origin CCV steelhead in the Central Valley provides the spatial structure necessary for the DPS to survive and avoid localized catastrophes. However, most natural-origin CCV steelhead 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 (NMFS 2011). 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.

According to the 2016 status review, (NMFS 2016a), there are some encouraging signs, as several hatcheries in the Central Valley have experienced increased returns of steelhead over the last few years. There has also been a slight increase in the percentage of wild steelhead in salvage at the south Sacramento-San Joaquin Delta (Delta) fish facilities, and the percentage of wild fish in those data remains much higher than at Chipps Island. 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 (natural-origin) steelhead at Chipps Island is still less than five percent 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.

According to the NMFS Recovery Plan (NMFS 2014), in order for CCV steelhead to be considered for delisting, the following criteria must be met: one population in the Northwestern California Diversity Group at low risk of extinction, two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction, four populations in the Northern Sierra Nevada Diversity Group at low risk of extinction, two populations in the Southern Sierra Nevada Diversity Group at low risk of extinction, and maintaining multiple other populations at moderate risk of extinction.

Critical Habitat: Physical or Biological Features for CCV Steelhead

Critical habitat for CCV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries, and the waterways of the Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high water mark (OHWM). In areas where the OHWM has not been defined, the lateral extent will be defined by the bankfull elevation which is the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series (Bain and Stevenson 1999) (70 FR 52488). Critical habitat for CCV steelhead is defined as specific areas that contain the PBFs and physical habitat elements essential to the conservation of the species. The following are the inland habitat types used as PBFs for CCV steelhead:

1. Freshwater Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most of the available spawning habitat for steelhead in the Central Valley is located in areas directly downstream of dams due to inaccessibility to historical spawning areas upstream and the fact that dams are typically built at high gradient locations. These reaches are often impacted by the upstream impoundments, particularly over the summer months, when high temperatures can have adverse effects upon salmonids spawning and rearing downstream of the dams. Even in degraded reaches, spawning habitat has a high value for the conservation of the species as its function directly affects the spawning success and reproductive potential of listed salmonids.

2. Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and survival; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large woody material (LWM), log jams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing

habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Freshwater rearing habitat also has a high value for the conservation of the species even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

3. Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream and downstream passage of adults, and the emigration of smolts. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For this reason, freshwater migration corridors are considered to have a high value for the conservation of the species even if the migration corridors are significantly degraded compared to their natural state.

4. Estuarine Areas

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PBF. Natural cover such as submerged and overhanging LWM, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging. Estuarine areas are considered to have a high value for the conservation of the species as they provide factors which function to provide predator avoidance and as a transitional zone to the ocean environment.

2.2.2 Global Climate Change

One factor affecting the range-wide status of CCV steelhead and aquatic habitat at large is climate change.

The world is about 1.3°F warmer today than a century ago and the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees in the 21st century (Intergovernmental Panel on Climate Change (IPCC) 2007). Much of

that increase likely will occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes *et al.* 1998). Using objectively analyzed data Liu and Huang (2000) estimated a warming of about 0.9°F per century in the Northern Pacific Ocean.

Sea levels are expected to rise by 0.5 to 1.0 meters in the northeastern Pacific coasts in the next century, mainly due to warmer ocean temperatures, which lead to thermal expansion much the same way that hot air expands. This will cause increased sedimentation, erosion, coastal flooding, and permanent inundation of low-lying natural ecosystems (*e.g*., salt marsh, riverine, mud flats) affecting listed salmonid PBFs. Increased winter precipitation, decreased snow pack, permafrost degradation, and glacier retreat due to warmer temperatures will cause landslides in unstable mountainous regions and destroy fish and wildlife habitat, including salmon-spawning streams. Glacier reduction could affect the flow and temperature of rivers and streams that depend on glacier water, with negative impacts on fish populations and the habitat that supports them.

Summer droughts along the South Coast and in the interior of the northwest Pacific coastlines will mean decreased stream flow in those areas, decreasing salmonid survival and reducing water supplies in the dry summer season when irrigation and domestic water use are greatest. Global warming may also change the chemical composition of the water that fish inhabit: the amount of oxygen in the water may decline, while pollution, acidity, and salinity levels may increase. This will allow for more invasive species to overtake native fish species and impact predator-prey relationships (Petersen and Kitchell 2001, Stachowicz *et al.* 2002).

In light of the predicted impacts of global warming, the California Central Valley has been modeled to have an increase of between 2 and 7 degrees Celsius by 2100, with a drier hydrology predominated by rainfall rather than snowfall (Dettinger 2004, Hayhoe *et al.* 2004, VanRheenen 2004, Stewart *et al.* 2005). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring and summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist downstream of existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures in rivers downstream of reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids that must hold and/or rear in the river downstream of the dams over the summer and fall periods.

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 action area for this project is along 7th Street in Modesto between Zeff Road and Tuolumne Boulevard in Stanislaus County, California. The proposed project's action area is within the Riverbank United States Geological Survey (USGS) 7.5 minute quadrangle. The center of the 7th

Street Bridge is located at 37.626443° N, -120.993592° W. The bridge crosses the Tuolumne River approximately 15.7 river miles (RM) upstream of its confluence with the San Joaquin River. The proposed project's action area includes the project footprint at the bridge site, and includes 293 linear meters upstream and downstream of the bridge, for a total of 586 linear meters (1,922.6 feet, 0.36 miles) of the Tuolumne River. The action area includes the portion of the river where listed fish and critical habitat are determined to likely experience potential adverse effects resulting from the project including sedimentation, turbidity, and hydroacoustic impacts.

