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: 2020-WCRO-00937

August 31, 2020

Dominic Vitali
Chief, District 10 Environmental
California Department of Transportation
P.O. Box 2048
Stockton, California 95201

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Manthey Road Bridge Replacement Project in the City of Lathrop.

Dear Mr. Vitali:

Thank you for your letter of April 6, 2020, 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 Manthey Road Bridge Replacement Project (Project). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR Part 402, as amended; 84 Fed. Reg. 44976, 45016 (August 27, 2019)).

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 (16 U.S.C. 1855(b)) for this action.

Based on the best available scientific and commercial information, the biological opinion concludes that the proposed Project is not likely to jeopardize the continued existence of the federally listed threatened California Central Valley (CCV) steelhead distinct population segment (DPS) (*Onchorynchus mykiss*) or the threatened southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*) and is not likely to destroy or adversely modify designated critical habitats for CCV steelhead or sDPS green sturgeon. For the above species, NMFS has 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 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. As such, Caltrans serves as the lead Federal Action Agency for the proposed Project.

Please contact Lyla Pirkola in NMFS' California Central Valley Office via email at lyla.pirkola@noaa.gov or via phone at (916) 930-5615 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator
California Central Valley Office

Enclosure

cc: Copy to File No: 151422-WCR2020-SA00018

David Moore, Associate Environmental Planner (Biologist), Caltrans District 10, David.J.Moore@dot.ca.gov

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

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

Manthey Road Bridge Replacement Project

NMFS Consultation Number: WCRO-2020-00937

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 Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
California Central Valley steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS)	Threatened	Yes	No	Yes	No
Southern DPS of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No

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

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

Issued By: A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for California Central Valley Office

Date: August 31, 2020

TABLE OF CONTENTS

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 and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 *et seq*.), and implementing regulations at 50 CFR 402, as amended.

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

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

1.2. Consultation History

- On October 9, 2019, Caltrans, the City of Lathrop, and NMFS met onsite to discuss project description, the environmental baseline, potential impacts to federally listed fish species, and avoidance, minimization, and compensation measures.
- On April 6, 2020, NMFS received a request for formal consultation from Caltrans for the Project for anticipated effects to ESA listed California Central Valley (CCV) steelhead and southern Distinct Population Segment (sDPS) of green sturgeon; and EFH for Chinook salmon.
- On April 20, 2020, NMFS responded with a letter of insufficiency requesting more information about the Project description.
- Additional requested information was received by NMFS on May 5, 2020. NMFS requested additional clarifying information at this time in response.
- Sufficient information was received by NMFS on May 7, 2020, and consultation was initiated on that date.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Under 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). We considered whether or not the proposed action would cause any other activities that would have consequences on CCV

steelhead and sDPS green sturgeon and their critical habitat and determined it would not. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur.

Project Description

The City of Lathrop (City) in coordination with Caltrans is proposing to replace the existing Manthey Road Bridge over the San Joaquin River in the City of Lathrop with a new bridge downstream of the existing railroad bridge and demolish the existing bridge. Caltrans determined that the bridge is functionally obsolete, structurally deficient, and that replacement is needed. Construction would be take place in two phases: phase one would be bridge construction along the new alignment, and phase two would be removal of the existing bridge. The new bridge would measure approximately 532 feet long by 53 feet wide and would accommodate two 12-foot traffic lanes, two 8-foot shoulders, two 5.5-foot sidewalks, and concrete barriers and handrails. The bridge would be supported by three sets of two piers supported by cast-in-steel-shell piles in the river and abutments on both ends supported by cast-in-drilled-hole piles. The bridge superstructure would be precast, pre-stressed concrete girders with a cast-in-place concrete deck, or post-tensioned concrete box girder. Construction would occur in two phases, phase one would begin in fall 2021 and occur over two construction seasons. Phase two would occur in spring 2023 following completion of the new bridge and is anticipated to take 8 months.

Construction Sequencing

Clearing and grubbing the construction area would occur first, followed by access roadway construction, excavation for abutments, drainage facilities, and retaining walls. In-water construction would begin on June 1 each year with the installation of the temporary trestle and barges, casings for bridge construction, and cofferdams for bridge demolition, as appropriate. All in-water work would be completed by October 31. After October 31, work would be confined to within the temporary steel casings or cofferdams (bridge demolition only) or be above the water. The temporary trestle, barges, and cofferdams (bridge demolition only) would remain in place to assist in the construction of foundations, columns and bent caps, as well as the erection of falsework for construction of the bridge girder. Separate trestles or barges and cofferdams would be required adjacent to the existing Manthey Road Bridge for demolition of the existing bridge. Once the superstructure is completed, the temporary trestle would be removed during the following in-water work window. Bridge demolition would commence following completion of the new bridge.

<u>Temporary Trestles</u>

Temporary trestles would be installed to support work platforms during bridge removal and bridge construction. Separate temporary trestles would be used for bridge removal and construction. The temporary trestle for bridge construction would be installed over an approximately three-week period in June in the first year of construction and would remain in place throughout the duration of bridge construction. Once the new bridge is constructed, the trestle for bridge removal would be installed over an approximately two-week period in June of the third year of construction and would remain in place throughout the duration of bridge removal.

The temporary trestle used for construction would require a maximum of 84 steel piles driven in-water, piles would be sized from 14-inch to 18-inch diameter. The temporary trestle used for demolition would require a maximum of 50 steel piles of the same size driven in-water.

Bridge Piers

Construction of the new bridge would require driving a total of six piles to support the new bridge. The 84-inch diameter piles would be embedded 90 to 125 feet beneath the existing river bottom in water depths ranging from approximately 5 to 13 feet. The piles would be installed in one construction season. In-water piles would be within bubble curtains using trestle- or barge-mounted cranes. The pile steel shells first would be positioned and allowed to sink under their own weight and/or pushed into the river bottom. The shells would be advanced further with a vibratory hammer to the maximum extent possible, and then driven to the required depth using an impact pile driver. Installation of the pile steel shells would occur in the proposed in-water work window of June 1 to October 31. New bridge piers will occupy a total of 231 square feet (0.005 acres) within the channel.

Cofferdams

Cofferdams would be installed to demolish the three in-water piers of the existing bridge. The sheet piles for the cofferdams would be installed and removed with a vibratory pile driver. Each of the three cofferdams would be approximately 25 feet wide and 50 feet long, up to 5,400 square feet (0.12 acres) total. The sheet piles for the cofferdams would be installed and removed during the in-water construction period (June 1 to October 31), unless floodwaters are predicted to overtop the cofferdams.

Vegetation Removal

Implementation of the proposed project would require that vegetation be trimmed or removed to demolish the existing Manthey Road Bridge and construct temporary access roads and the new bridge and roadway approaches. Construction of the proposed project would result in the temporary loss of up to 0.08 acre and the permanent loss of up to 0.07 acre of riparian woodland within the action area. Of which approximately 0.031 acre (0.016 acre of temporary loss and 0.014 acre of permanent loss) is below the mean high water line (MHWL) and contributes to overhead shade and instream shaded riverine aquatic (SRA) cover. Clearing of the existing riparian woodland that contributes to SRA cover would result in the temporary loss of up to 271 linear feet and the permanent loss of up to 62 linear feet of overhead SRA cover (shade) along the shoreline of the San Joaquin River.

To compensate for impacts to CCV steelhead and sDPS green sturgeon resulting from the proposed action, off-site mitigation credits will be purchased from a NMFS-approved mitigation bank. Credits will be purchased at a 3:1 ratio for permanent in-water habitat impacts (0.40 acre), a 1:1 ratio for temporary riparian habitat impacts (0.016 acre), and a 3:1 ratio for permanent riparian impacts (0.014 acre). A total of 1.258 acres of credits will be purchased. NMFS-approved mitigation banks with service areas that include the proposed action area are Fremont Landing Conservation Bank, the Bullock Bend Mitigation Bank, the Liberty Island Conservation Bank and the North Delta Fish Conservation Bank.

1.4. Proposed Avoidance and Minimization Measures

The following BMPs are proposed by Caltrans to minimize or avoid overall impacts associated with the proposed action:

- Install Orange Construction Barrier Fencing around the Construction Area to Protect Adjacent Sensitive Biological Resources.
    - The City and/or its contractor will install orange construction fencing between the construction area and adjacent sensitive biological resource areas.
    - Orange fencing placemen will be installed as one of the first orders of work, prior to equipment staging.
    - Protected areas will be designated and clearly identified on construction plans, prior to construction bid.
    - Before construction begins, the construction contractor will work with the engineer and a resource specialist to verify the locations for the orange construction fencing and will place stakes around the sensitive resource sites to indicate these locations.
    - The fencing will be installed before construction activities are initiated, maintained throughout the construction period, and removed after completion of construction.

- Conduct Environmental Awareness Training for Construction Employees.
    - The City will retain a qualified biologist to conduct environmental awareness training for construction crews before project implementation.
    - The awareness training will be provided to all construction personnel to brief them on the need to avoid effects on sensitive biological resources (*e.g.*, native trees, natural communities of special concern, and special-status species habitats in and adjacent to the construction area).
    - The education program will include a brief review of the special-status species with the potential to occur in the action area (including their life history, habitat requirements, and photographs of the species).
    - The training will identify the portions of the action area in which the species may occur, as well as their legal status and protection. The program also will cover the restrictions and guidelines that must be followed by all construction personnel to reduce or avoid effects on these species during project implementation and the ramifications for non-compliance.
    - Employees will also be educated about the importance of controlling and preventing the spread of invasive plants.

- Conduct Biological Monitoring.
    - An appointed monitor, trained by a qualified biologist, will ensure that activities are being conducted in accordance with the agreed upon project schedule and agency conditions of approval.
    - If any violations are noted or if any sensitive species are encountered, the appointed monitor will contact the project biologist for guidance.
    - A qualified biologist will be available to conduct site visits as required.

- Additional monitoring will occur for turbidity and activities involving dewatering and pile driving.

- Conduct All In-Water Construction Activities between June 1 and October 31, and Only during Daylight Hours.
  - All in-water activities will be limited to June 1 to October 31 when listed species are less abundant, or absent from, the San Joaquin River. This work window avoids sensitive life stages, such as spawning and peak migration.
  - In-water construction will only occur during daytime hours to provide fish in the area an extended quiet period during night hours for feeding and migration.

- Protect Water Quality and Prevent Erosion and Sedimentation in Drainages and Wetlands
  - A Storm Water Pollution Prevention Plan (SWPPP) will be developed and implemented to minimize introduction of construction related contaminants and mobilization of sediment in the San Joaquin River. The SWPPP will include:
    - Description of site characteristics, including runoff and streamflow characteristics and soil erosion hazard, and construction procedures;
    - Guidelines for proper application of erosion and sediment control BMPs;
    - Description of measures to prevent and control toxic materials spills; and
    - Description of construction site housekeeping practices.
  - BMPs will address soil stabilization, sediment control, wind erosion control, vehicle tracking control, non-stormwater management, and waste management practices. BMPs include:
    - Equipment used in and around drainages and wetlands will be in good working order and free of dripping or leaking engine fluids. All vehicle maintenance will be performed at least 300 feet from all streams.
    - A hazardous materials spill prevention control and countermeasure plan will be developed before construction begins include strict onsite handling rules to keep construction and maintenance materials from entering the river, including procedures related to refueling, operating, storing and staging construction equipment and preventing and responding to spills. The plan also will identify the parties responsible for monitoring a spill response. During construction, any spills will be cleaned up immediately according to the spill prevention control and countermeasure plan. The City will review and approve the contractors' spill prevention control and countermeasure plan before allowing construction to begin.
    - Concrete, solvents and adhesives, thinners, paints, fuels, sawdust, dirt, gasoline, asphalt and concrete saw slurry, and heavily chlorinated water will be prohibited from being rinsed into the streets, shoulder areas or gutters.
    - Any surplus concrete rubble, asphalt, or other rubble from construction that is unable to be reused or recycled will be taken to a landfill.
    - An erosion and sediment control plan will be developed and implemented, including the following provisions and protocols:
      - The SWPPP for the project will detail the applications and type of measures and the allowable exposure of unprotected soils.

