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

Refer to NMFS No: WCRO-2018-00256

September 11, 2019

Mr. Mark Ziminske
Environmental Resources Branch Chief
Department of the Army
U.S. Army Corps of Engineers
Sacramento District
1325 J Street,
Sacramento, California 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the 2018/2019 San Joaquin River Public Law 84-99 Emergency Levee Repair Sites

Dear Mr. Ziminske:

Thank you for your letter of November 19, 2018, requesting initiation of consultation with the 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 2018/2019 San Joaquin River Public Law 84-99 Emergency Levee Repair Sites.

The enclosed biological opinion is based on our review of the proposed action as detailed in the provided biological assessment, and project effects on the federally listed threatened California Central Valley steelhead (*Oncorhynchus mykiss*) distinct population segment and their designated critical habitat, southern Distinct Population Segment of North America green sturgeon (*Acipenser medirostris*) and their critical habitat, and Central Valley spring-run Chinook salmon (*O. tshawytscha*), in accordance with Section 7 of the ESA. Using the best available scientific and commercial information, NMFS concludes that the project is not likely to jeopardize the continued existence of these federally listed species, nor adversely modify or destroy California Central Valley steelhead or North American green sturgeon critical habitat. 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 the incidental take of federally listed fish that will occur with project implementation.

Please note that NMFS has decided to issue this biological opinion for the 2018/2019 San Joaquin River Public Law 84-99 Emergency Levee Repair Sites because doing so would be beneficial to the goals of both agencies and consistent with the Endangered Species Act. In the future, however, NMFS will decline to enter into consultation for repair sites under Public Law (PL) 84-99 where repairs have already been completed or where construction has already started

unless site-specific consultation under 50 CFR 402.05 has also begun prior to ground-breaking. NMFS encourages the U.S. Army Corps of Engineers to request to enter into site-specific consultations as soon as repair requests are made and approved by the Corps under PL 84-99.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. This biological opinion also includes NMFS' review of the potential effects of the proposed action on EFH for Pacific Coast Salmon, as designated under the MSA. The document concludes that the project will adversely affect the EFH of Pacific Coast Salmon in the action area and includes EFH Conservation Recommendations.

As required by section 305(b)(4)(B) of the MSA, the action agency 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 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 your response to the EFH portion of this consultation, we ask that you clearly identify the number of Conservation Recommendations accepted.

Please contact Katherine Schmidt in the California Central Valley Office at (916) 930-3685 or katherine.schmidt@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Maria Rea

Maria Rea
Assistant Regional Administrator
California Central Valley Office

Enclosure

cc: To the file 151422-WCR2018-SA00471
David Colby, U.S. Army Corps of Engineers, David.J.Colby@usace.army.mil

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

2018/2019 San Joaquin River Public Law 84-99 Emergency Levee Repair Sites

National Marine Fisheries Service Environmental Consultation Organizer #WCRO-2018-00256

Action Agency: U.S. Army Corps of Engineers

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?
Central Valley spring-run Chinook Salmon Evolutionarily Significant Unit (*O. tshawytscha*)	Threatened	Yes	No	N/A	N/A
California Central Valley steelhead Distinct Population Segment (DPS) (*Oncorhynchus mykiss*)	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:

Maria Rea
Assistant Regional Administrator

Date: September 11, 2019

TABLE OF CONTENTS

LIST OF ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
ACID	Anderson-Cottonwood Irrigation District Diversion Dam
AMM	avoidance and minimization measure
BA	biological assessment
BMP	best management practice
CCV	California Central Valley
CDFW/CDFG	California Department of Fish and Wildlife
CRs	Conservation Recommendations (EFH)
CV	Central Valley
dB	decibels
Delta	Sacramento-San Joaquin River Delta
DPS	distinct population segment
DQA	Data Quality Act
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionary significant unit
FHWG	Fisheries Hydroacoustic Working Group
FWCA	Fish and Wildlife Coordination Act
HAPCs	Habitat Areas of Particular Concern
ITS	incidental take statement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEP	non-essential experimental population
NMFS	National Marine Fisheries Service
OHWM	ordinary high water mark
opinion	biological opinion
PBFs	physical or biological features
PFMC	Pacific Fishery Management Council
RD	Reclamation District
rkm	river kilometer
RMS	root-mean-square
RPMs	reasonable and prudent measures
sDPS	southern distinct population segment
SEL	sound exposure level
SJR	San Joaquin River
SJRRP	San Joaquin River Restoration Program
SWE	snow water equivalent
SWPPP	stormwater pollution prevention plan
SWRCB	State Water Resources Control Board
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