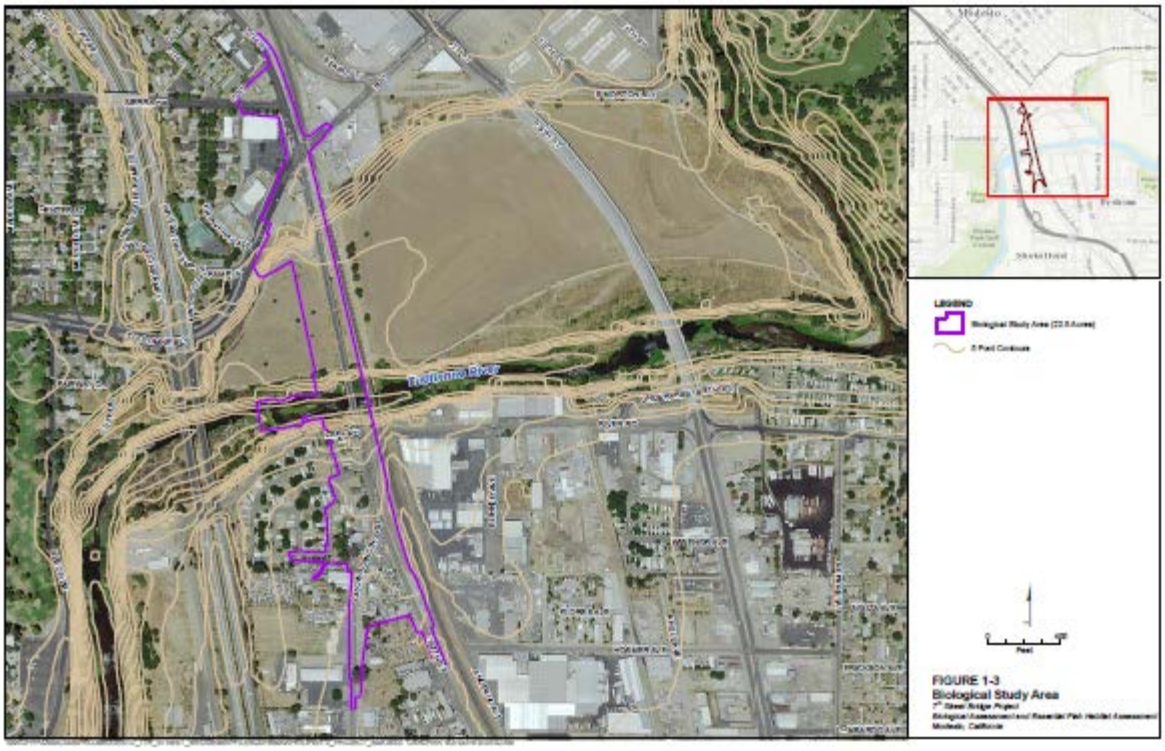

Figure 1. Proposed project's action area (from Caltrans 2016).

2.4 Environmental Baseline

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 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

2.4.1 Status of Listed Species in the Action Area

The proposed project's action area functions primarily as rearing habitat and as a migration corridor for CCV steelhead.

The Tuolumne River serves as migratory corridor for both upstream and downstream migration, connecting spawning habitat within the upper Tuolumne River to the San Francisco Bay estuary and the Pacific Ocean. Adults can be found in the Tuolumne River primarily during the fall and winter seasons while juveniles occupy the river during the first half of the year. Juvenile rearing tends to occur in areas with cool, clear fast-moving water where riffle habitat is predominant over pool habitat (Moyle 2002). Therefore, it is more likely that juveniles found within the action area will be migrating rather than rearing. Juvenile steelhead may be present at medium relative abundance through July. Adults are not expected to be present in the action area in most of the proposed work window, but may be present in low numbers in September and October (G. Murphey, *pers. comm.* 2017).

According to the 2016 status review (NMFS 2016a), the license for the Don Pedro Project on the Tuolumne River, owned by Turlock & Modesto Irrigation Districts, expired in May 2016. This project is going through the relicensing process now. This project has been voluntarily releasing more summer flow than required under their current license, and there has been a small improvement in *O. mykiss* snorkel counts in the Tuolumne River since 1996 (Ford and Kirihara 2009), though these are small improvements from an extremely low baseline. Fewer than 100 fish were observed (river wide) in 65 percent (17 of 26) of years between 1982 and 2009. The highest counts, by some margin, were observed in the high water years of 2006 and 2011, with declining counts in each of the drier years following one of the wet years (Stillwater Sciences 2014).

2.4.2 Status of Critical Habitat in the Action Area

The action area includes designated critical habitat for CCV steelhead. PBFs within the action area for CCV steelhead include (1) freshwater rearing sites and (2) freshwater migration corridors. Both of these PBFs have been degraded from their historical condition due to human activity on and near the Tuolumne River. Naturally occurring floodplain habitat has been largely removed in the vicinity of the action area due to bank revetment and other levee repair actions, limiting habitat value for juvenile rearing. Similarly, habitat complexity has been reduced due to revetment activities and removal of vegetation, reducing macroinvertebrate production, shelter from predators, and thermal refugia.

2.4.3 Factors Affecting Listed Species and Critical Habitat in the Action Area

The action area encompasses a small portion of the area utilized by the CCV steelhead DPS. This section will focus on the specific factors in the action area that are most relevant to the proposed project.

The Tuolumne River has been degraded from its historic condition. Many anthropomorphic and naturally occurring factors have led to the decline of anadromous fish in the surrounding lotic ecosystem. Due to the construction of La Grange and New Don Pedro Dams as well as various other dams and water diversions constructed on the Tuolumne River, flows and temperatures through the action area have been altered from their natural and historic regimes. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices upstream require peak flood discharges to be held back and released over

a period of weeks to avoid overwhelming the flood control structures downstream of the reservoirs (*i.e.* levees and bypasses). Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extended the reservoir releases over a longer period. These actions reduce or eliminate the scouring flows necessary to mobilize gravel and clean sediment from the spawning reaches of the river channel and disrupt natural sediment transfer in general. Altered flow regimes can influence migratory cues, water quality (including contaminants, dissolved oxygen, and nutrients for primary productivity), and temperature.

Drought conditions have played a significant role in the past 4 years as flows have decreased and temperatures have increased, leading to unfavorable environmental conditions in the river. This has resulted in direct and indirect impacts to listed fish as well as impacts to critical habitat. Increased temperatures have the potential to disrupt aquatic macroinvertebrate production, leading to declines in food availability in the action area (Ward and Stanford 1982). In addition, due to low-flows, high concentrations of inorganic nutrients from agricultural activity may occur in the action area (Paerl *et al.* 2011). For CCV steelhead, rearing site and migration corridor PBFs have been partially degraded as a result of flow and temperature alteration due to dam construction.

Artificially-created levees have been constructed along the banks of the Tuolumne River, substantially reducing the density of riparian vegetation within the action area. Riparian vegetation provides a host of ecosystem services and its removal has diminished habitat value within the action area. Riparian vegetation plays a key role in the value for the conservation of the species of rearing habitat for all salmonid life stages. It provides shading to lower stream temperatures; increases the recruitment of large woody material into the river, increasing habitat complexity; provides shelter from predators; and enhances the productivity of aquatic macroinvertebrates (Anderson and Sedell 1979, Pusey and Arthington 2003). It has also been shown to directly influence channel morphology and may be directly correlated with improved water quality in aquatic systems (Schlosser and Karr 1981, Dosskey *et al.* 2010).

Point and non-point sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of and within the action area. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish. Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high trace element (*i.e.* heavy metals) concentrations may deleteriously affect early life-stage survival of fish in the San Joaquin River (U.S. Fish and Wildlife Service (USFWS) 1995).