- Discharge from dewatering operations, if needed, and runoff from disturbed areas will be made to conform to the water quality requirements of the waste discharge permit issued by the Central Valley RWQCB.
- Throughout construction of the proposed project, soil exposure will be minimized through use of temporary BMPs, groundcover, and stabilization measures.
- Temporary erosion control measures will be applied to contain soil and filter runoff from disturbed areas by berms, vegetated filters, silt fencing, straw bales/wattle, plastic sheeting, catch basins, silt/sediment basins and traps, check dams, geofabric, sandbag dikes, temporary revegetation or other ground cover, or other means necessary.
- Temporary measures will be removed after the working area is stabilized, or as directed by the engineer.
- The contractor will conduct periodic maintenance of temporary erosion and sediment control measures.
- Exposed dust-producing surfaces will be sprinkled daily, if necessary, until wet.
- Paved roads will be swept daily following construction activities.
- Exposed stockpiles of dirt or other loose granular construction materials will be enclosed.
- An appropriate seed mix will be planted on disturbed areas upon construction completion.

- Monitor Turbidity in the San Joaquin River.
    - Turbidity levels will be monitored during in-water construction activities.
    - Turbidity will be measured using standard water quality monitoring techniques and, as required by the water quality certification for the project to determine whether changes in ambient turbidity levels exceed 20 percent, the threshold derived from the Basins Plan for the Sacramento and San Joaquin Rivers (Central Valley Regional Water Quality Control Board 2011).
    - If it is determined that turbidity levels exceed the 20-percent threshold, the City and/or its contractors will adjust work to ensure that turbidity levels do not exceed the 20-percent threshold.

- Implement Cofferdam Restrictions.
    - Cofferdam footprints will be limited to the minimum necessary to support construction activities.
    - Sheetpiles used for cofferdams will be installed and removed using a vibratory pile driver.
    - Cofferdams will be installed and removed only during the proposed in-water work window (between June 1 and October 31), except in the unlikely event that one or more sheet piles need to be removed to prevent fish entrapment if the cofferdam is overtopped by floodwaters.

- Cofferdams will be capped or opened to avoid entrapping special-status fish species when winter/spring flows are predicted to overtop cofferdams.
- All pumps used during dewatering of cofferdams will be screened according to NMFS guidelines for screens.

- Prepare and Implement a Fish Rescue and Relocation Plan.
  - A fish rescue and relocation plan will be developed and implemented to recover any fish trapped in cofferdams. The fish rescue and relocation plan will be submitted to NMFS for approval at least 60 days before initiating activities to install cofferdams. At a minimum, the plan will include the following:
    - A requirement that fish rescue and relocation activities will commence immediately after cofferdam closure and that dewatering has sufficiently lowered water levels inside cofferdams to make it feasible to rescue fish.
    - A description of the methods and equipment proposed to collect, transfer, and release all fish trapped within cofferdams. This may include seining, dip netting, and/or electrofishing as approved by NMFS. Precise methods and equipment will be developed cooperatively by NMFS and the project proponent and/or contractor.
    - Only NMFS-approved fish biologists will conduct fish rescue and relocation.
    - A fish rescue and relocation report will be prepared and submitted to NMFS within 5 business days following the completion of fish relocation. Data will be provided in tabular form and at a minimum will include the following:
      - Species and number rescued and relocated.
      - Approximate size of each fish (or alternatively, approximate size range if a large number of individuals are encountered)
      - Date and time of their capture.
      - General condition of all live fish (*e.g.*, good–active with no injuries, fair–reduced activity with some superficial injuries, poor–difficulty swimming/orienting with major injuries).
      - For dead fish, additional data will include fork length and description of injuries and/or possible cause of mortality if it can be determined.
- Prevent the Spread or Introduction of Aquatic Invasive Species.
  - The City or its contractors will coordinate with the California Department of Fish and Wildlife Invasive Species Program to ensure that the appropriate best management practices are implemented to prevent the spread or introduction of invasive species.
  - Construction supervisors and managers will be educated about the importance of controlling and preventing the spread of invasive species.
  - Vessel and equipment operators and maintenance personnel will be trained in the recognition and proper prevention, treatment, and disposal of invasive species.
  - If feasible, prior to departure from their place of origin and before in-water construction equipment is allowed to operate within the waters of the San Joaquin River, vessels and equipment will be inspected and all dirt, mud, plant matter, and

    - animals will be removed from all surfaces that are submerged or may become submerged, or places where water can be held and transferred to the surrounding water.
- Minimize or Avoid Temporary Construction Lighting and Permanent Bridge Lighting from Directly Radiating on Water Surfaces of the San Joaquin River.
    - Temporary construction lighting will be limited to the minimal amount of lighting necessary to safely and effectively illuminate work areas will be used when needed. Lights will be shielded and focused on work areas, away from the water surface of the San Joaquin River.
    - Permanent bridge lighting will use the minimal amount of lighting necessary to safely and effectively illuminate vehicular, bicycle, and pedestrian areas on the bridge. Lighting of the bridge for aesthetic purposes will be minimized. Lights will be shielded and focused away from the water surface of the San Joaquin River.

- Implement Measures to Minimize Exceedance of Interim Threshold Sound Levels during Pile Driving.
    - The contractor will first vibrate all piles to the maximum extent practical before using an impact hammer.
    - During impact driving, the contractor will limit the number of strikes per day to the minimum necessary to complete the work, and will limit the total number of hammer strikes to 14,400 strikes per day (*i.e.*, 1,800 hammer strikes per pile per day) for the piles for the temporary trestles and barges, and 2,500 strikes per day for the piles for the bridge piers.
    - Impact pile driving events (days) will be followed by a minimum period of 12 hours with no impact pile driving to allow the accumulated sound exposure level (SEL) to reset to zero.
    - During impact driving, the City will require the contractor to use a bubble curtain or similar attenuation device (*e.g.*, dewatered cofferdam) to minimize the extent to which the interim peak and cumulative sound exposure level thresholds are exceeded for piles driven in water.

- Develop and Implement a Hydroacoustic Monitoring Plan.
    - The City and/or its construction contractor will monitor underwater noise levels during all impact pile driving activities on land and in water to ensure that that peak and cumulative SELs do not exceed estimated values (Table 5-2).
    - The monitoring plan will describe the methods and equipment that will be used to document the extent of underwater sounds produced by pile driving, including the number, location, distances, and depths of the hydrophones and associated monitoring equipment.
    - The monitoring plan will include a reporting schedule that includes provision of daily summaries of the hydroacoustic monitoring results to the resource agencies and more comprehensive reports on a monthly basis during the pile-driving season.
    - The reports will include the number of piles installed per day, the number of strikes per pile, the interval between strikes, the peak sound pressure level (SPL),

SEL, and root mean square per strike, and accumulated SEL per day at each monitoring station.
    - The City or its contractors will ensure that a qualified fish biologist is onsite during impact pile driving to document any occurrences of stressed, injured, or dead fish. If stressed, injured, or dead fish are observed during pile driving, the City and/or its construction contractor will immediately reduce the number of strikes per day to ensure that fish are no longer showing signs of stress, injury, or mortality.
- Compensate for Temporary Effects on and Permanent Loss of Riparian Habitat
    - The City will purchase riparian habitat credits from an approved mitigation bank with a service area appropriate to the project. If no suitable mitigation bank options are available at the time of construction, the City will pay into the National Fish and Wildlife Foundation Sacramento District in-lieu fee program. The final compensation ratio of restored or created riparian habitat for each acre of riparian habitat removed will be approved by CDFW in order to result in no net loss of riparian habitat.
    - SRA cover mitigation will include the following:
        - Compensate for the 0.016 acre of temporary loss of SRA cover vegetation at a 1:1 replacement ratio by purchasing a total of 0.016 acre of SRA cover credits.
        - Compensate for the 0.014 acre of permanent loss of SRA cover vegetation at a 3:1 replacement ratio by purchasing a total of 0.042 acre of SRA cover credits.
        - SRA cover credits totaling 0.058 acre (0.016 acre + 0.042 acre) will be purchased prior to project groundbreaking from a NMFS-approved mitigation bank within the approved service area for the project that provides riparian forest floodplain conservation credits as off-site compensation for impacts on federally listed anadromous salmonids, designated critical habitat, and EFH for Chinook salmon.
- Purchase Channel Enhancement Credits at a NMFS-Approved Anadromous Fish Conservation Bank for Impacts on Critical Habitat.
    - Permanent impacts on critical habitat, including the permanent shading of up to 0.40 acre of aquatic habitat, will be mitigated at a 3:1 ratio. The City proposes to mitigate permanent impacts on critical habitat for North American green sturgeon and CCV steelhead through purchase of 1.20 acres of mitigation credits at a NMFS-approved anadromous fish conservation bank.

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

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide a biological opinion (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 incidental take statement (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 biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

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

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

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44976, 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.

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

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species. This opinion analyzes the effects of the Project on the following distinct population segments (DPSs): California Central Valley (CCV) steelhead DPS (*O. mykiss*), and the southern DPS (sDPS) North American green sturgeon (*A. medirostris*). See Table 1 for species and Table 2 for critical habitat information.

Table 1. Description of species, current Endangered Species Act (ESA) listing classifications, and summary of species status.

Species	Listing Classification and Federal Register Notice	Status Summary
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	According to the NMFS 5-year species status review (NMFS 2016a), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of extinction. Most natural-origin CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.
Southern DPS of North American green sturgeon	Threatened, 71 FR 17757; April 7, 2006	According to the NMFS 5-year species status review (NMFS 2015) and the 2018 final recovery plan (NMFS 2018), some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers. Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather River. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the majority of spawning occurs in a single reach of the main stem Sacramento River. Current threats include poaching and habitat degradation. A recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so species can be evaluated relative to recovery criteria (Mora *et al.* 2017).

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

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

Critical Habitat	Designation Date and Federal Register Notice	Description
Southern DPS of North American green sturgeon	October 9, 2009; 74 FR 52300	Critical habitat includes the stream channels and waterways in the Delta to the ordinary high water line. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Critical habitat in coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are included as critical habitat for sDPS green sturgeon. PBFs considered essential to the conservation of the species for freshwater and estuarine habitats include: food resources, substrate type or size, water flow, water quality, migration corridor; water depth, sediment quality. In addition, PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. Although the current conditions of PBFs for sDPS green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

2.2.1. Recovery Plans

In July 2014, NMFS released a final Recovery Plan for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead (NMFS 2014, Recovery Plan). The Recovery Plan outlines actions to restore habitat, access, and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids. Key actions for the Recovery Plan include conducting landscape-scale restoration throughout the Delta, incorporating ecosystem restoration into Central Valley flood control plans that includes breaching and setting back levees, and restoring flows throughout the Sacramento and San Joaquin River basins and the Delta. In August 2018, NMFS released a final Recovery Plan for the sDPS green sturgeon (NMFS 2018), which focuses on fish screening and passage projects, floodplain and river restoration, and riparian habitat protection in the Sacramento River Basin, the Delta, San Francisco Estuary, and nearshore coastal marine environment as strategies for recovery.

2.2.2. Global Climate Change

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al*. 2000) Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Projected warming is expected to affect Central Valley salmon and steelhead. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006).

Although CCV steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile CCV steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile CCV steelhead, which range from 14°C to 19°C (57°F to 66°F). The Anderson Cottonwood Irrigation Dam (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River. The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher than ACID during late spring and summer. Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected.

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011, Wade *et al*. 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure *et al*. 2013).

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 Project is located in the City of Lathrop in San Joaquin County approximately 0.3 miles northeast of Stewart Road over the San Joaquin River. The action area includes all terrestrial and aquatic areas disturbed by project activities, including the project footprint (areas proposed for staging, trestle construction, barge anchoring, new bridge construction, existing bridge removal) and all areas affected by Project pile driving-related noise and water quality impacts. Based on an analysis of sound expected to be generated by driving the three 84-inch-diameter piles, the cumulative sound exposure level (SEL) interim criteria of 183 decibel (dB) could be exceeded for a distance of up to 20,703 feet (6,310 meters) upstream and downstream from the source pile. Although noise levels could exceed background levels beyond that point, a distance to any lesser threshold cannot be realistically predicted because of the physical geography of the river. The San Joaquin

River has river channel bends, and the straight-line distance of open water is 1,345 feet upstream and 2,000 feet downstream of the proposed bridge crossing. Based on these anticipated noise effects, the action area includes the entire width of the San Joaquin River channel and extends 2,000 feet beyond the straight-line, open-water distances (3,345 feet upstream and 4,000 feet downstream of the proposed bridge crossing). This distance encompasses the existing bridge that would be demolished, and the expected limits of increases in suspended sediment and turbidity downstream from proposed in-water construction activities. The action area includes the San Joaquin River up to 2,000 feet from the bridge as well as adjacent upland areas in the vicinity of the proposed action.