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

1.1. Background

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

NMFS has decided to issue this biological opinion for the batch of sites in the San Joaquin River (SJR) basin described in section 1.3 Proposed Federal Action where repairs have already been completed or where construction has already started as agreed upon in early coordination meetings between USACE and NMFS, because doing so would be beneficial to the goals of both agencies and consistent with the Endangered Species Act. In the future, however, NMFS will decline to enter into consultation under Public Law (PL) 84-99 where repairs have already been completed or where construction has already started unless site-specific consultation under 50 CFR 402.05 has also begun prior to ground-breaking in order to assure consistency with 50 CFR 402.05. NMFS encourages USACE to request to enter into site-specific consultations as soon as repair requests are made and approved by USACE under PL 84-99.

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.

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available on-line through the NOAA Institutional Repository after approximately two weeks. A complete record of this consultation is on file at NMFS's West Coast Region, California Central Valley Office.

1.2. Consultation History

April 1, 2017. A Federal Disaster Declaration was issued by President Trump for thirty-four California counties for storms and resultant flooding, mudslides, and landslides.

May 30 to June 18, 2017. Site visits were conducted by United States Army Corps of Engineers (USACE) staff to determine habitat value and potential impacts to species.

June 21, 2017. A meeting was held with U.S. Fish and Wildlife Service (USFWS), NMFS, and the USACE to determine a path forward regarding consultation.

June 13 through July 14, 2017. Draft construction designs for sites in seven districts were sent to USFWS and NMFS. Informal discussions regarding potential impacts were discussed.

July 18, 2017. The USACE determined that PL 84-99 Order 1 and 2 sites present an imminent threat to public life and property. A total of 18 sites moved forward for construction in 2017.

August 24, 2017. The USACE initiated ESA Section 7 consultation on 17 critical sites for PL 84-99.

August 1-3, August 21-24, and September 11, 2017. Site visits were conducted at sites in the San Joaquin area to determine habitat value and potential impacts to species.

September 5, 2017. USFWS Opinion (08ESMF00-2017-F-2928) received.

September 27, 2017. NMFS Opinion (WCR-2017-7965) received.

October 2, 2017. Contracts for construction of 16 sites in the Sacramento River basin awarded.

October 5-November 28, 2017. Construction conducted at 15 critical sites in the Sacramento River area. Environmental monitoring conducted during construction as applicable.

December 2017-March 2018. Draft construction designs for sites to be constructed in 2018 were sent to USFWS and NMFS. Informal discussions regarding potential impacts occurred.

August 8, 2018. The USACE reinitiated ESA Section 7 consultation on 16 sites planned to be constructed in 2018 and 2019. Upon request from USFWS, the USACE revised this consultation for only the 8 sites with species impacts planned for construction in 2018. Further discussions with NMFS determined that only those sites with impacts to fisheries species should be considered, and the biological assessment (BA) was to be revised.

October 2018. Due to contract issues, construction was deferred to 2019. Informal discussions with USFWS and NMFS determined that a revised re-initiation of consultation would be the most appropriate approach for 2019 construction. Additionally, the USACE received a consultation withdrawal notification from NMFS based on insufficient information and construction deferred to 2019. One repair site, 1151-12, on the San Joaquin River was completed in 2018.

November 14, 2018. A meeting was held between NMFS and USACE staff and leadership to discuss the most appropriate path forward. There was agreement on an expedited consultation on a subset of waterside sites due to be completed in 2019 or that were completed in 2018, in exchange for increased environmental consideration at the sites. The consultations were divided between the Sacramento and San Joaquin basins for review batching purposes.