2.4.4 Importance of the Action Area to the Survival and Recovery of Listed Species

The Tuolumne River in the action area contains rearing habitat and a migration corridor for juvenile CCV steelhead. The proposed project's action area comprises approximately 586 linear meters of the river (0.36 RM). The Tuolumne River totals 53.32 RM from La Grange Dam to the confluence of the San Joaquin River, making the action area approximately 0.67% of the total length of possible rearing habitat in the Tuolumne River. The lower Tuolumne River is classified as a Core 2 watershed for CCV steelhead in the recovery plan (NMFS 2014). Core 2 watersheds have "populations [that] meet, or have the potential to meet, the biological recovery standard for

moderate risk of extinction" (NMFS 2014). Besides maintaining any Core 2 populations, establishing and maintaining two viable populations of CCV steelhead in the San Joaquin River basin (southern Sierra Nevada diversity group) is vital to the recovery of the species (NMFS 2014).

Since it provides passage for CCV steelhead between the Delta and their spawning habitat upstream, the migration corridor PBF is important for their survival and recovery. Adult CCV steelhead return from the ocean via the Tuolumne River to spawn upstream.

2.4.5 Climate Change

Rangewide climate change information for CCV steelhead is presented in section 2.2.2 of this opinion.

In the future, the action area will likely experience additional changes in environmental conditions due to climate change. These changes may overlap with the direct and indirect effects of long term proposed actions. Thus, for long-term actions, we can no longer assume current environmental variability adequately describes environmental baseline conditions. Instead, we need to project baseline conditions into the future, synchronizing our projections with the duration of the effects of the proposed action we are analyzing.

Within the context of the relatively brief period of time over which the proposed action is scheduled to be constructed, however, the near term effects of global climate change are unlikely to result in any perceptible declines to the overall health or distribution of CCV steelhead within the action area that are the subject of this consultation.

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

The proposed action includes activities that may directly or indirectly impact CCV steelhead or its critical habitat. The following is an analysis of the potential direct and indirect effects to CCV steelhead and its critical habitat that is likely to occur as a result of implementing the 7th Street Bridge Replacement Project

2.5.1 Effects of the Proposed Action to Listed Fish Species

For our analysis on the effects of the proposed action to listed species, we have used the presence of species in the action area from the *Environmental Baseline* section of this BO to determine the species, life stage, and specific months they are present for determining exposure to project impacts. The in-water construction period will occur from June 1 through October 15 over two seasons. Adult CCV steelhead may be present in the Tuolumne River from September through

May, and therefore may overlap with in-water work during the September and October months. Some CCV steelhead juveniles may still be moving through the action area through June.

The following sections analyze the potential effects of the proposed project activities to listed CCV steelhead due to: 1) pile driving and acoustic impacts, 2) increased sedimentation and turbidity, 3) general construction-related effects, 4) contaminants and pollution-related effects, 5) dewatering of coffer dams and/or attenuation casings, 6) fish capture and relocation, and 7) loss and degradation of habitat.

1) Pile Driving and Acoustic Impacts

Piles that are driven into river bed substrate propagate sound through the water which can damage a fish's swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder (Gisiner 1998, Popper *et al.* 2006). The swim bladder is the primary physiological mechanism which controls a fish's buoyancy. A perforated or hemorrhaged swim bladder has the potential to compromise the ability of a fish to orient itself both horizontally and vertically in the water column. This can result in diminished ability to feed, migrate, and avoid predators. Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish's viscera (Gaspin 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings 1995). It is important to note that acute injury resulting from acoustic impacts should be scaled based on the mass of a given fish. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper and Hastings 2009).

Fish can also be injured or killed when exposed to lower sound pressure levels for longer periods of time. Hastings (1995) found death rates of 50 percent and 56 percent for gouramis (*Trichogaster sp*.) when exposed to continuous sounds at 192 dB at 400 Hz and 198 dB at 150 Hz, respectively, and 25 percent for goldfish (*Carassius auratus*) when exposed to sounds of 204 dB at 250 Hz for two hours or less. Hastings (1995) also reported that acoustic "stunning," a potentially lethal effect resulting in a physiological shutdown of body functions, immobilized gourami within eight to thirty minutes of exposure to the aforementioned sounds.

Multiple studies have shown responses in the form of behavioral changes in fish due to human-produced noise (Wardle *et al.* 2001, Slotte *et al.* 2004, Popper and Hastings 2009). Instantaneous behavioral responses may range from mild awareness to a startle response. Fish may also exhibit movements that displace them from a position normally occupied in their habitat for short or long durations. Depending on the innate behavior that is being disrupted, the direct and indirect adverse effects could be varied. This is of particular concern for juvenile fish as there are innate behaviors that are essential to their maturation and survival such as feeding, sheltering, and migratory patterns. An example of a significant, direct adverse effect would be cessation or alteration of migratory behavior. In the context of the proposed action area, the migratory behavior of juvenile salmonids may be affected by various pile driving and acoustic impacts. Though pile driving may affect or delay migratory behavior, it is not expected to prevent salmonids from passing upstream or downstream because pile driving will not be continuous through the day, and will not occur at night, when the majority of fish migrate.

Based on recommendations from the Fisheries Hydroacoustic Working Group (FHWG), NMFS uses a dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (FHWG 2008). For a single strike, the peak exposure level above which injury is expected to occur is 206 dB. However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB. So, the accumulated sound exposure level (SEL) level above which injury of fish is expected to occur is 187 dB for listed fish not less than 2 grams and 183 dB for fish less than 2 grams. If either the peak SEL or the accumulated SEL threshold is exceeded, then physical injury is expected to occur. Behavioral effects may still occur below these thresholds for injury. NMFS uses a 150 dB root mean square (RMS) threshold for behavioral responses in salmonids. Though the dB value is the same, the 150 dB_{RMS} threshold for behavioral effects is unrelated to the 150 dB effective quiet threshold.

The removal of the old bridge and the construction of the new bridge site will require the installation of temporary work trestles. The temporary work trestles will be supported by 40, 12-inch diameter steel piles. Caltrans expects that the piles for the temporary trestle will be installed using an impact hammer. According to Caltrans (2012), the unmitigated installation of 12-inch steel piles with the use of an impact hammer will result in single-strike sounds levels of 192 dB_{peak} and 177 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 170 dB. Due to the variations and uncertainties with degree of attenuation, Caltrans (2012) recommends that the assumed attenuation for any attenuation device be limited to 5 dB. As such, with the use of attenuation such as a bubble curtain, the maximum single-strike sound level is conservatively estimated to be 187 dB_{peak} and 172 dB_{RMS} at 10 meters (32.8 feet) from the pile and an estimated SEL of 165 dB.