Since the proposed action includes the purchase of mitigation credits from a conservation bank, the action area also includes the areas affected by mitigation banks that have service areas relevant to the Project areas. These include the Fremont Landing Conservation Bank, which is a 100-acre site along the Sacramento River (Sacramento River Mile 78 through 80); Bullock Bend Mitigation Bank, which is a 116.15-acre site along the Sacramento River (Sacramento River Mile 80); Liberty Island Conservation Bank, which is a 186-acre site located at the south end of the Yolo Bypass on Liberty Island in the Delta; and North Delta Fish Conservation Bank, which is an 811-acre site located in Yolo County on Liberty Island.

2.4. Environmental Baseline

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

2.4.1. Occurrence of Listed Species and Critical Habitat in the Action Area

The federally listed anadromous species that use and occupy the action area are migrating adult and juvenile CCV steelhead and juvenile, subadult and adult sDPS green sturgeon. The action area is within designated critical habitat for CCV steelhead and sDPS green sturgeon. The San Joaquin River mainstem is the primary migration corridor for both adult and juvenile CCV steelhead life stages originating in the San Joaquin River Basin. The Delta and the San Joaquin River contain important rearing habitat for juveniles. All anadromous fish that utilize the San Joaquin River Basin must also pass through the Delta at least twice to successfully complete their life histories. Juvenile and subadult sDPS green sturgeon may be present throughout the Delta during every month of the year, whereas spawning and post-spawn adults are unlikely to migrate through the action area (east of the Delta), because their primary migratory route between the ocean and upstream spawning habitats lies predominantly in the Sacramento River and its tributaries.

CCV steelhead

The life history strategies of CCV steelhead are extremely variable between individuals, and it is important to take into account that CCV steelhead are iteroparous (*i.e*., can spawn more than once in their lifetime) (Busby *et al*. 1996), and therefore may emigrate back down the system after spawning. As such, the determination of the presence or absence of CCV steelhead in the Delta accounts for both upstream and downstream migrating adult steelhead (kelts).

Adult CCV steelhead enter freshwater in August (Moyle 2002) and peak migration of adults moving upriver occurs in August through September (Hallock *et al*. 1957). Adult CCV steelhead will hold until flows are high enough in the tributaries to migrate upstream where they will spawn from December to April (Hallock *et al*. 1961). After spawning, most surviving steelhead kelts migrate back to the ocean and reach the Sacramento River during March and April, and have a high presence in the Delta in May. Migrating adult CCV steelhead through the San Joaquin River are present from July to March, with the highest abundance between December and January. Small, remnant populations of CCV steelhead are known to occur in the Stanislaus River and the Tuolumne River and their presence is assumed on the Merced River due to proximity, similar habitats, historical presence, and recent otolith chemistry studies verifying at least one steelhead in the limited samples collected from the river (Zimmerman *et al*. 2008). Out-migrating juveniles from these tributaries would have to pass through the action area during their emigration to the ocean. . The temporal occurrence and relative abundance of juvenile CCV steelhead in the action area can be inferred based on juvenile fish monitoring surveys (trawls) conducted by USFWS and CDFW at Mossdale (USFWS 2017). Based on data collected from January 2001 through December 2018, juvenile CCV steelhead occur in the action area from January to June, with a peak in April and May, and in October.

The proposed construction period is June 1 to October 31. This will overlap with the adult CCV steelhead migration period in the San Joaquin River Basin (*i.e*., the months of September and October), but will avoid the peak of spawning migration from November through January.

sDPS green sturgeon

Adult sDPS green sturgeon enter the San Francisco Bay starting in February, have been recorded in San Pablo Bay in March (Heublein *et al*., 2008), and in the Sacramento River system between late February and late July (Moyle *et al*., 1995). In general, sDPS green sturgeon enter the San Francisco Bay estuary in winter and continue upstream to their spawning grounds from mid- winter to late summer. Spawning occurs from April to July in the mainstem Sacramento River (Poytress *et al*. 2015) and Feather River (Seesholtz *et al*. 2014). Adults have been recorded out-migrating from the Sacramento River in the fall (November to December) and summer (June to August) (Heublein *et al*., 2008). It has been suggested that spawning may also occur in the San Joaquin River (Moyle *et al*. 1995) however, this was based on a 1-year study in the 1960's collecting a large number of young green sturgeon during the summer at a shallow shoal area in the lower San Joaquin River (Radtke 1966). Data on sDPS green sturgeon distribution is extremely limited and out-migration appears to be variable occurring at different times of year. Seven years of CDFW

catch data for adult sDPS green sturgeon show that they are present in the Delta during all months of the year. Adult and juvenile sDPS green sturgeon are therefore assumed to be present in the Delta year-round.

Prior to October 2017, all accounts of sDPS green sturgeon sightings in the San Joaquin River Basin were anecdotal at best or misidentified white sturgeon (Gruber *et al*. 2012, Jackson *et al*. 2016). During late October in 2017, an adult sDPS green sturgeon was sighted in the Stanislaus River near Knights Ferry by a fish biologist and its identity was genetically confirmed by genetic analysis of green sturgeon environmental DNA in the surrounding water (Breitler 2017). This is the first confirmed sighting of a green sturgeon in a San Joaquin River tributary, and indicates that adults are able to pass upstream of the proposed action area given river flows of suitable quality and amount. Since only one adult has been confirmed in the Stanislaus River and spawning activities in the San Joaquin River Basin have never been recorded, the production of juveniles from the Stanislaus River is not considered likely in the near future. However, with the implementation of recovery actions, potential spawning grounds may become available for sDPS green sturgeon.

While the San Joaquin River Basin may not produce juvenile sDPS green sturgeon, juveniles may use both estuarine and freshwater portions of the Delta to rear for 1 to 3 years prior to exiting the system and entering the Pacific Ocean. During this period, they may range and stray up non-natal waterways searching for appropriate food resources, water quality conditions, and shelter. Therefore, foraging juveniles, subadults, and adults may be found in the San Joaquin River at the location of the proposed action at nearly any time of year, depending on the local water depth, temperature, and quality.

Both adult and juvenile sDPS green sturgeon are expected to occur in the action area, but in low numbers. The Delta serves as an important migratory corridor for adults during their spawning migrations and as year-round rearing habitat for juveniles. Both non-spawning adults and subadults use the Delta and estuary for foraging during the summer. Since there are no physical barriers to sDPS green sturgeon moving into the action area during their rearing or foraging behaviors, presence in the action area is seen as feasible and likely. The proposed construction period is from June 1 to October 31. Since adult, subadult, and juvenile sDPS green sturgeon may be present in the Delta year round, the construction period will overlap with their presence.

CCV steelhead and sDPS green sturgeon Critical Habitat

The action area occurs within the San Joaquin Delta hydrologic unit ([HU] 18040003) and is included in the critical habitat designated for CCV steelhead and sDPS green sturgeon. The San Joaquin Delta HU is in the southwestern portion of CCV steelhead range and includes portions of the south and central Delta channel complex. The San Joaquin Delta HU encompasses approximately 628 square miles, with 455 miles of stream channels (at 1:100,000 hydrography). The PBFs of CCV steelhead critical habitat within the action area include freshwater rearing habitat, freshwater migration corridors. The features of the PBFs included in these different sites essential to the conservation of the CCV steelhead DPS include the following: estuarine areas with sufficient water quality and quantity, natural cover, forage, and passage conditions to support rearing and migration of CCV steelhead. Habitat within the action area is primarily utilized for

freshwater rearing and migration by CCV steelhead juveniles and smolts and for adult freshwater migration. No spawning of CCV steelhead occurs within the action area. In regards to the designated critical habitat for sDPS green sturgeon, the action area includes the following PBFs: adequate food resources for all life stages utilizing the Delta; water flows sufficient to allow adults, subadults, and juveniles to orient to flows for migration and normal behavioral responses; water quality sufficient to allow normal physiological and behavioral responses; unobstructed migratory corridors for all life stages utilizing the Delta; a broad spectrum of water depths to satisfy the needs of the different life stages present in the estuary; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The general condition and function of this habitat for both CCV steelhead and sDPS green sturgeon have already been described in the Status of the Species and Critical Habitat section of this opinion. The substantial degradation over time of several of the essential critical elements has diminished the function and condition of the freshwater rearing and migratory habitats in the action area. It has only rudimentary functions compared to its historical status. The channels of the south Delta have been heavily riprapped with coarse stone slope protection on artificial levee banks and these channels have been straightened to enhance water conveyance through the system. The extensive riprapping and levee construction has precluded natural river channel migrations and the formation of riffle pool configurations in the Delta's channels. The natural floodplains have essentially been eliminated, and the once extensive wetlands and riparian zones have been cleared for farming. Little riparian vegetation remains in the south Delta, limited mainly to tules growing along the foot of artificial levee banks. Numerous artificial channels also have been created to bring water to irrigated lands that historically did not have access to the river channels (*i.e.*, Victoria Canal, Grant Line Canal, Fabian and Bell Canal, Woodward Cut, etc.). These artificial channels have disturbed the natural flow of water through the south Delta. As a byproduct of this intensive engineering of the Delta's hydrology, numerous irrigation diversions have been placed along the banks of the flood control levees to divert water from the area's waterways to the agricultural lands of the Delta's numerous "reclaimed" islands. Most of these diversions are not screened adequately to protect migrating fish from entrainment. Sections of the south Delta have been routinely dredged to provide adequate intake depth to these agricultural water diversions, in order to reduce the probability of pump cavitation or loss of head on siphons.

Water flow through the south Delta is highly manipulated to serve human purposes. Rainfall and snowmelt is captured by reservoirs in the upper watersheds, from which its release is dictated primarily by downstream human needs. The SWP and CVP pumps draw water towards the south Delta, which creates a net upstream flow of water towards their intake points. Fish, and the forage base they depend upon for food, represented by free-floating phytoplankton and zooplankton, as well as larval, juvenile, and adult forms, are drawn along with the current towards these diversion points. In addition to the altered flow patterns in the south Delta, numerous discharges of treated wastewater from sanitation wastewater treatment plants (*e.g.*, Cities of Tracy, Stockton, Manteca, Lathrop, Modesto, Turlock, Riverbank, Oakdale, Ripon, Mountain House, and the Town of Discovery Bay) and the untreated discharge of numerous agricultural waste ways are emptied into the waters of the San Joaquin River and the channels of the south Delta. This leads to cumulative additions to the system of thermal effluent loads as well as cumulative loads of potential contaminants (*i.e.*, selenium, boron, endocrine disruptors,

pesticides, biostimulatory compounds, etc.). The seasonal installation of temporary rock barriers by the California Department of Water Resources (DWR) has been an ongoing activity in the channels of the south Delta since 1991.

Installation of a fall rock barrier at the head of Old River has occurred intermittently since the early 1960s, in order to enhance water quality downstream in the Port of Stockton and the Stockton Deepwater Channel; additionally, South Delta agricultural barriers will be installed. These barriers alter the hydrology of the south Delta each time they are installed by redirecting flows and increasing water elevation behind the barriers.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its conservation value remains high for San Joaquin River basin steelhead. This segment of CCV steelhead must pass through the San Joaquin Delta HU to reach their upstream spawning and freshwater rearing areas on the tributary watersheds and to pass through the region again during the downstream migrations of both adult runbacks and juvenile smolts. Therefore, it is of critical importance to the long-term viability of the San Joaquin River basin portion of CCV steelhead to maintain a functional migratory corridor and freshwater rearing habitat throughout the action area and the San Joaquin Delta HU.

2.4.2. Factors Affecting Listed Species and Critical Habitat in the Action Area

The action area encompasses a small portion of the area utilized by CCV steelhead and the sDPS green sturgeon. Many of the range-wide factors affecting these species are discussed in section 2.2 of this opinion, and are considered the same in the action area. This section will focus on the specific factors in the action area that are most relevant to the proposed Manthey Road Bridge Replacement Project.

The magnitude and duration of peak flows during the winter and spring, which affects listed salmonids in the action area, are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices 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 low-lying terraces under cultivation (*i.e.*, orchards and row crops) in the natural floodplain along the basin tributaries. Consequently, managed flows in the main stem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize sediments and create natural riverine morphological features within the action area. Furthermore, the unimpeded river flow in the San Joaquin River basin is severely reduced by the combined storage capacity of the different reservoirs located throughout the basin's watershed. Very little of the natural hydrologic input to the basin is allowed to flow through the reservoirs to the valley floor sections of the tributaries leading to the Delta. Most is either stored or diverted for anthropogenic uses. Elevated flows on the valley floor are typically only seen in wet years or flood conditions, when the storage capacities of the numerous reservoirs are unable to contain all of the inflow from the watersheds above the reservoirs.