November 19, 2018. A letter was received by NMFS from USACE requesting expedited consultation on the 2018/2019 San Joaquin River (SJR) Public Law 84-99 Emergency Levee

Repair Sites discussed in this opinion, and included a draft BA offered for comments and review. USACE identified the proposed action as having adverse effects on:

- California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS), threatened, and its critical habitat
- Southern Distinct Population Segment (sDPS) North American green sturgeon (*Acipenser medirostris*), threatened, and its critical habitat
- Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) evolutionarily significant unit (ESU), threatened
- Pacific Coast Salmon EFH

CV spring-run Chinook salmon critical habitat has been designated but does not occur within the action area. NMFS initiated the 2018/2019 SJR Public Law 84-99 Emergency Levee Repair Sites consultation on this date.

December 12, 2018. NMFS reviewed and returned the draft BA back to USACE staff with comments and suggestions via email.

December 22, 2018. Partial federal government shutdown begins; Department of Commerce and NMFS staff are furloughed as appropriations lapse.

January 10, 2019. USACE staff returns a revised draft BA to NMFS via email, providing textual changes and clarifications.

January 28, 2019. President Trump signs a continuing resolution, re-establishing appropriates necessary to reopen the Department of Commerce and NMFS staff returns to duty.

February 5, 2019. NMFS staff are directed to add 38 days to all open consultation timelines in light of the delay caused by the partial Federal shutdown, which results in all affected consultations (such as this opinion) having a timeline of 173 days from initiation, compared to the generally expected 135 days from the time of initiation. Therefore, this opinion would be expected to be complete on May 11, 2019, if another due date was not mutually agreed upon by both Federal agencies.

April 11, 2019. USACE notifies NMFS staff that the proposed in-water work windows for the action will be changed from June 1st to October 15th to April 20th to October 15th. Because the work windows will no longer sufficiently avoid peak fish use of the action area, NMFS requests more information regarding the work window change and how many pile driving days will occur and when, so impact to listed fishes can be re-evaluated. NMFS staff also requested that USACE respond via formal letter since this project change reset the consultation timeline.

June 18, 2019. USACE staff responded to NMFS staff's information request with partial information.

July 15, 2019. USACE staff provided a signed letter and information regarding the work windows used at each repair site. NMFS subsequently removed all references of adhering to the previously proposed work window from the opinion and re-evaluated the project's impact.

1.3. Proposed Federal Action

Under ESA implementing regulations, "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 implementing regulations, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (50 CFR 600.910). Under the FWCA, an agency is required to consult whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license (16 USC 662(a)).

The USACE has authority under PL 84-99, Flood Control and Coastal Emergencies (33 U.S.C. 701n) (69 Stat. 186) for emergency management activities. Under PL 84-99, the Chief of Engineers, acting for the Secretary of the Army, is authorized to undertake activities including disaster preparedness, advance measures, emergency operations (flood response and post flood response), rehabilitation of flood control works threatened or destroyed by flood, protection or repair of federally authorized shore protective works threatened or damaged by coastal storms, and provisions of emergency water due to drought or contaminated source. The PL 84-99 authority would address erosion/slough, erosion, sinkholes, seepage/boils, and a levee breach in the levees located in the CCV SJR basins. Portions of the levee system on the SJR, Bear Creek, King's River, and Mormon Slough were damaged during the series of storms that struck Northern California from early January 2017 to March 2017.

The proposed action includes several features across the CCV. Of the initial sites put forward for PL 84-99 assistance, this BA focuses on three sites anticipated to have had or will have adverse effects to listed anadromous fishes and their habitats in the SJR basin due to the levee repair construction that must take place. One site was completed in 2018 and two sites are planned for repair in 2019 (*Table 1*).

Table 1. PL 84-99 2018 - 2019 San Joaquin River Basin construction work schedule information provided by USACE.