Sheet piles for coffer dams will be installed with a vibratory hammer. Since the acoustic effects are less by using a vibratory hammer, Caltrans does not plan to employ any additional methods to attenuate the sound caused by installing the sheet piles. Currently, NMFS does not have established thresholds for the use of vibratory hammers. Vibratory hammers could cause mechanical stress to eggs (J. Pearson-Meyer, *pers. comm.* 2017), but the action area does not serve as a spawning area for listed salmonids so effects due to vibratory hammers will not be considered further in this BO.

For the acoustic analysis for the 12-inch steel pipes, Caltrans estimated 3000 strikes per day with the impact hammer. Distances to the thresholds for acoustic effects at the 7th Street Bridge are summarized in Table 2. If the 12-inch steel piles are installed with attenuation, physical injury due to cumulative sound exposure is likely to occur out to 71 meters for fish greater than 2 grams and out to 100 meters for fish less than 2 grams, and non-injurious behavioral responses are expected out to 293 meters. Caltrans estimates that each pile may require up to 300 strikes and 10 piles may be installed a day. So, for the 40, 12-inch piles for the temporary trestles, a total of 12,000 strikes may be required per trestle. Since Caltrans plans to build a separate trestle for both removal of the old bridge and construction of the new bridge, the 12,000 total strikes will likely be conducted during each of the two working seasons, or 62,000 strikes per construction season. We expect that small numbers of juvenile CCV steelhead will have a behavioral response and fewer will be injured or due to pile driving primarily in the month of June. We expect that adult

CCV steelhead will have a behavioral response to pile driving and will not be injured or killed as a result of this avoidance behavior.

Table 2 Acoustic effects at the 7th Street Bridge in Modesto, CA.

Pile Type	Driver Type	Number of Strikes Per Pile	Strikes Per Day	Reference Distance (m)	Attenuation (dB)	Peak (dB)	SEL (dB)	RMS (dB)	Distance (m) to Threshold			
									Onset of Physical Injury			Behavior
									Peak dB	Cumulative SEL dB		RMS dB
										Fish >2 g	Fish < 2 g	
									206 dB	187 dB	183 dB	150 dB
12-inch steel pile	Impact	300	3000	10	0	192	170	177	1	153	215	631
12-inch steel pile	Impact	300	3000	10	5	187	165	172	1	71	100	293

2) Increased Sedimentation and Turbidity

Increased sedimentation and turbidity may result from a number of sources associated with the proposed project. The use of heavy equipment in and along the river banks, removing piles, and driving piles may cause turbidity within the action area. Increased sedimentation and turbidity are expected to have varying effects among different life stages of CCV steelhead that are expected to be present in the action area during the proposed in-water construction window. High levels of suspended sediment reduces the ability of listed fish to feed and respire, resulting in increased stress levels and reduced growth rates, and a reduced tolerance to fish diseases and toxicants (Waters 1995). CCV steelhead are not known to spawn in the action area, therefore egg life stages are not expected to be present. Juvenile CCV steelhead are known to rear in and migrate through the proposed action area, and may be present during the scheduled in-water work window. In a lab study, juvenile steelhead and coho salmonids were found to occupy a parcel of water by choice between 57 and 77 nephelometric turbidity units (NTU) (Sigler *et al.* 1984). This result suggests that juvenile salmonids may not exhibit avoidance behavior in low to moderate turbidities during migration. One effect of turbidity that has important implications for juvenile salmonids is that predator avoidance behavior has been shown to decrease at increased levels of turbidity (Gregory 1993). Growth and survival amidst increased sediment and turbidity levels has also been shown to decrease resulting from reduced prey detection and availability and physical injury due to increased activity, aggression, and gill fouling (Sigler *et al.* 1984, Suttle *et al.* 2004, Kemp *et al.* 2011).

Based on the proposed project description and associated AMMs, sedimentation events and elevation of turbidity associated with construction are expected to be localized, minor, transient in nature and not expected to exceed background levels beyond 500 feet downstream of the construction site. As such, the adverse effects to juvenile CCV steelhead are expected to be include injury or death from predation during the month of June within a 500 foot area spanning the entire channel of the Toulumne River downstream of the bridge construction site. Adult steelhead are not expected to be adversely affected do to their larger size and ability to avoid predators.

3) Instream Construction-related Effects

Adult and juvenile CCV steelhead may be impacted by instream construction activities in the form of behavioral responses from noise and disturbance caused by construction activities that cause them to to swim away from the action area. This avoidance behavior may result in short-term stress to individual fish from being displaced from their rearing area and needing to locate a new rearing area, which may result in: crowding and competition with resident fish for food and habitat, which can lead to reduced growth, and increased predation risk while they are locating a new rearing area. However, displaced fish will likely locate to areas downstream that have suitable habitat and low competition, therefore these potential adverse effects are not expected to occur. Because only a small number of CCV steelhead are likely to be in the action area and temporarily displaced by the proposed project, it is not expected to affect the survival chances of individual fish or affect the population based on the size of the area that will be affected and the small number of fish likely to be displaced.

Instream construction activities are expected to cause mortality of, or reduced abundance of benthic aquatic macroinvertebrates within the area where the bridge repairs will occur. Effects to aquatic macroinvertebrates from coarse sediment smothering will be temporary because post construction the stream will be restored to its original contours and rapid recolonization (about two weeks to two months) is expected (Merz and Chan 2005). Furthermore, downstream drift is expected to temporarily benefit any downstream, drift-feeding organisms, including juvenile CCV steelhead. The benthic macroinvertebrate production within the site is expected to increase when the project is complete. The amount of food available for juvenile CCV steelhead is therefore expected to return to pre-project conditions, at a minimum. Although juvenile CCV steelhead may be exposed to construction areas with reduced prey base, juveniles will be able to move to adjacent suitable habitat, and food resources will only be temporarily impacted.

Though there may be some temporary effects to food resources for juvenile CCV steelhead and some temporary disturbance to juvenile and adult CCV steelhead due to construction effects, they are not expected to result in adverse effects.

4) Contaminants and Pollution-related Effects

During construction, the potential exists for spills or leakage of toxic substances that could enter the Tuolumne River. Refueling, operation, and storage of construction equipment and materials could result in accidental spills of pollutants (e.g., fuels, lubricants, concrete, sealants, and oil). High concentrations of contaminants can cause direct and indirect effects on fish. Potential direct effects include mortality from exposure or increased susceptibility to disease that reduces the overall health and survival of the exposed fish. The severity of these potential effects depends on the contaminant, the concentration, duration of exposure, and sensitivity of the affected life stage. A potential indirect effect of contamination is reduced prey availability; invertebrate prey survival could be reduced following exposure, therefore making food less available for fish. Fish consuming infected prey may also absorb toxins directly. For CCV steelhead, potential direct and indirect effects of reduced water quality during project construction will be addressed by

implementation of the AMMs incorporated in the project SPCC. These measures include provisions to avoid, and if necessary, clean up accidental releases of hazardous materials.