High water temperatures also limit habitat availability for listed fish in the San Joaquin River and the lower portions of the tributaries feeding into the main stem of the river. High summer water temperatures in the lower San Joaquin River frequently exceed 72°F, and create a thermal barrier to the migration of adult and juvenile fish.

Levee construction and bank protection have affected fish habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA cover. Such bank protection generally results in two levels of impacts to the environment: (1) site-level impacts, which affect the basic physical habitat structure at individual bank protection sites; and (2) reach-level impacts, which are the cumulative impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach (USFWS 2000). Armored embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat. Impacts at the reach level result primarily from halting erosion and controlling riparian vegetation. Reach-level impacts, which cause significant impacts to fish are reductions in new habitats of various kinds, changes to sediment and organic material storage and transport, reductions of lower food-chain production, and reduction in large woody debris (LWD). The use of rock armoring limits recruitment of LWD from non-riprapped areas, and greatly reduces, if not eliminates, the retention of LWD once it enters the river channel. Riprapping creates a relatively clean, smooth surface that diminishes the ability of LWD to become securely snagged and anchored by sediment. LWD tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological functioning aspects are thus greatly reduced, because wood needs to remain in place for extended periods to generate maximum values to fish and wildlife (USFWS 2000). Recruitment of LWD is limited to any eventual tree mortality or abrasion and breakage that may occur during high flows (USFWS 2000). Juvenile fish are likely being impacted by reductions, fragmentation, and general lack of connectedness of remaining near shore refuge areas.

Point and non-point sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within the action area. The effects of these impacts are discussed in Section 2.2 of this opinion. Environmental stresses, because 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 Central Valley watersheds (USFWS 1995).

2.4.3. Mitigation Banks and the Environmental Baseline

Mitigation banks present a unique factual situation, and this warrants a particular approach to how they are addressed. Specifically, when NMFS is consulting on a proposed action that includes mitigation bank credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that a section 7 consultation occurred at the time of bank establishment. A traditional reading of "environmental baseline" might suggest that the overall ecological benefits of the mitigation bank actions therefore belong in the environmental baseline. However, under this reading, all proposed actions, whether or not they included proposed credit purchases, would benefit from the environmental 'lift' of the entire mitigation bank because it would be factored into the environmental baseline. In addition, where proposed actions did

include credit purchases, it would not be possible to attribute their benefits to the proposed action, without double counting. These consequences undermine the purposes of mitigation banks and do not reflect their unique circumstances. Specifically, mitigation banks are established based on the expectation of future credit purchases. In addition, credit purchases as part of a proposed action will also be the subject of a future section 7 consultation.

It is therefore appropriate to treat the beneficial effects of the bank as accruing incrementally at the time of specific credit purchases, not at the time of bank establishment or at the time of bank restoration work. Thus, for all projects within the service area of a bank, only the benefits attributable to credits sold are relevant to the environmental baseline. Where a proposed action includes credit purchases, the benefits attributable to those credit purchases are considered effects of the action. That approach is taken in this opinion.

The Project occurs within the service area of four banks approved by NMFS, with available credits for purchase or which are anticipated to have available credits for purchase prior to construction under the proposed action:

Bullock Bend Mitigation Bank: Established in 2016, the Bullock Bend Mitigation Bank is a 119.65-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 106) and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are salmonid floodplain restoration, salmonid floodplain enhancement and salmonid riparian forest credits available. All features of this bank are designated critical habitat for the species analyzed in this opinion. The ecological value (increased rearing habitat for juvenile salmonids) of the credits that have been sold to date is part of the environmental baseline.

Fremont Landing Conservation Bank: Established in 2006, the Fremont Landing Conservation Bank is 100-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80) and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are off-channel shaded aquatic habitat credits, riverine shaded aquatic habitat credits and floodplain credits available. All features of this bank are designated critical habitat for the species analyzed in this opinion. The ecological value (increased rearing habitat for juvenile salmonids) of the credits that have been sold to date is part of the environmental baseline.

Liberty Island Conservation Bank: Established in 2010, the Liberty Island Conservation Bank is a 186-acre site located at the southern end of the Yolo Bypass on Liberty Island in the Delta. It is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead. There are riparian shaded aquatic, salmonid preservation and salmonid restoration credits available. All features of this bank are designated critical habitat for the species analyzed in this opinion. The ecological value (increased rearing habitat for juvenile salmonids) of the credits that have been sold to date is part of the environmental baseline.

North Delta Fish Conservation Bank: Established in 2013, North Delta Fish Conservation Bank is an 811-acre site located in Yolo County and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are salmonid preservation and salmonid enhanced and created credits that are anticipated to be available prior to construction under the proposed action. All features of this bank are designated critical habitat for the species analyzed in this opinion.

2.4.4. NMFS Recovery Plan Recommendations

The NMFS Recovery Plan (NMFS 2014) identifies recovery actions for the San Joaquin River Basin CCV steelhead populations whose range includes the proposed action area. Recovery efforts focus on addressing several key stressors that are vital to CCV steelhead: (1) elevated water temperatures affecting adult migration and holding; (2) low flows and poor fish passage facilities, affecting attraction and migratory cues of migrating adults; and (3) possible catastrophic events (*e.g.*, fire or volcanic activity).

CCV steelhead DPS

The NMFS Recovery Plan (NMFS, 2014) criteria for CCV steelhead describes the San Joaquin River's eastside tributaries (Stanislaus, Tuolumne, and Merced rivers) as Core 2 populations (meaning these watersheds have the potential to support viable populations, due to lower abundance, or amount and quality of habitat) downstream of major dams, and as candidates to reach viable population status if reintroduced upstream of the dams, and lists the San Joaquin River, below Friant Dam, as the primary candidate to reach viable population status (Core 1).

sDPS green sturgeon

As previously mentioned, sDPS green sturgeon spawning has not been observed in the San Joaquin River; therefore, the San Joaquin River Basin is not a main focus of their Recovery Plan. However, the sDPS does utilize the lower San Joaquin River and the discovery of an individual adult in the Stanislaus River in October 2017 highlights that passage for adults is possible during certain river conditions, the Recovery Plan goals are not likely to be modified unless adult spawning or juvenile reproduction occurs (NMFS 2018).

2.5. Effects of the Action

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

2.5.1. Effects to Species

The following is an analysis of the potential effects to listed fish species that may occur as a result of implementing the proposed action on the San Joaquin River. For our analysis, we have used the presence of listed species in the action area to determine the risk each species and life stage may face if exposed to Project impacts. The expected effects of the proposed action include impacts due to: (1) changes in water quality, (2) noise exposure, (3) loss of habitat and (4) dewatering and fish relocation.

Water Quality

Sediment and Turbidity
Construction activities could result in increased turbidity, suspended sediment concentrations, and contaminant concentrations. Construction activities, including demolition of the existing structure, construction of the new bridge structure, use of staging areas, installation and removal of piles, and dewatering could disturb sediments and soils within and adjacent to waterways. Any construction-related erosion or disturbance of sediments and soils would increase turbidity and sedimentation downstream of the Project area. The distance soils would be transported is dependent on river flows.

The abundance, distribution, and survival of fish populations have been linked to levels of turbidity and silt deposition. Prolonged exposure to high levels of suspended sediment could reduce visual capability in fish in aquatic habitats within the Project area, leading to reduced feeding and growth rates. Such exposure could also result in a thickening of the gills, potentially causing the loss of respiratory function; in clogging and abrasion of gills; and increased stress levels, which in turn could reduce tolerance to disease and toxicants (Waters 1995). Turbidity also could result in increased water temperature and decreased dissolved oxygen levels, especially in low-velocity pools, which can cause stressed respiration.

Many fish, including salmonids, are visual feeders, and turbid waters reduce the ability of these fish to locate and capture prey. Some fish, particularly juveniles, could become disoriented and leave the areas where their main food sources are located, ultimately reducing growth rates. Prey of fish populations, such as macroinvertebrates, could be adversely affected by declines in habitat quality (water quality and substrate conditions) caused by increased turbidity, decreased dissolved oxygen content, and an increased level of pollutants.

Avoidance of adverse habitat conditions by fish is the most common response to increases in turbidity and sedimentation (Waters 1995). Fish are not expected to occupy areas unsuitable for survival unless they have no other option. Therefore, increased turbidity attributed to construction activities could preclude fish from occupying habitat required for specific life stages. A review by Lloyd (1987) indicated that several behavioral characteristics of salmonids can be altered by even relatively small changes in turbidity (10 to 50 nephelometric turbidity units [NTUs]) that are expected to result from this proposed Project. Salmonids exposed to slight to moderate increases in turbidity exhibited avoidance, reduced feeding rates and reduced use of overhead cover. Reaction distances of rainbow trout to prey were reduced with increases of turbidity of only 15 NTUs over an ambient level of 4 to 6 NTUs in experimental stream channels (Barret *et al*. 1992), indicating that they are more susceptible to predation in elevated turbidity.

The in-water work activities that would result in increased sediment and turbidity would occur during June to October. This period coincides with when CCV steelhead are least likely to be present in the action area. Adult CCV steelhead may commence their upstream migration as early as October. However, juveniles would not likely be migrating downstream during this time. Rearing juveniles, resident or holding CCV steelhead are not expected to occur in the Project site during the in-water work window, due to unsuitable habitat conditions, such as warm water temperatures. This species is only likely to be present within the action area during migrations, so timing the construction outside of the primary migratory periods will limit the potential for CCV steelhead exposure to construction activities. If an adult steelhead were to enter the action area, they will likely exhibit avoidance behavior in response to construction and associated activities. Therefore, adverse effects are not expected to impact adults. Any increases in turbidity will most likely disrupt feeding and migratory behavior activities of juvenile CCV steelhead. Turbidity and sedimentation events are not expected to affect visual feeding success of green sturgeon, as they are not believed to utilize visual cues (Sillman *et al*. 2005). Green sturgeon, which can occupy waters containing variable levels of suspended sediment and thus turbidity, are not expected to be impacted by the slight increase in the turbidity levels anticipated from the construction activities.

Installation of cofferdams, pile driving, and removal of piles is expected to result in short-term, localized increases in turbidity. Therefore, there could be some impacts to the listed species, if present during the installation of the cofferdam and associated construction activities. However, because the cofferdam will isolate the work area, continued increases in turbidity and sediment mobility during in-water work activities is not expected to occur.

Contaminants

During construction, the potential exists for spills or leakage of toxic substances that could enter the waterways. Refueling, operation, and storage of construction equipment and materials could result in accidental spills of pollutants (*e.g*., fuels, lubricants, sealants, and oil). Adverse effects to listed fish may result from point and non-point source chemical contaminant discharges within the action area. These contaminants include, but are not limited to, oil and gasoline product discharges, lime, bentonite, and concrete.

Concrete work will be performed during construction of the new bridge. Contact with uncured concrete may cause significant increase in the pH of the surrounding waters, negatively affecting aquatic life. Lime is a major component of cement and concrete work. It easily dissolves in water and drastically changes the pH of water increasing the alkalinity (pH 11-13), which causes burns on fish and kills other aquatic life. Project activities that cause concrete to contact water include concrete cutting, demolition of structures, washing concrete dust residues, raw concrete spills, disposal of concrete, dampening freshly laid concrete, and washing equipment.

Bentonite is used as a lubricant for pile placement or to seal joints between adjacent sheet piles for temporary cofferdams. Bentonite is potentially lethal to fish. Steelhead and Coho salmon show reduced growth rates or increased emigration rates when exposed to 125 to 175 mg/L bentonite (Sigler *et al*. 1984).

High concentrations of contaminants can cause short-term and long-term effects to fish. The severity of these effects depends on the contaminant, the concentration, duration of exposure, and sensitivity of the affected life stage. Sublethal effects include increased susceptibility to disease that reduces the overall health and survival of the exposed fish. A long-term effect of contamination is reduced prey availability (Kidd *et al*. 2014). Invertebrate prey species survival can be reduced, therefore, less food is available for fish. In addition, fish consuming prey affected by contamination can absorb toxins directly. Small numbers of juvenile CCV steelhead may be present, however, implementation of avoidance and minimization measures, including implementation of a SWPPP and BMPs, would minimize any risk, and therefore, avoid potential for exposure to hazardous chemicals.

Green sturgeon may be more susceptible to aquatic contaminants, since they are benthic foragers. Studies on white sturgeon found that bioaccumulation of pesticides and other contaminants adversely affect growth and reproductive development (Feist *et al*. 2005). However, with the implementation of the water quality conservation measures (as described in the Project description) and in-water work window, exposure to contaminants is expected to be avoided.

Noise Exposure

Pile Driving

Construction of the new Manthey Road Bridge will require the use of both vibratory and impact pile driving to install sheet piling for cofferdams, steel pipe piles for temporary trestles or barges, bridge pier piles, and removal of temporary piles. During the construction period, steel pipe piles and sheetpiles will be temporarily placed into the San Joaquin River by combination of vibratory hammer and impact hammer during the proposed in-water work window of June 1 to October 31. Installation of the steel shell piles for permanent bridge piers will occur in one construction season, installation and removal of the steel piles and H piles for trestles and barges will occur over two seasons.

Pile driving near or in water has the potential to kill, injure, and cause delayed death to fish through infection of minute internal injuries, or cause sensory impairments leading to increased susceptibility to predation. The pressure waves generated from driving piles into river bed substrate propagate through the water and can damage a fish's swim bladder and other internal organs by causing sudden rapid oscillations in pressure, which translates to rupturing or hemorrhaging tissue in the bladder when the air in swim bladders expand and contract (Gisiner 1998, Popper *et al*. 2006). Sensory cells and other internal organ tissue may also be damaged by pressure waves generated during pile driving activities as sound reverberates through a fish's viscera (Caltrans 2015). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings and Popper 2005). Smaller fish with lower mass are more susceptible to the impacts of elevated sound fields than larger fish, so acute injuries resulting from acoustic impacts are expected to scale based on the mass of a given fish. Since juveniles and fry have less inertial resistance to a passing sound wave, they are more at risk for non-auditory tissue damage (Popper and Hastings 2009) than larger fish (yearlings and adults) of the same species. Beyond immediate injury,

multiple studies have also shown responses in the form of behavioral changes in fish due to human-produced noises (Wardle *et al*. 2001, Slotte *et al*. 2004, Popper and Hastings 2009). Based on recommendations from the Fisheries Hydroacoustic Working Group, NMFS uses interim dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (Fisheries Hydroacoustic Working Group (FHWG) 2008, Caltrans 2015). The interim thresholds of underwater sound levels denote the expected instantaneous injury/mortality and cumulative injury, as well as a third threshold criterion for behavioral changes to fish. Impact pile driving is expected to produce underwater pressure waves exceeding all three threshold levels. Vibratory pile driving generally stays below injurious thresholds, but often introduces pressure waves that will incite behavioral changes. Even at great distances from the pile driving location, underwater pressure changes/noises from pile driving is likely to cause flight, hiding, feeding interruption, area avoidance, and movement blockage, as long as pile driving is ongoing.

For a single strike, the peak exposure level (peak) above which injury is expected to occur is 206 decibels (dB) (reference to one micro-pascal [1µpa] squared per second). 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. Therefore, the accumulated SEL level above which injury to fish is expected to occur is 187 dB for fish greater than 2 grams in weight, 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 to fish within the estimated distance thresholds. Underwater sound levels below injurious thresholds are expected to produce behavioral changes. NMFS uses a 150 dB root-mean-square (RMS) threshold for behavioral responses in salmonids and green sturgeon.

The permanent piles for the bridge abutments will be installed using a vibratory hammer rather than an impact hammer to the maximum extent possible. The proposed action includes installation of six (6) 84-inch diameter steel shell piles. According to the Caltrans acoustic report in the Biological Assessment, the installation of 84-inch diameter steel shell piles with an impact hammer in the water without attenuation will result in single-strike sound levels of 216 dBpeak and 202 dB root mean square (RMS) at 10 meters (32.8 feet) from the pile with an estimated sound exposure level (SEL) of 192 dB. Attenuated in-water impact pile driving of 84-inch diameter piles for this Project could generate underwater sound waves of up to 216 dB peak, 192 dB SEL, and 202 dB RMS, as measured at 10 meters from the strikes. (Table 1). Strikes per day will be limited to 2,500/day to minimize accumulated sounds exposure.

These estimates are calculated from field data gathered from pile driving activities at other locations and are considered informative only; not the definite levels that will be generated by impact pile driving in the San Joaquin River during the course of this Project. This is because each pile-driving situation is unique. Variations in the substrate, channel shape, depth, salinity, and water temperature can alter how the underwater pressure waves propagate and the amount of transmission loss that will dampen the underwater sounds as they travel. The largest piles proposed for in-water use are 84-inch CISS piles; estimated sound exposure levels for this pile are interpolated from data for larger diameter piles, in lieu of data for 84-inch piles.

Table 1: Summary of Estimated Underwater Attenuated Sound Exposure Levels.

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
84" diameter pile steel shells	impact hammer	5000	2,500	10	5	211	187	197	22	1842	2929	13594
84" diameter pile steel shell s	impact hammer	5000	2,500	10	0	216	192	202	46	3969	6310	29286
14 to 18" steel H piles	impact hammer	1800	14,400	10	5	203	172	184	6	293	293	1848
14 to 18" steel pipe piles	impact hammer	1800	14,400	10	5	203	171	182	6	251	251	1359
14 to 18" steel H piles	impact hammer	1800	14,400	10	0	208	177	189	14	631	631	3981
14 to 18" steel pipe piles	impact hammer	1800	14,400	10	0	206	176	187	14	541	541	2929

Attenuated strikes of 84-inch piles would be expected to attenuate to the ambient underwater noise level of 150 dB at 13,594 meters. However, the Caltrans 2015 Pile Driving Compendium states, "it is not possible to reliably predict audibility (or detectability) with any certainty at distances beyond 500 to 1,000 meters. Consequently, the Project action area based on pile driving sound should never be considered to extend more than 1,000 meters (3,280 feet or 0.62-mile) from the pile driving activity." Based on this guidance, noise effects are only considered within 1000 meters of the pile driving activity. Installation of all piles will use an attenuation measure. NMFS considers that attenuation measures, such as pile driving behind a bubble curtain or within a dewatered cofferdam, reduce the underwater pressure waves by 5 dB for each application.

The distance that behavioral changes are expected is up to 13,594 meters from the driven pile, where the RMS sound will be above 150 dB RMS. SELs below 150 dB are assumed to not accumulate and cause fish injury, or be significantly different from ambient conditions, (*i.e.*, effective quiet). Pressure levels in excess of 150 dBRMS are expected to cause temporary behavioral changes (startle and stress) that could decrease a fish's ability to avoid predators or delay normal migration past the work site. The background RMS sound pressure levels, or effective quiet, are assumed to be 150 dB RMS and the acoustic impact area is the area where the predicted RMS sound pressure level generated by pile driving exceeds this threshold. Once the pressure waves attenuate below this level, fish are assumed to no longer be adversely affected by pile driving sounds. Under the concept of effective quiet being less than or equal to 150 dBRMS, the distance fish are expected to be adversely affected during pile driving is out to 13,594 meters from the location of the pile being driven, assuming a transmission loss constant of 15 (FHWG 2008). This distance effectively covers the width of the San Joaquin River bank to bank and would be expected to propagate approximately through the entire action area, 1,000 meters both up- and downstream from the pile driving location.

CCV steelhead adults can begin their upstream migration anytime from July through December, and sDPS green sturgeon may remain in freshwater systems feeding and rearing throughout the year. It is possible that adult CCV steelhead may use the action area as a migration corridor, while sDPS green sturgeon adults and juveniles may use the action area as foraging and rearing habitat during the in-water work window, whenever water temperatures are suitable (at least below 75°F). Water temperatures are likely to drop in September, with atmospheric temperature drops and increased cloud cover and rainfall. In some years, water temperatures may be tolerable to anadromous fish use throughout the summer, as seen in 2011 and 2017. Therefore, CCV steelhead and sDPS green sturgeon are assumed to be present when local water temperatures are below 75°F, though the total number of individual fish using the area during the work window is expected to be low.

Due to the large area that will be impacted by elevated underwater sounds above effective quiet (at least 1,000 meters from the location of the pile being driven), CCV steelhead, and sDPS green sturgeon are expected to be adversely affected by impact pile driving associated with this action. While vibratory pile driving is generally not directly injurious to fishes even when performed in water without attenuation, it is likely that the underwater pressure waves and sounds will disturb the normal behaviors of fish using this area. This disturbance could include potentially interrupting migration patterns and foraging activities, even while the Project observes the proposed in-water work window and uses underwater sound control measures.

Impact pile driving is expected to directly injure or kill fishes within certain distance thresholds, depending on the size of pile being driven, the number of strikes used in a day, and whether attenuation measures are being employed. Using the greatest numbers of strikes estimated to drive the largest piles (up to 2500), it is expected that fish may be killed within 22 meters (attenuated) to 46 meters (unattenuated) of the driven pile due to in-water impact pile driving. Fish may be injured between 1,842 and 6,310 meters from the driven pile, due to the cumulative SELs produced by in-water impact pile driving. CCV steelhead and sDPS green sturgeon are expected to be affected.

Acoustic Effects of Barge Traffic

Barge and tugboat traffic will create additional sources of noise in the aquatic environment. This could result in negative impacts to listed species present. Ships under power produce a substantial amount of mechanical- and flow-induced noise from motor, propeller, and hull turbulence. Measurements of sound intensity from commercial shipping have shown sound levels up to approximately 180 dB (ref. 1 µPa) at the point source (1 meter from ship) (Kipple and Gabriele 2007). This level of noise will drop off by 40 dB at 100 yards away and approximately 53 dB lower at one-quarter mile (Kipple and Gabriele 2007).

Elevated noise levels generated by the passage of vessels, such as tugboats, would subject fish within the confines of the channel to anthropogenic-produced noise conditions. The relatively rapid passage of the barge and tugboat past a given point will somewhat attenuate these effects by decreasing the duration of the elevated sound levels, but some temporary effects can be anticipated to occur, depending on the proximity of the exposed fish to the sound source.

The presence of underwater noise may adversely affect a fish's ability to detect predators, locate prey, or sense their surrounding acoustic environment (Slabbekoorn *et al*. 2010, Radford *et al*. 2014). Other species of fish have been shown to respond to recorded ambient shipping noise by either reacting more slowly to predators, thus increasing their susceptibility to predation (Simpson *et al*. 2015, Simpson *et al*. 2016), or becoming hyper-alert and reacting more quickly to a visual predator stimulus, causing them to cease feeding and hide (Voellmy *et al*. 2014b). Voellmy *et al*. (2014a) state that elevated sound levels could affect foraging behavior in three main ways: 1) noise acts as a stressor, decreasing feeding behavior directly through reduced appetite, or indirectly through a reduction in activity, locomotion, and alterations to the cognitive processes involved in food detection, classification, and decision making; 2) noise acts as a distracting stimulus, diverting an individual's limited amount of attention from their primary task to the noise stimuli that have been added to the environment; and 3) noise masks crucial acoustic cues, such as those made by both prey and predators.

Fish also may exhibit noise-induced avoidance behavior that causes them to move into less suitable habitat for foraging or will wait to feed when the noise has abated. Voellmy *et al*. (2014a) surmised that sustained decreases in food consumption could have long-term energetic impacts that result in reductions in growth, survival, and breeding success. Moreover, compensatory feeding activities could increase predation risks by increasing time exposed to predators or by forcing animals to feed in less favorable conditions, such as in times or areas of higher predation pressure.

Increased noise, produced by barge and tugboat traffic may result in CCV steelhead and green sturgeon fleeing the area of those noises and moving into the San Joaquin River's shallowest margins or adjacent habitat. The channel margins of many Delta waterways have submerged and emergent vegetation (*e.g*., Egeria) and rock riprapped levees where predatory species are likely to occur in greater numbers than in the open waters of the channel. This scenario, therefore, could increase the predation risk of salmonids, particularly smolts. Likewise, elevated noise exposure can reduce the ability of fish to detect piscine predators, by either reducing the sensitivity of the auditory response in the exposed fish or masking the noise of an approaching predator. Such would be the case if open water predators, such as striped bass (*Morone saxatilis*), encounter the juvenile fish in the open channel, while a barge and tugboat were present.