With the AMMs in place, impacts from contaminants are expected to be improbable for CCV steelhead, therefore no adverse effects are anticipated.

5) De-watering of Coffer Dams and/or Attenuation Casing

If coffer dams are used, the area behind the coffer dam will be de-watered. Additionally, de-watered attenuation casings may be used to minimize acoustic impacts to fish. There is some potential for fish to be trapped within the piles or attenuation casing. Caltrans has determined that recovery and relocation of fish entrapped within the piles or attenuation casing is not feasible, therefore any fish entrapped within the piles will likely die. For the dewatered areas behind the coffer dam, a fish capture and relocation will be conducted, see section 6) below for discussion of effects from the fish capture and relocation. Avoidance and minimization measures for de-watering primarily consist of timing the in-water work to avoid sensitive life stages. It is likely that not all fish will be captured and relocated prior to dewatering, in which case some fish will be stranded and will perish. NMFS assumes for the purpose of this effects analysis, that a cofferdam will be used, and that during dewatering small numbers of juvenile CCV steelhead are expected to be injured or killed during the month of June. We do not expect adult steelhead to be in the action area when the coffer dams are installed, therefore we do not anticipate any adverse effects to adults.

6) Fish Capture and Relocation

Following installation of the coffer dams around piers K and L, dewatering of approximately 1,800 square feet behind the coffer dam will take place to isolate the work area for pile driving and pier installation. Seine nets, dip nets, and/or electrofishing methods may be used to remove fish. Fish will be captured and removed from the area behind the cofferdam prior to being dewatered, and then transferred to the immediate adjacent flowing water downstream of the work area. Fish may experience abrasion from handling, exposure to air, and close proximity to one another with increased turbidity likely as they are captured and moved. Electrofishing or other fish capture and relocation techniques may result in some incidental injury or mortality. Small numbers of juvenile CCV steelhead may be killed, injured, or harassed due to fish capture and relocation during the month of June. We do not expect adult steelhead to be in the action area when the coffer dams are installed, therefore we do not anticipate any adverse effects to adults.

Up to 20 juvenile CCV steelhead and 20 adult CCV steelhead may need to be relocated from the immediate vicinity of the construction activities depending on when during the season dewatering occurs. During capture and relocation up to one individual juvenile CCV steelhead may be injured and another one may die and up to one individual adult CCV steelhead may be injured and another one may die.

7) Loss and Degradation of Habitat

Loss and degradation of habitat from increasing the width of the bridge and placing rock revetment into the river channel is expected to adversely affect juvenile CCV steelhead by reducing natural cover, preventing riparian habitat from establishing and generally causing significant degradation to habitat that will cause harm to individuals by increasing the likelihood of injury and death from habitat modifications that reduce the quantity and quality of rearing habitat and by creating habitat conditions that increase the likelihood predation. The number of individual fish that will be affected is difficult to quantify, but we expect the harm will be directly associated with the permanent increase in the spatial footprint of the bridge by 4,532 square feet and the placement of approximately 2,150 square feet of revetment.

2.5.2 Effects of the Proposed Action to Critical Habitat

Critical habitat has been designated in the proposed action area for CCV steelhead. As described earlier, the PBFs within the action area for CCV steelhead are (1) freshwater rearing sites and (2) freshwater migration corridors.

Freshwater rearing sites for CCV steelhead may be temporarily adversely affected. If the cofferdams or the temporary trestle are left in the water over the intervening winter between the two in-water work seasons, the available river space for rearing will be reduced for two years. The existing bridge piles occupy approximately 861 square feet of the Tuolumne River floodplain and river channel. The new bridge piles will occupy approximately 154 square feet of the Tuolumne River floodplain and river channel, increasing available CCV steelhead freshwater rearing sites by up to 707 square feet by the time the project is completed. The existing bridge covers 3,399 square feet of the Tuolumne River floodplain and river channel and the proposed replacement bridge will increase this amount to 7,931 square feet of the Tuolumne River floodplain and river channel, resulting in a net loss of 4,532 square feet of floodplain and channel habitat that will reduce the quantity and quality of existing PBFs in the action area.

Freshwater migration corridors for CCV steelhead may be temporarily adversely affected. The presence of the temporary trestle and cofferdams may temporarily affect localized flow conditions and migration corridors since the trestle piles and cofferdam sheet piles will be driven into the riverbed.

Freshwater migration corridors for CCV steelhead will be adversely affected with the addition of the RSP near the abutments. Abutment 1, will require 125 cubic yards (1,010 square feet) of RSP and abutment 2, will require 135 cubic yards (1,140 square feet) of RSP for a total of 260 cubic yards (2,150 square feet) for both abutments.

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). 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.

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).

2.6.1 Water Diversions

Water diversions for municipal and industrial use are found in action area. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous species.

2.6.2 Increased Urbanization

Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those which are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

Increased urbanization also is expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially re-suspending contaminated sediments and degrading areas of submerged vegetation. This in turn will reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids moving through the system. Increased recreational boat operation is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the associated water bodies.

2.6.3 Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur within the Tuolumne River watershed. The effects of such actions result in continued degradation, simplification and fragmentation of riparian and freshwater habitat.

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 diminishes the value of designated or proposed critical habitat for the conservation of the species.

CCV steelhead have experienced significant declines in abundance and available habitat in the California Central Valley relative to historical conditions. The rangewide status of the species (Section 2.2) details the current status of this DPS and its critical habitat. The environmental baseline (Section 2.4) describes the current baseline conditions found in the action area portion of the Tuolumne River, where the proposed action is to occur. Section 2.2.2 discusses the vulnerability of listed species and critical habitat to climate change projections in the California Central Valley. Reduced summer flows and increased water temperatures will likely be exacerbated by increasing surface temperatures in the Tuolumne River basin which will reduce growth, fitness, and survival of CCV steelhead. The environmental baseline section describes the Tuolumne River as a manipulated system with flow and temperature regimes that differ drastically from their historical condition. Cumulative effects are likely to include decreased water flow, increased river traffic, and increased stormwater runoff from increased urbanization and from concurrent state and local projects in the action area which will further decrease the survival of CCV steelhead.

Effects of the Proposed Action to Listed Species

The project is expected to adversely affect a small number of juvenile and adult CCV steelhead through pile driving, de-watering, and fish capture and relocation. Exposure to juveniles are expected to be limited to the month of June and exposure to adults limited to September and October. With the AMMs and BMPs to be put into place, the effects to fish due to sedimentation or turbidity, general construction, or contamination are expected to be minor and unlikely to adversely affect fish.