Because of the variability and uncertainty associated with the population sizes of the species present, annual variation in the timing of migration and variability regarding individual habitat use of the action area, the actual number of individuals of listed fish present in the action area during the in-water work window is not known. However, exposure would be limited to small numbers of individuals, since most juvenile CCV steelhead would have left the action area by late spring and are least likely present in the action area during in-water work season. Green sturgeon abundance in the San Joaquin River in the action area is likely low. Therefore, low numbers of individuals are expected to be impacted by elevated noise levels from barge or tugboat.

Dewatering and Fish Relocation

Fish capture and relocation may be necessary during dewatering activities, if listed fish are present and found in the enclosed area of the cofferdam. Up to 0.12 acres of the San Joaquin

River will be dewatered during bridge demolition activities. Each step during the capture/relocation process could induce physiological stress leading to injury or death, even when a skilled fish biologist performs the relocation. The potential capture and relocation of CCV steelhead and sDPS green sturgeon associated with the dewatering of the cofferdam are expected to adversely affect a small number of fish if present in the action area. Although upstream-migrating adult CCV steelhead and rearing or migrating adult sDPS green sturgeon may occur in the Project area during in-water work, the large size and probable avoidance of the enclosed area makes it unlikely that they would be trapped in the cofferdams. Juvenile green sturgeon could occur during any month in the Delta, although in small numbers in the action area.

Because of the variability and uncertainty associated with the population sizes of the species present, annual variation in the timing of migration and variability regarding individual habitat use of the action area, the actual number of individuals present in the action area during the in-water work window is not known. However, there would be few individuals present, since most juvenile CCV steelhead would have left the action area by late spring and are likely to be present in low numbers in the action area during the in-water work season. Juvenile CCV steelhead or green sturgeon that evade capture and remain in the construction area may be injured or killed from construction activities. This includes desiccation, if fish remain in the dewatered area, or death, if personnel or equipment crush fish. However, because experienced biologists will be collecting fish, most are expected to be removed from the area. Juvenile CCV steelhead or green sturgeon may be present during relocation, and thus subject to the above effects. Effects to adult CCV steelhead and green sturgeon are improbable, due to their large size and probable avoidance.

2.5.2. Effects to Critical Habitat

The Project is expected to adversely impact PBFs of critical habitat for CCV steelhead (freshwater rearing and migratory habitat) and sDPS green sturgeon (food resources, water flow, and water quality). The proposed Project is expected to cause short- and long-term, and permanent effects on critical habitat for CCV steelhead and sDPS green sturgeon. Potential Project effects include temporary water quality degradation from localized increases in turbidity and suspended sediment, permanent habitat loss/modification of critical habitat, and in-channel disturbance from pile driving and other construction activities. Long-term effects on designated critical habitat include degradation of the CCV steelhead PBF of freshwater rearing habitat and the green sturgeon PBF of food resources. This is expected to result in decrease of survival of fish in the action area, which is due to the overwater bridge structure. Artificial shade can create sharp contrasting shadows that can impair fish vision, limit photosynthetic production, alter fish behavior and may favor ambush predators.

Sedimentation and Turbidity

There is potential for degradation of PBFs resulting from turbidity and sedimentation associated with the proposed action. Kemp *et al*. (2011) describe a suite of physiochemical effects to lotic aquatic systems resulting from increased sedimentation and turbidity-related events. Sedimentation events in a system that shares both lotic and estuarine characteristics have the potential to increase turbidity on a broad temporal scale and reduce oxygen supply. These impacts could degrade the PBFs for CCV steelhead and green sturgeon, such as riparian habitat,

which provides the necessary habitat for successful juvenile development and survival. BMPs, such as groundcover and stabilization, will be implemented during construction to help prevent Project-disturbed soil on land from entering the water. With the minimization and avoidance measures included in the proposed action, turbidity and sedimentation are expected to result in minor and short-term effects to PBFs of designated critical habitat for CCV steelhead (freshwater rearing habitat) and green sturgeon (food resources and water quality) in the action area.

Riparian Vegetation Removal
Removal of riparian vegetation will occur during the clearing of staging areas and access roads, and grading activities. These activities have the potential to result in direct or indirect adverse effects to critical habitat PBFs. Riparian vegetation plays a key role in the conservation value of rearing habitat for many salmonid life stages. It provides shading to reduce stream temperatures, increases the recruitment of large woody material into the river that increases habitat complexity, provides shelter from predators, and enhances the productivity of aquatic macroinvertebrates (Anderson and Sedell 1979, Pusey and Arthington 2003). Riparian vegetation has also been shown to directly influence channel morphology and may be directly correlated with improved water quality in riverine systems through biogeochemical cycling, soil and channel chemistry, water movement, and erosion (Schlosser and Karr 1981, Dosskey *et al*. 2010). The proposed action will result in the temporary loss of 0.016 acres and a permanent loss of 0.014 acres of riparian habitat due to disturbance from Project activities. This loss of riparian habitat will result in the degradation of migratory corridors and rearing habitat PBFs for CCV steelhead and green sturgeon. With implementation of BMPs to minimize riparian removal and compensatory mitigation credit purchase as proposed, impacts to critical habitat due to riparian habitat removal are expected to be minimal.

Overwater Structure Shading
The new bridge structure would result in permanent shading of 0.40 acres over the waters of the San Joaquin River. This overwater structure may decrease temperatures in the action area benefitting habitat quality. The structure will also reduce natural cover and may facilitate increased predation on juvenile CV steelhead and green sturgeon, which permanently degrades rearing habitat quantity and quality.

Night Lighting
The design of the new bridge includes the permanent installation of night lighting. Night lighting has the potential to result in permanent adverse effects to critical habitat PBFs. Night lights can shine onto waters during nighttime hours and may result in increased predation on juvenile CCV steelhead and green sturgeon by predatory fish, birds, and mammals (Kahler *et al*. 2000). BMPs, including limitation of night work and placement of permanent lighting away from water surfaces, will be implemented to incorporate night lighting designs, which limit the amount of light shining on water surfaces. The lights will be shielded and focused on the bridge away from water surfaces. This action will minimize the extent of any negative effects to low levels associated with night lighting.

2.5.3. Mitigation/Conservation Bank Credit Purchase

To address permanent and temporary loss of riparian and aquatic habitats, the proposed action includes purchase of mitigation bank credits. Credits will be purchased at a 1:1 ratio for

temporary riparian impacts, a 3:1 ratio for permanent riparian impacts, and a 3:1 ratio for permanent impacts to aquatic habitat. Caltrans will purchase 0.058-acre credits of salmonid or riparian SRA habitat credits for the temporary loss of 0.016 acres and permanent loss of 0.014 acres of riparian habitat. Caltrans will purchase 1.2 acres of salmonid credits for the 0.40 acres of permanent artificial shade.

The purchase of compensatory mitigation credits will restore and preserve, in perpetuity, SRA habitat or similar types of riverine habitat that will be beneficial to salmonids. The mitigation banks that serve the action area offer floodplain or other habitat that can support migrating juvenile and adult CCV steelhead and sDPS green sturgeon in the same way that river margin habitat otherwise would have, had the project not occurred. SRA habitat types of conservation credits can benefit both adult and juvenile CCV steelhead and sDPS green sturgeon, even if such banks are located far from the action area and individuals affected by the project would be unlikely to benefit from the compensation purchase.

Both the riparian and aquatic habitat impacts affect designated critical habitat, as well as listed fish species, described above in this opinion. The purchase of mitigation credits will address the loss of ecosystem functions due to the modification of the riverbank. These credit purchases are ecologically relevant to the PBFs of critical habitat and the species affected by the proposed action, because both banks include SRA, riparian forest and floodplain credits with habitat values that are already established and meeting performance standards. Also, the banks are located in areas that will benefit the CCV steelhead DPS affected. The purchase of mitigation credits at one of these banks is expected to benefit the PBFs of freshwater rearing habitat and migration corridors for juvenile CCV steelhead by providing suitable floodplain and riparian habitat. The floodplains and riparian forest in the bank benefit the growth and survival of rearing salmonids by providing habitat with abundant food in the form of aquatic invertebrates, structural diversity, such as instream woody material (IWM) and cooler stream temperatures.

The purchase of credits provides a high level of certainty that the benefits of a credit purchase will be realized, because all of the NMFS-approved banks considered in this opinion have mechanisms in place to ensure credit values are met over time. Such mechanisms include legally binding conservation easements, long-term management plans, detailed performance standards, credit release schedules that are based on meeting performance standards, monitoring plans and annual monitoring reporting to NMFS, non-wasting endowment funds that are used to manage and maintain the bank and habitat values in perpetuity, performance security requirements, a remedial action plan, and site inspections by NMFS. In addition, each bank has a detailed credit schedule, and each tracks their credit transactions and availability on the Regulatory In-lieu fee and Bank Information Tracking System (RIBITS). RIBITS was developed by the U.S. Army Corps of Engineers with support from the Environmental Protection Agency, the U.S. Fish and Wildlife Service, the FHWA, and NMFS to provide better information on mitigation and conservation banking and in-lieu fee programs across the country. RIBITS allows users to access information on the types and numbers of mitigation and conservation bank and in-lieu fee program sites, associated documents, mitigation credit availability, service areas, as well information on national and local policies and procedures that affect mitigation and conservation bank and in-lieu fee program development and operation.

2.6. Cumulative Effects

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

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).

The private and State activities described below are likely to adversely affect CCV steelhead, sDPS green sturgeon, and their designated critical habitats. These potential factors are ongoing and expected to continue into the future. However, the extent of the adverse effects from these activities is uncertain, and it is not possible to accurately predict the extent of the effects from these future non-Federal activities.

2.6.1. Agricultural Practices

Agricultural practices in the action area may adversely affect riparian habitats through upland modifications of the watershed that lead to increased siltation, reductions in water flow, or agricultural runoff. Grazing activities from cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which can flow into the receiving waters of the associated watersheds. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect listed salmonids reproductive success and survival rates (Dubrovsky *et al*. 1998, Daughton 2003).

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 would 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 that are situated away from waterbodies, would not require Federal permits, and thus would 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 would 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 would 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 Repairs

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, as well as illegal placement of riprap occur, within the 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 diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1. Summary Status of CCV steelhead DPS and Designated Critical Habitat

The 2016 status review (NMFS 2016) concluded that overall, the status of CCV steelhead appears to have changed little since the 2011 status review, that CCV steelhead should remain listed as threatened, as the DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Further, there is still a general lack of data on the status of wild steelhead populations. There are some encouraging signs, as several hatcheries in the Central Valley (such as Mokelumne River) 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 Delta fish facilities, and the percent of wild fish in those data remains much higher than at Chipps Island. Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin River Basin continue to show an overall very low abundance and fluctuating return rates. The NMFS Recovery Plan (NMFS 2014) strategy for CCV steelhead lists the San Joaquin River's eastside tributaries (Stanislaus, Tuolumne, and Merced rivers) as Core 2 populations. These eastside tributary watersheds have the potential to support viable populations, although with lower abundance based on amount and quality of habitat downstream of major dams. The Recovery Plan also lists these tributaries as candidates to reach viable population status, if species are

reintroduced upstream of the dams, and lists the San Joaquin River, below Friant Dam, as a candidate to reach viable population status. The action area provides habitat to these eastside tributaries.

2.7.2. Summary Status of the sDPS green sturgeon and Designated Critical Habitat

The federally listed sDPS green sturgeon and its designated critical habitat occur in the action area and may be affected by the proposed action. It was listed as threatened in 2006 and its designated critical habitat in 2009. Adult sDPS green sturgeon potentially migrate through the action area to reach upstream riverine habitat based on catches of sDPS green sturgeon in the San Joaquin River mainstem, upstream of the Delta (CDFW sturgeon report card data). There is a strong need for additional information regarding sDPS green sturgeon, especially concerning a robust abundance estimate, a greater understanding of their biology, and further information about their micro- and macro-habitat ecology. The upstream portion of the San Joaquin River is not known to currently host sDPS green sturgeon spawning; therefore, the San Joaquin River Basin is not a main focus of their recovery plan. Though the sDPS does utilize the lower San Joaquin River and the discovery of an individual adult in the Stanislaus River October 2017 highlights that passage for adults is possible during certain river conditions, the recovery plan and efforts are not likely to be modified, unless adult spawning or juvenile reproduction occurs (NMFS 2018).

2.7.3. Status of the Environmental Baseline and Cumulative Effects in the Action Area

Listed salmonids primarily use the action area as a migration corridor and rearing site. For CCV steelhead, the San Joaquin migratory corridor is an important piece of the recovery criteria (NMFS 2014), which includes two viable populations for CCV steelhead to be established in the San Joaquin River Basin. The San Joaquin River Basin is not the main focus for sDPS green sturgeon recovery plan. Currently, the San Joaquin River, although degraded due to levees and lack of floodplain habitat, is an important migratory corridor for the recovery of these species.