Pile driving is expected to result in adverse effects in the form of behavioral effects, injury, or death from acoustic impacts. Behavioral effects from pile driving is expected to include temporary disruptions in the feeding, sheltering, and migratory behavior of adult steelhead. Although pile driving is expected to result in short-term (hours) delay of migration, the activity is not expected to prevent salmonids from passing upstream or downstream because pile driving will not be continuous through the day, and will not occur at night, when the majority of fish migrate. Pile driving effects will be minimized by avoiding the peak migration periods of CCV steelhead.

Juvenile CCV steelhead may be injured or killed when they are captured and relocated from the area to be dewatered. However, the measures proposed will minimize the likelihood of injuries and mortalities. Up to 20 juvenile CCV steelhead and 20 adult CCV steelhead may need to be relocated from the immediate vicinity of the construction activities depending on when during the season dewatering occurs. During capture and relocation up to one individual juvenile CCV steelhead may be injured and another one may die and up to one individual adult CCV steelhead may be injured and another one may die.

The loss and degradation of habitat from increasing the width of the bridge and placing rock revetment into the river channel is expected to adversely affect juvenile CCV steelhead in the form of harm directly associated with the permanent increase in the spatial footprint of the bridge by 4,532 square feet and the placement of approximately 2,150 square feet of revetment.

Effects of the Proposed Action to Critical Habitat

Freshwater rearing freshwater migration corridors may be temporarily adversely affected. If the cofferdams or the temporary trestle are left in the water over the intervening winter between the two in-water work seasons, the available river space for rearing will be reduced for two years. PBFs will also be adversely affected because the new bridge footprint will increase and result in a net loss of 4,532 square feet of floodplain and channel habitat that will reduce the quantity and quality of existing PBFs in the action area. Freshwater migration corridors for CCV steelhead will be adversely affected with the addition of the RSP near the abutments. Abutment 1, will require 125 cubic yards (1,010 square feet) of RSP and abutment 2, will require 135 cubic yards (1,140 square feet) of RSP for a total of 260 cubic yards (2,150 square feet) for both abutments.

Freshwater migration corridors for CCV steelhead will also be temporarily adversely affected. The presence of the temporary trestle and cofferdams will temporarily affect localized flow conditions and migration corridors since the trestle piles and cofferdam sheet piles will be driven into the riverbed.

Summary of Effects to DPS

VSP parameters for CCV steelhead DPS of spatial structure, diversity, abundance, and productivity are not expected to be appreciably reduced as a result of the proposed project. Construction is expected to cause adverse effects to a small number of juvenile CCV steelhead in the month of June, and a small number of adults in the months of September and October. The construction timing will avoid the largest proportions (peak) of juvenile and adult CCV steelhead that migrate through the action Construction-related impacts are expected to primarily be limited to harassment, which will be temporary (hours) and will not impede adult fish from reaching upstream spawning and holding habitat, or juvenile fish from migrating downstream, capture during relocation, and a very small proportion that may be injured or killed as a result of dewatering and relocation. CCV steelhead in the Tuolumne River are identified in the NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014) as a Core 2 population. Core 2 populations meet, or have the potential to meet, the biological recovery standard for moderate risk of extinction. These watersheds have lower potential to support viable populations, due to lower abundance, or amount and quality of habitat. These populations provide increased life

history diversity to the ESU/DPS and are likely to provide a buffering effect against local catastrophic occurrences that could affect other nearby populations, especially in geographic areas where the number of Core 1 populations is lowest.

Bridge construction is not identified as a key threat. Key recovery actions for the Tuolumne River focus on stream flow restoration downstream of flow-regulating dams and also conducting surveys and improving scientific understanding as to why resident *O. mykiss* greatly outnumber anadromous CCV steelhead.

Overall, considering the status of the species, the environmental baseline, and cumulative effects, NMFS expects that any adverse effects of the proposed action are not the type or magnitude that are expected to appreciably reduce the likelihood of both the survival and recovery of the affected listed species in the action area, or at the DPS level. Nor are any adverse effects of the proposed action to critical habitat expected to appreciably reduce the value of designated critical habitat for the conservation of the species.

Within the context of the relatively brief period of time over which the proposed action is scheduled to occur, the short term effects of global climate change are unlikely to result in any perceptible declines to the overall health or distribution of the listed populations of anadromous fish within the action area that are the subject of this consultation.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, 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

NMFS cannot precisely quantify and track the amount of individual CCV steelhead expected to be incidentally taken because of the variability and uncertainty associated with the population size of the species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates those elements of the proposed project that are expected to result in take that are more predictable and/or measurable. Ecological surrogates provide the ability to be monitored to determine the extent of incidental take that is occurring. The most appropriate thresholds for incidental take are ecological surrogates of temporary habitat disturbance as described below. The behavioral modifications or fish responses that result from the habitat disturbance are also described below.

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

Take in the form of injury and death to juvenile CCV steelhead in the month of June from pile driving activities sound levels at or less than 206 dB peak, 187 dB cumulative SEL, or 150 dB RMS.

Take in the form of injury or death to juvenile CCV steelhead from coffer dam construction and dewatering during the month of June. The total area to be dewatered will be approximately 1,800 square feet. Cofferdams may need to be removed between in-water work seasons, so approximately 1,800 square feet may be dewatered per season.

Take in the form of capture, handling, injury and death to juvenile CCV steelhead during the month of June as a result of fish capture and relocation actions that will remove fish from coffer dams and release them into Tuolumne River downstream of the construction site. Up to 20 juvenile CCV steelhead and 20 adult CCV steelhead may need to be relocated from the immediate vicinity of the construction activities depending on when during the season dewatering occurs. During capture and relocation up to one individual juvenile CCV steelhead may be injured and another one may die and up to one individual adult CCV steelhead may be injured and another one may die.

Take in the form of harm to juvenile CCV steelhead from loss and degradation of floodplain and river channel habitat causing injury and death from habitat modifications that reduce the quantity and quality of rearing habitat and by creating habitat conditions that increase the likelihood predation associated with increasing the spatial footprint of the bridge by 4,532 square feet and the placement of approximately 2,150 square feet of RSP.

If any specific parameter of this ecological surrogate is exceeded, the anticipated incidental take levels described are also exceeded, triggering the need to reinitiate consultation.

2.9.2 Effect of the Take

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 CCV steelhead or destruction or adverse modification of designated critical habitat for CCV steelhead.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary 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 to reduce the potential sound impacts to listed species.

2. Measures shall be taken to reduce the effect of harm associated with increasing the footprint of the bridge and placing RSP.

3. Measures shall be taken by Caltrans to monitor construction activity, and impacts to CCV steelhead and critical habitat.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and Caltrans or any applicant must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). Caltrans 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 incidental take statement (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. Noise attenuation methods, such as a bubble curtain, shall be used to keep sound levels indicated in the surrogate.
   b. If sound levels exceed those indicated in the surrogate, pile driving shall cease and Caltrans shall call NMFS to discuss additional measures for reducing the levels.
   c. Pile-driving shall not be conducted at night when migration is most prevalent.

2. The following terms and conditions implement reasonable and prudent measure 2:
   a. Caltrans shall provide and implement a plan that must be approved by NMFS that offsets the spatial and temporal effects of the harm to CCV steelhead associated with increasing the spatial footprint of the bridge and the placement of RSP. The action could include restoring riparian or floodplain habitat or other stream habitat restoration actions that improve growth and survival conditions of CCV steelhead in the Tuolumne River.
   b. The report shall be submitted to NMFS within 90 days of receipt of the BO.

3. The following terms and conditions implement reasonable and prudent measure 3:
    a. Caltrans shall provide a report of project activities to NMFS by December 31 of each construction year.
    b. The report shall include project schedules, project completions, and details regarding project implementation for each given year.
    c. This report shall include a summary description of in-water construction activities, avoidance and minimization measures taken, and any observed take incidents.
    d. Caltrans shall contact NMFS at any time surrogates listed above have been exceed to discuss additional measures to minimize/reduce.

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).

(1) Caltrans should provide a NMFS-approved Worker Environmental Awareness Training Program for construction personnel to be conducted by a NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program should provide workers with information on their responsibilities with regard to federally-listed fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this BO. Written documentation of the training must be submitted to NMFS within 30 days of the completion of training. Completion of this training is consistent with agency requirements set forth in section 7(a)(1).

(2) Caltrans should work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the Tuolumne River Basins. Implementation of future restoration projects is consistent with agency requirements set forth in section 7(a)(1).

(3) Caltrans should purchase advance mitigation credits from a NMFS approved conservation bank or in-lieu fee program with a service area that encompasses the proposed action area. The credits should be at a 3:1 ratio for the area of the new bridge over EFH. Confirmation of the credit purchase should be made prior to construction.

2.11 Reinitiation of Consultation

This concludes formal consultation for the 7th Street Bridge Project in Stanislaus County.

As 50 CFR 402.16 states, reinitiation of formal consultation is required 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 agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 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) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

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

3.1 Essential Fish Habitat Affected by the Project

EFH designated under the Pacific Coast Salmon FMP may be affected by the proposed action. Species that utilize EFH designated under this FMP within the action area include fall-run/late fall-run Chinook salmon. The HAPC that may be either directly or indirectly adversely affected include (1) complex channels and floodplain habitats.

3.2 Adverse Effects on Essential Fish Habitat

Consistent with the ESA portion of this document which determined that aspects of the proposed action will result in impacts to pacific coast salmonids and critical habitat, we conclude that aspects of the proposed action would also adversely affect EFH for these species. We conclude

that the following adverse effects on EFH designated for Pacific Coast Salmon are reasonably certain to occur:

Sedimentation and Turbidity

- Reduced habitat complexity
- Degraded water quality
- Reduction in aquatic macroinvertebrate production

Contaminants and Pollution-related Effects

- Degraded water quality
- Reduction in aquatic macroinvertebrate production, or bioaccumulation in prey

De-watering of cofferdams and/or Attenuation Casing

- Degraded water quality
- Temporary loss of habitat

3.3 Essential Fish Habitat Conservation Recommendations

In order to minimize effects to EFH, Caltrans should implement the terms and conditions that apply to effects to critical habitat, specifically terms and conditions numbers 1 and 3 from section 2.9.4 above. Additionally, the following are EFH conservation recommendations for impacts to complex channels and floodplain habitat:

(1) Caltrans should provide a NMFS-approved Worker Environmental Awareness Training Program for construction personnel to be conducted by a NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program should provide workers with information on their responsibilities with regard to federally-listed fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this BO. Written documentation of the training should be submitted to NMFS within 30 days of the completion of training.

(2) Caltrans should work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the Tuolumne River Basin.

(3) Caltrans should purchase advance mitigation credits from a NMFS approved conservation bank or in-lieu fee program with a service area that encompasses the proposed action area. The credits should be at a 3:1 ratio for the area of the new bridge over EFH. Confirmation of the credit purchase shall be made prior to construction.

Fully implementing the EFH conservation recommendations above would protect approximately 3.27 acres of designated EFH within the action area for Pacific coast salmon by avoiding or minimizing the adverse effects described in section 3.2.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, Caltrans must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. 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' 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 measures proposed by the agency for avoiding, mitigating, or 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

Caltrans 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' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. FISH AND WILDLIFE COORDINATION ACT

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development (16 USC 661). The FWCA establishes a consultation requirement for Federal agencies that undertake any action to modify any stream or other body of water for any purpose, including navigation and drainage (16 USC 662(a)), regarding the impacts of their actions on fish and wildlife, and measures to mitigate those impacts. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources, and providing equal consideration for these resources. NMFS' recommendations are provided to conserve wildlife resources by preventing loss of and damage to such resources. The FWCA allows the opportunity to provide recommendations for the conservation of all species and habitats within NMFS' authority, not just those currently managed under the ESA and MSA.

The following recommendation applies to the proposed action:

(1) Caltrans should post interpretive signs within the action area describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

The action agency must give these recommendations equal consideration with the other aspects of the proposed action so as to meet the purpose of the FWCA.

This concludes the FWCA portion of this consultation.

5. 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 BO addresses these DQA components, documents compliance with the DQA, and certifies that this BO has undergone pre-dissemination review.

5.1 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 BO are the California Department of Transportation and the County of Stanislaus. Other interested users could include: city of Modesto, U.S. Coast Guard, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife. Individual copies of this BO were provided to the California Department of Transportation. This BO will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

5.2 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.

5.3 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 BO 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.

6. REFERENCES

Literature and Federal Register Notices Cited

Anderson, N. H. and J. R. Sedell. 1979. Detritus Processing by Macroinvertebrates in Stream Ecosystems. Annual Review of Entomology 24(1):351-377.

Bain, M. B. and N. J. Stevenson. 1999. Aquatic Habitat Assessment: Common Methods. American Fisheries Society, Bethesda, Maryland.

California Department of Transportation. 2012. Compendium of Pile Driving Sound Data. State of California Department of Transportation.

California Department of Transportation. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. State of California Department of Transportation.

California Department of Transportation. 2016. 7th Street Bridge Project Biological Assessment and Essential Fish Habitat Assessment. State of California Department of Transportation.

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

Dosskey, M. G., P. Vidon, N. P. Gurwick, C. J. Allan, T. P. Duval, and R. Lowrance. 2010. The Role of Riparian Vegetation in Protecting and Improving Chemical Water Quality in Streams. Wiley Online Library.