The Cumulative Effects section of this opinion describes how continuing or future effects, such as the discharge of point and non-point source chemical contaminants discharges and increased urbanization affect the species in the action area. These actions typically result in habitat fragmentation, and conversion of complex nearshore aquatic habitat to simplified habitats that incrementally reduces the carrying capacity of migratory corridors.

2.7.4. Summary of Project Effects on CCV steelhead and sDPS green sturgeon

1) Construction-related effects
   During construction, some behavioral effects, as well as injury or death to individual fish, are likely to result. Construction activities would occur June 1 to October 31, when the abundance of CCV steelhead is low and outside most of the migrating adult and juvenile timing period, which would result in correspondingly low numbers of fish injured or killed. Construction will occur when both juvenile and adult sDPS green sturgeon may be present in the San Joaquin River. However, available information indicates that sDPS green sturgeon are present in low densities and numbers in this area of the Delta based on the low numbers of fish catches on the CDFW sturgeon report cards. The majority of

reported sDPS green sturgeon catches in monitoring efforts and sport fishing catches indicate that sDPS green sturgeon utilize other areas of the Delta and Sacramento River watershed for their life history needs. Using the same reasoning as given for CCV steelhead, there is a low likelihood of injury/death to green sturgeon, due to the proposed work window and the low numbers of fish present. During construction activities, some water quality impacts will occur, such as dewatering and noise-related effects. However, with the implementation of avoidance and minimization measures, impacts would be minimized and affect a low number of listed species.

2) Long-term effects
CCV steelhead and sDPS green sturgeon individuals will at some point pass under the new bridge structure. These species would be susceptible to increased predation and decreased water quality from the presence of this overwater structure. The proportion of the populations that will come in contact with the bridge structure as fish migrate through the San Joaquin River is unknown, since the spatial distribution of fish across the channel by the different fish species and life stages is unknown. However, it is certain that the bridge structure increases the risk to passing CCV steelhead and sDPS green sturgeon, resulting in adverse effects. The bridge structure is expected to result in minimal effects over the foreseeable future.

2.7.5. Summary of Project Effects on CCV steelhead and sDPS green sturgeon critical habitat

Within the action area, the relevant PBFs of the designated critical habitats for listed CCV steelhead are migratory corridors and rearing habitat. For sDPS green sturgeon, PBFs include food resources, water flow, and water quality.

Based on the effects of the proposed Project described previously in this opinion, the impacts are expected to degrade designated critical habitat for both CCV steelhead and sDPS green sturgeon. The quality of the current conditions of the PBFs for CCV steelhead and sDPS green sturgeon in the action area are poor compared to historical conditions (pre-levees). The habitat does not provide the functionality necessary for the long-term survival and recovery of the species. In particular, levees, riprapping, and removal of riparian vegetation have greatly diminished the value of the aquatic habitat in the action area by decreasing rearing area, food resources via food-web degradation, and complexity and diversity of habitat forms necessary for holding and rearing (channel and bathymetry diversity). Perpetuating the overwater structure with the construction of the new Manthey Road Bridge structure would contribute to the degradation of designated critical habitat.

The temporary construction impacts to designated critical habitat would negatively affect the ability of CCV steelhead and sDPS green sturgeon to use the action area as rearing habitat and as migratory corridors during the overlap of migration periods and construction, as discussed in the Effects to Species section. Construction effects would last for the entirety of each work season, but would not permanently modify critical habitat function, as noise and turbidity would end after construction ends.

The presence of the structure will continue into the foreseeable future, thus creating a minor perpetual source of water quality and predation impacts to the action area, and a permanent adverse effect to rearing and migratory corridor PBFs.

2.7.6. Mitigation/Conservation Bank Credits

Caltrans' mitigation credit purchase is expected to mitigate some of the impacts from the Manthey Road Bridge project by providing some benefits to the CCV steelhead DPS by improving riverine or floodplain habitat conditions elsewhere through restoration and ensuring their preservation into the future. The benefits offered to these populations are expected to exist in perpetuity. Although some of the banks that cover the action area in their service area may not technically offer sDPS green sturgeon credits, we expect that some sDPS green sturgeon individuals should benefit from the purchase of credits from these banks, since individuals should be able to access the purchased riverine habitat areas created and maintained by the banks/programs.

2.7.7. Summary of the Risk to the DPS for each Species and Critical Habitat

According to the most recent status reviews, CCV steelhead DPS and sDPS green sturgeon are at risk of becoming endangered, due to past and present activities within the range of the DPS. Significant habitat loss, degradation, and fragmentation has occurred in the San Joaquin watershed. Cumulative effects, like water diversions, increased urbanization, and continuing rock projects, will all continue to happen in the action area without necessarily requiring Federal permitting. During this proposed Project, fish are expected to be harassed, injured, or killed during completion of the proposed action through various pathways. Construction-related effects from the Project, as well as dewatering and fish capture and relocation, turbidity increases, increased shading/loss of cover, and a loss of critical habitat, are all expected to adversely affect fish. Avoidance and mitigation measures, as well as BMPs, are included in the proposed Project to decrease the likelihood and level of effects to listed species and critical habitat.

The proposed construction will temporarily decrease the area's ability to safely support CCV steelhead and sDPS green sturgeon at a variety of life stages and will increase mortality events and behavioral changes. The Recovery Plan (NMFS 2014) identifies the population of CCV steelhead in the San Joaquin River, below Friant Dam, as the primary candidate to reach viable population status. Effects of the bridge structure will permanently impact individuals of this population that migrate through and rear in the area. Effects to sDPS green sturgeon would not likely reach the population level as individuals have been known to utilize the San Joaquin River but the watershed is not a main focus of the Recovery Plan, as spawning does not occur. These permanent impacts only represent a small loss in the scope of available habitat at the designation scale for these species, but the intrinsic value of the area for conservation of the species remains high.

To mitigate the adverse effects of the project, Caltrans proposes to purchase mitigation credits off-site at a 1:1 ratio for 0.016 acres of temporal loss of riparian habitat, a 3:1 ratio for the 0.014 acres of permanent loss of riparian habitat, and at a 1:1 ratio for 1.01 acre of increased overwater structure shade, for a total of 1.258 acres purchased. The purchase of mitigation bank credits will

offset impacts by increasing floodplain and shaded aquatic and riverine habitat for the CCV steelhead DPS and sDPS green sturgeon.

Combining the adverse and beneficial effects (compensatory mitigation) associated with the proposed action described above, including the environmental baseline, cumulative effects, status of the species, and critical habitat, the Project is not expected to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing their numbers, reproduction, or distribution; or appreciably diminish the value of designated critical habitat for the conservation of the species.

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, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of CCV steelhead and sDPS green sturgeon, or destroy or adversely modify designated critical habitat for CCV steelhead and sDPS green sturgeon.

2.9. Incidental Take Statement

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

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:
NMFS anticipates that adult and juvenile CCV steelhead and sDPS green sturgeon will be killed, injured, or harmed as a result of Project implementation, due to expected presence in the action area during the scheduled in-water work window. Specifically, take will result from dewatering and pile driving activities. Additionally, take is expected as a result of bridge shade/reduced riparian cover in critical habitat. This is expected to reduce the primary productivity of the affected habitat and increase the number of predatory fishes and their ability to prey on listed fish species resulting in injury, death and harm to listed species.

It is not practical to quantify or track the amount or number of individuals that are expected to be incidentally taken as a result of the proposed action, due to the variability associated with the response of listed fish to the effects of the proposed action, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating ecological surrogates, and it is practical to quantify and monitor the surrogates to determine the extent of incidental take that is occurring. The most appropriate threshold for incidental take is an ecological surrogate of temporary habitat disturbance expected to occur during dewatering and pile driving activities and permanent habitat disturbance expected to occur due to the bridge shade in critical habitat.

Pile driving, dewatering, capture, and handling result in fish behavioral modifications, stranding, harm, injury, or death. Bridge shade/reduced riparian cover reduces primary productivity of affected habitats and increases the number of predatory fishes in the action area and/or their ability to prey on listed fish species leading to injury. NMFS anticipates incidental take will be limited to the following forms:

1) Take in the form of harm, injury and death to listed fish due to handling or stranding during the dewatering of approximately 0.12 acres of river habitat. This habitat disruption will affect the behavior of listed fish resulting in decreased survival, reduced growth and reduced fitness, respectively.
2) Take in the form of harm, injury and death to listed fish, due to pile driving. The 150dB RMS behavioral threshold is expected to be 13,594 meters from the pile. The 187dB cumulative threshold is expected to be 1,842 meters from the piles, 183dB cumulative threshold is expected to be 2,929 meters from the pile, and the peak 206dB threshold is expected to be 22 meters from the pile.
3) Take in the form of harm to listed fish from loss and degradation of river channel habitat leading to injury and death by creating habitat conditions that increase predation associated with the new bridge components. The total spatial footprint of the bridge over the waters of the San Joaquin River is 0.4 acres.

If the total acreage of dewatering areas for the Project exceeds 0.12 acres by more than 10 percent, the anticipated take levels described are also exceeded, triggering the need to reinitiate consultation. If monitoring indicates that sound levels greater than 206 dB peak, 187 dB or 183 dB cumulative SEL, or 150 dB RMS extend beyond the distances expected for the pile size and attenuation type, work should stop and NMFS should be contacted within 24 hours, to determine if incidental take has been exceeded. If the Manthey Road Bridge structure shade footprint over the San Joaquin River exceeds 0.4 acres, the anticipated incidental take levels described area would be exceeded, triggering the need to reinitiate consultation.

2.9.2. Effect of the Take

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

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are 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 by Caltrans, or the contractor, to reduce underwater sound impacts and other disturbances related to pile driving and barge and boat traffic, as discussed in this opinion (Section 1.4).
2) Measures shall be taken by Caltrans, or the contractor, to reduce mortality of listed species requiring capture/relocation in association with dewatering activities.
3) Measures shall be taken by Caltrans, or the contractor, to reduce the extent of degradation and alteration to the habitats in the action area as a result of riparian removal and overwater structure placement, related to both short- and long-term effects of this Project, as discussed in this opinion.
4) Measures shall be taken by Caltrans, or the contractor, to prepare and provide NMFS with a plan and a report describing how listed species in the action area would be protected and/or monitored and to document the observed effects of the action on listed species 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 RPMs (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 ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
    a. In-water and barge-mounted pile driving shall only occur during the June 1st – October 31st work window. Impact pile driving within a cofferdam surrounded by water is considered in-water pile driving.
    b. A soft start method (initially driving the pile with low hammer energy and increasing hammer energy as necessary) shall be used at the beginning of each pile driving day to allow fish to leave the work area before strikes become lethal.
    c. During the in-water work window of June 1st– October 15th, when water temperatures are below 75°F, the daily work schedule shall be limited to between one hour after sunrise to one hour before sunset, to avoid peak fish migration times and to allow for cumulative SEL impacts to reset daily.
    d. Attenuation measures shall be used during impact pile driving to control and dampen underwater pressure wave propagation. Effective attenuation measures include:
        i. Pile driving within a dewatered cofferdam or caisson.
        ii. Use of a bubble curtain around the piles.
        iii. Use of a cushion block between the hammer and the pile.

e. Underwater sound monitoring shall be conducted during impact pile driving when water temperatures are below 75°F, to ensure incidental take limits are not exceeded according to the ecological surrogates assigned.
    i. No more than 206 dB peak beyond a 22 meter radius from each pile driven with an impact hammer.
    ii. No more than 187 dB SEL cumulative beyond 1,842 meters from the construction site boundary.
    iii. No more than 183 dB SEL cumulative beyond 2,929 meters from the construction site boundary.
    iv. No more than 150 dB RMS beyond 13,594 meters from the construction site boundary.

2. The following terms and conditions implement reasonable and prudent measure 2:
    a. During dewatering activities, a qualified fish biologist shall be present onsite to make observations, and capture/relocate fish, if they become entrapped in the dewatered area.
    b. Only fish biologists trained in salmonid capture and relocation shall remove and relocate fish during dewatering activities.
    c. A fish relocation plan will be submitted to NMFS for approval 30 days prior to commencing construction activities.

3. The following terms and conditions implement reasonable and prudent measure 3:
    a. The removal of existing vegetation shall be minimized.
    b. Caltrans shall develop and implement a Riparian Plan addressing onsite habitat enhancement and purchase of mitigation bank credits to compensate for the permanent and temporal loss of habitat. The plan shall be submitted to NMFS for approval 30 days prior to the start of construction. As proposed by Caltrans, credits will be purchased at a 1:1 ratio for temporary riparian impacts and a 3:1 ratio for permanent riparian and in-water impacts. The plan shall also include provisions for leaving the root system of removed trees, only include planting of native species, and revegetation as close to the channel bank as practicable.

4. The following terms and conditions implement reasonable and prudent measure 4:
    a. Caltrans, or its applicant, shall provide a report of Project activities to NMFS by December 31 of each year that construction takes place.
    b. The report shall include a summary description of in-water construction activities, incidental take avoidance and minimization measures taken, and any observed take incidents, including number and species captured and relocated during dewatering.
    c. Updates and reports required by these terms and conditions shall be submitted to:

Cathy Marcinkevage
Assistant Regional Director
Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

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 continue to 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 and sturgeon habitat restoration projects.

2.11. Reinitiation of Consultation

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

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity," and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem

components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]. This analysis is based, in part, on the EFH assessment provided by Caltrans and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by PFMC managed salmon within the USGS 4th field hydrologic units identified by the fishery management plan (PFMC 2014). This designation includes the Lower San Joaquin River (HUC 18040002) for all runs of Chinook salmon that historically and currently use these watersheds (spring-run, fall-run, and late fall-run). The Pacific Coast salmon fishery management plan also identifies Habitat Areas of Particular Concern (HAPCs): complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation, of which the HAPC for complex channel and floodplain habitat is expected to be either directly or indirectly adversely affected by the proposed action.

3.2. Adverse Effects on Essential Fish Habitat

Effects to Pacific Coast salmon HAPCs for complex channel and floodplain habitat are discussed in the context of effects to critical habitat PBFs as designated under the ESA and described in section 2.5.2. A list of adverse effects to EFH HAPCs is included in this EFH consultation. The effects are expected to be similar to the impacts affecting critical habitat and include the following: sediment and turbidity, in-channel disturbance from pile driving, and permanent habitat loss/modification.

Sediment and turbidity
- Degraded water quality
- Reduction/change in aquatic macroinvertebrate production

In-channel disturbance from pile driving
- Channel disturbance and noise pollution from pile driving activity and associated piles

Permanent habitat loss/modification
- Reduced shelter from predators
- Reduction/change in aquatic macroinvertebrate production
- Reduced habitat complexity

3.3. Essential Fish Habitat Conservation Recommendations

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

1) Caltrans should revegetate areas adjacent to the channel with native plant species immediately following the final construction season.
2) Caltrans should recommend to contractors to use biodegradable lubricants and hydraulic fluid in construction machinery. The use of petroleum alternatives can greatly reduce the risk of contaminants from directly or indirectly entering the aquatic ecosystem.

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

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

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

3.5. Supplemental Consultation

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. Data Quality Act Documentation and Pre-Dissemination Review

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

4.1. Utility

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

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

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

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion [*and EFH consultation, if applicable*] 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, if applicable*], and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. REFERENCES

Anderson, N. H. and J. R. Sedell. 1979. Detritus Processing by Macroinvertebrates in Stream Ecosystems. Annual Review of Entomology 24(1):27.

Barrett, J.C., G.D. Grossman, J. Rosenfeld. 1992. Turbidity-induced changes in reactive distance of rainbow trout. Transactions of the American Fisheries Society 121:437-443.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F.W. Waknitz, I. V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon and California. National Marine Fisheries Service. Seattle, Washington: 275.

Breitler, A. 2017, 10/30/17. Fish out of (normal) water. Rare sturgeon seen in Stanislaus River. Recordnet.com. Retrieved from http://www.recordnet.com/news/20171030/fish-out-of-normal- water-rare-sturgeon-seen-in-stanislaus-river

California Department of Fish and Game. Sturgeon Report Card Data.

California Department of Transportation 2015. Compendium of Pile Driving Sound Data, Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish: 1-215.

California Department of Transportation 2012. Appendix I: Compendium of Pile Driving Sound Data, in Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish: 215p.

Cohen, S. J., K. A. Miller, A. F. Hamlet and W. Avis 2000. "Climate change and resource management in the Columbia River basin." Water International 25(2): 253-272.

Daughton, C.G. 2003. Cradle-to-cradle stewardship of drugs for minimizing their environmental disposition while promoting human health. I. Rationale for and avenue toward a green pharmacy. Environmental Health Perspectives 111:757-774.

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

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 1. Journal of the American Water Resources Association 2010: 261-277.

Dubrovsky, N. M., D.L. Knifong, P.D. Dileanis, L.R. Brown, J.T. May, V. Connor, and C.N. Alpers 1998. Water quality in the Sacramento River basin. U.S. Geological Survey Circular 1215. United States Geological Survey.

Feist, B. E., E.A. Steel, G.R. Pess and R.E. Bilby. 2003. The influence of scale on salmon habitat restoration priorities. Animal Conservation 6(03): 271-282.

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

Gisiner, R. C. 1998. Workshop on the effects of anthropogenic noise in the marine environment proceedings 10 - 12 February 1998, Office of Naval Research.

Gruber, J. J., Z. J. Jackson, J. P. Vaneenennaam. 2012. 2011 San Joaquin River Sturgeon Spawning Survey. Lodi Fish and Wildlife Office, Anadromous Fish Restoration Program and U.S. Fish and Wildlife Service. Stockton, California: 28.

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

Hallock, R. J. 1961. "An Evaluation of Stocking Hatchery-reared Steelhead Rainbow Trout (Salmo gairdnerii gairdnerii) in the Sacramento River System." Fish Bulletin 114: 3-74.

Hastings, M. C. and A. N. Popper 2005. Effects of Sound on Fish, California Department of Transportation: 1-82.

Heublein, J. C., J .T. Kelley, C. E. Crocker, A. P. Klimley, S. T. Lindley. 2009. "Migration of green sturgeon, Acipenser medirostris, in the Sacramento River." Environmental Biology of Fishes. 84(3): 245-258.

Jackson, Z. J., J. J. Gruber, J. P. Vanennaam. 2016. "White Sturgeon Spawning in the San Joaquin River, California, and Effects of Water Management." Journal of Fish and Wildlife Management 7(1): 171-180.

Kahler T., M. Grassley, D. Beauchamp. 2000. Final Report: A summary of the effects of bulkheads, piers, and other artificial structures and shorezone development on ESA-listed salmonids in lakes. The Watershed Company, prepared for the City of Bellevue. 29-37.

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.

Kidd K.A., M. J. Paterson, M.D. Rennie, C. L. Podemski, D. L. Findlay, P. J. Blanchfield and K. L. Jones. 2014. Direct and indirect responses of a freshwater food web to a potent synthetic oestrogen. Philosophical transactions of the Royal Society of London. Series B, Biological sciences 369. doi: 10.1098/rstb.2013.0578.

Kipple, B. and C. Gabriele. 2007. Underwater Noise from Skiffs to Ships. Pages 172-175 in J. F. Piatt and S. M. Gende, editors. Proceedings of the Fourth Glacier Bay Science Symposium, October 26-28, 2004: U.S. Geological Survey Scientific Investigations Report 2007-5047.

Lloyd, D. S. 1987. "Turbidity as a Water Quality Standard for Salmonid Habitats in Alaska." North American Journal of Fisheries Management 7(1): 34-45.

McClure, M. M. 2011. Climate Change. p. 261-266 In: Ford, M. J. (ed.). Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Pacific Northwest. N. F. S. Center, 281 pp.

McClure, M. M., Alexander, M., Borggaard, D., Boughton, D., Crozier, L., Griffis, R., Jorgensen, J.C., Lindley, S.T., Nye, J., Rowland, M.J. and Seney, E.E. 2013. "Incorporating climate science in applications of the U.S. endangered species act for aquatic species." Conservation Biology 27(6): 1222-1233.

Moyle, P. B. 1995. "Conservation of Native Freshwater Fishes in the Mediterranean-type Climate of California, USA: A Review." Biological Conservation 72: 271-279.

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

National Marine Fisheries Service 1997. Fish Screening Criteria for Anadromous Salmonids. U.S. Department of Commerce. NMFS Southwest Region. Santa Rosa, California.

National Marine Fisheries Service 2014. Final 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. Sacramento, California.

National Marine Fisheries Service 2015. 5-Year Summary and Evaluation: Southern Distinct Population Segment of the North American Green Sturgeon. U.S. Department of Commerce. Long Beach, California.

National Marine Fisheries Service 2016. 5-Year Status Review: Summary and Evaluation of California Central Valley Steelhead Distinct Population Segment. Department of Commerce. Sacramento, California.

National Marine Fisheries Service 2018. Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (Acipenser medirostris). National Marine Fisheries Service.

PFMC. 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

Popper, A. N., Carlson, T.J., Hawkins, A.D., Southall, B.L. and Gentry, R.L. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper: 15p.

Popper, A. N. and M. C. Hastings 2009. "The effects of human-generated sound on fish." Integr Zool 4(1): 43-52.

Poytress W.R., J. J. Gruber, J. P. Eenennaam, M Gard. 2015. “Spatial and Temporal Distribution of Spawning Events and Habitat Characteristics of Sacramento River Green Sturgeon”, Transactions of the American Fisheries Society, 144:6, 1129-1142

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.

Radford, A. N., E. Kerridge, and S. D. Simpson. 2014. Acoustic Communication in a Noisy World: Can Fish Compete with Anthropogenic Noise? Behavioral Ecology 25(5): 1022-1030.

Radtke, L. D. 1966. "Ecological Studies of the Sacramento-San Joaquin Delta. Part II: Fishes of the Delta: Distribution of Smelt, Juvenile Sturgeon, and Starry Flounder in the Sacramento-San Joaquin Delta with Observations on Food of Sturgeon." Fish Bulletin 136: 115-129.

Seesholtz, A. M., M. J. Manuel, J. P. Vaneenennaam. 2014. "First Documented Spawning and Associated Habitat Conditions for Green Sturgeon in the Feather River, California." Environmental Biology of Fishes 98(3): 905-912.

Sillman A.J., A. K. Beach, D. A. Dahlin, E. R. Loew. 2005. “Photoreceptors and visual pigments in the retina of the fully anadromous green sturgeon (Acipenser medirostris) and the potamodromous pallid sturgeon (Scaphirhynchus albus).” Journal of Comparative Physiology A, 191(9) 799-811.

Sigler, J.W., T.C. Bjornn, and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society 113:142-150.

Simpson, S. D., J. Purser, and A. N. Radford. 2015. Anthropogenic Noise Compromises Anti-Predator Behaviour in European Eels. Global change biology 21(2): 586-593.

Slabbekoorn, H., N. Bouton, I. van Opzeeland, A. Coers, C. ten Cate, and A. N. Popper. 2010. A Noisy Spring: The Impact of Globally Rising Underwater Sound Levels on Fish. Trends Ecology and Evolution 25(7): 419-427.

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.

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., 293 pp.

U.S. Fish and Wildlife Service. 2017. Delta juvenile fish monitoring program data. Available: https://www.fws.gov/lodi/juvenile_fish_monitoring_program/jfmp_index.htm. Accessed: April 8, 2017.

Voellmy, I. K., J. Purser, D. Flynn, P. Kennedy, S. D. Simpson, and A. N. Radford. 2014a. Acoustic Noise Reduces Foraging Success in Two Sympatric Fish Species Via Different Mechanisms. Animal Behaviour 89: 191-198.

Voellmy, I. K., J. Purser, S. D. Simpson, and A. N. Radford. 2014b. Increased Noise Levels Have Different Impacts on the Anti-Predator Behaviour of Two Sympatric Fish Species. PLoS ONE 9(7): e102946.

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

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.

Williams, J. G. 2006. "Central Valley Salmon: A Perspective on Chinook and Steelhead in the Central Valley of California." San Francisco Estuary and Watershed Science 4(3): 1-398.

Williams, T. H., B. C. Spence, D. A. Boughton, R. C. Johnson, E.G.R. Crozier, N. J. Mantua, M. R. O'Farrell, S. T. Lindley. 2016. Viability Assessment for Pacific Salmon and Steelhead listed under the Endangered Species Act: Southwest. National Marine Fisheries Service: 1-53.

Zimmerman, C. E., G. W. Edwards, K. Perry. 2008. Maternal origin and migratory history of Oncorhynchus mykiss captured in rivers of the Central Valley, California. California Department of Fish and Game: 54.