Fisheries Hydroacoustic Working Group. 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities.

Ford, T. and S. Kirihara. 2009. Lower Tuolumne River Annual Report - 2009 Snorkel Report and Summary Update. Report 2009-5, Turlock and Modesto Irrigation Districts and Stillwater Sciences.

Gaspin, J. B. 1975. Experimental Investigations of the Effects of Underwater Explosions on Swimbladder Fish. I. 1973 Chesapeake Bay Tests. DTIC Document.

Gisiner, R. C. 1998. Proceedings: Workshop on the Effects of Anthropogenic Noise in the Marine Environment, 10-12 February 1998. United States, Office of Naval Research.

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, NOAA Technical Memorandum NMFS-NWFSC-66, 637 pp.

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.

Hastings, M. C. 1995. Physical Effects of Noise on Fishes. INTER-NOISE and NOISE-CON Congress and Conference Proceedings 1995(2):979-984.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. Emissions Pathways, Climate Change, and Impacts on California. Proceedings of the National Academy of Sciences of the United States of America 101(34):6.

Intergovernmental Panel on Climate Change. 2007. Summary for Policymakers: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, 18 pp.

Kemp, P., D. Sear, A. Collins, P. Naden, and I. Jones. 2011. The Impacts of Fine Sediment on Riverine Fish. Hydrological Processes 25(11):1800-1821.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1):26.

Liu, Z. and B. Huang. 2000. Cause of Tropical Pacific Warming Trend. Geophysical research letters 27(13):1935-1938.

Merz, J. E. and L. K. O. Chan. 2005. Effects of Gravel Augmentation on Macroinvertebrate Assemblages in a Regulated California River. River Research and Applications 21(1):61-74.

Moyle, P. B. 2002. Inland Fishes of California. University of California Press, Berkeley and Los Angeles.

Murphey, G. 2017. Fish Presence in the Tuolumne River. pers. comm. N. McIntosh. February 14, 2017.

National Marine Fisheries Service. 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act.

National Marine Fisheries Service. 2005. Endangered and Threatened Species: Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. Federal Register 70(170):52488-56627.

National Marine Fisheries Service. 2011. 5-Year Review: Summary and Evaluation of Central Valley Steelhead. U.S. Department of Commerce, 34 pp.

National Marine Fisheries Service. 2014. 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. California Central Valley Area Office.

National Marine Fisheries Service. 2016a. 5-Year Review: Summary and Evaluation of California Central Valley Steelhead Distinct Population Segment. U.S. Department of Commerce, 44 pp.

National Marine Fisheries Service. 2016b. Endangered and Threatened Species; 5-Year Reviews for 28 Listed Species of Pacific Salmon, Steelhead, and Eulachon. Federal Register 81(102):33468-33469.

National Marine Fisheries Service, S. R. 1996. Juvenile Fish Screen Criteria for Pump Intakes. E. T. S. Division, 4 pp.

Noakes, D., R. Beamish, L. Klyashtorin, and G. McFarlane. 1998. On the Coherence of Salmon Abundance Trends and Environmental Factors. North Pacific Anadromous Fish Commission Bulletin 1:454-463.

Pacific Fishery Management Council and National Marine Fisheries Service. 2014. Environmental Assessment and Regulatory Impact Review Pacific Coast Salmon Plan Amendment 18: Incorporating Revisions to Pacific Salmon Essential Fish Habitat.

Paerl, H. W., N. S. Hall, and E. S. Calandrino. 2011. Controlling Harmful Cyanobacterial Blooms in a World Experiencing Anthropogenic and Climatic-Induced Change. Science of the Total Environment 409(10):1739-1745.

Pearson-Meyer, J. 2017. Vibratory Hammer Acoustic Effects. pers. comm. N. McIntosh. February 9, 2017.

Petersen, J. H. and J. F. Kitchell. 2001. Climate Regimes and Water Temperature Changes in the Columbia River: Bioenergetic Implications for Predators of Juvenile Salmon. Canadian Journal of Fisheries and Aquatic Sciences 58(9):1831-1841.

Popper, A. N., T. J. Carlson, A. D. Hawkins, B. L. Southall, and R. L. Gentry. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper. Report to the Fisheries Hydroacoustic Working Group, California Department of Transportation, USA, 15pp.

Popper, A. N. and M. C. Hastings. 2009. The Effects of Human-Generated Sound on Fish. Integrative Zoology 4(1):43-52.

Pusey, B. J. and A. H. Arthington. 2003. Importance of the Riparian Zone to the Conservation and Management of Freshwater Fish: A Review. Marine and Freshwater Research 54(1):1-16.

Schlosser, I. J. and J. R. Karr. 1981. Riparian Vegetation and Channel Morphology Impact on Spatial Patterns of Water Quality in Agricultural Watersheds. Environmental Management 5(3):233-243.

Sigler, J. W., T. 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(2):142-150.

Slotte, A., K. Hansen, J. Dalen, and E. Ona. 2004. Acoustic Mapping of Pelagic Fish Distribution and Abundance in Relation to a Seismic Shooting Area Off the Norwegian West Coast. Fisheries Research 67(2):143-150.

Stachowicz, J. J., H. Fried, R. W. Osman, and R. B. Whitlatch. 2002. Biodiversity, Invasion Resistance, and Marine Ecosystem Function: Reconciling Pattern and Process. Ecology 83(9):2575-2590.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward Earlier Streamflow Timing across Western North America. Journal of climate 18(8):1136-1155.

Stillwater Sciences. 2014. *Oncorhynchus Mykiss* Population Study Report - Don Pedro Project Ferc No. 2299. Prepared for: Turlock Irrigation District and Modesto Irrigation District

Suttle, K. B., M. E. Power, J. M. Levine, and C. McNeely. 2004. How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids. Ecological Applications 14(4):969-974.

U.S. Fish and Wildlife Service. 1995. Working Paper on Restoration Needs: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California. D. o. Interior.

VanRheenen, N. T., Andrew W. Wood, Richard N. Palmer, Dennis P. Lettenmaier. 2004. Potential Implications of PCM Climate Change Scenarios for Sacramento-San Joaquin River Basin Hydrology and Water Resources. Climatic Change 62(62):257-281.

Ward, J. V. and J. A. Stanford. 1982. Thermal Responses in the Evolutionary Ecology of Aquatic Insects. Annual Review of Entomology 27(1):97-117.

Wardle, C., T. Carter, G. Urquhart, A. Johnstone, A. Ziolkowski, G. Hampson, and D. Mackie. 2001. Effects of Seismic Air Guns on Marine Fish. Continental Shelf Research 21(8):1005-1027.

Waters, T. F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7.