Repair Site Name	Water Body Name	Construction Start/Stop Dates: In-Water	Construction Start/Stop Dates: Bank	Vibratory Hammer Days
#0281-11, Unit 15 West	Mormon Slough/Calaveras River	Start: 4/22/2019 Stop: 10/15/2019	Start: 4/22/2019 Stop: 10/31/2019	10 days for installation and 10 days for removal

Repair Site Name	Water Body Name	Construction Start/Stop Dates: In-Water	Construction Start/Stop Dates: Bank	Vibratory Hammer Days
#1151-12 Bank Erosion	San Joaquin River-Lower Mainstem	Start: 10/11/2018[1] Stop: 11/5/2018	Start: 10/11/2018[1] Stop: 11/5/2018	N/A
#1151-12 Wave Wash	San Joaquin River-Lower Mainstem	Start: 10/11/2018[1] Stop: 11/5/2018	Start: 10/11/2018[1] Stop: 11/5/2018	N/A
#1151-17 Bank Erosion	San Joaquin River-Lower Mainstem	Start: 6/1/2019 Stop: 10/15/2019	Start: 4/1/2019 Stop: 10/31/2019	N/A

[1] Approximate dates.

1.3.1. Site 0281-11; Mormon Slough – Unit 15 West, Calaveras River Right Bank

The Mormon Slough levee system provides flood protection from flood flows on the Calaveras River, Mormon Slough, the Stockton Diverting Canal, and Potter Creek to: adjacent agricultural lands; the city of Stockton; three mainline railroads (two local railroads, and one branch line); US Highway 99; and numerous State highways and County roads.

The USACE recommends repair of the damaged levee requiring reconstruction of the area of erosion and sloughing. Given the height of the near vertical banks and instability of the waterside levee slope, reconstruction of the levee is required in order to repair the erosion and sloughing damages due to the 2017 flood events (Figures 1a and 1b).

Levee reconstruction includes adding slope protection to prevent future erosion. The reconstructed levee would transition and tie-in to the existing levee outside the eroded area. Transition zones of 20 feet on either side of the site were assumed, for a total site length of 120 feet. The extent of the repair sites would be verified by a USACE engineer prior to construction. The site would be cleared and stripped of any vegetation, loose topsoil, debris, organic matter, and other deleterious materials. The existing waterside slope would be excavated to an approximate 2H:1V slope. Excavated soil would be stockpiled at a pre-approved staging area designated by the USACE as to minimize impacts to any special status species and can be reused as levee fill. Total excavation required for this site is estimated to be 2,480 cubic yards. Additional excavation will be required for benching during construction.

Dewatering and diversion of water from the site area would be required. Construction of a cofferdam would be required within the Calaveras River up to 50 feet beyond the limits of the site to facilitate dewatering. The cofferdam would be installed via vibratory hammer/pile driving. Water would be diverted around the site area until construction is complete. For estimating purposes, it is assumed that diversion of water would be required for 3 months.

A layered rock foundation would be constructed at the toe of the levee. Quarry stone would be placed on the bottom of the channel against the toe of the eroded bank below the water level. The stone would be placed such that each stone has three points of contact with other stone. The

stone would be placed with a slope of approximately 2H:1V until it reaches the Summer Mean Water Surface Elevation of approximately 4.7 feet NAVD88. Engineered soil-filled quarry stone would then be placed in compacted lifts on top of the quarry stone layer. The engineered soil-filled quarry stone would follow the same 2H:1V slope as the quarry stone for a height of approximately 8 feet. An approximately 1 foot thick transition layer would be placed on top of the engineered soil-filled quarry stone. The transition layer would be filter compatible material such that soil particles cannot move between the quarry stone layer and the levee fill material above.

Levee fill material would be placed on top of the transition layer. Existing levee fill material can be reused. Additional imported fill, with similar engineering properties to the existing levee material, would be required. The levee fill material would be placed in lifts not exceeding 8 inches loose thickness and compacted to a minimum of 95% maximum dry density based on ASTM D698. Lifts would be keyed in to the adjacent existing levee inwardly and longitudinally. The new levee slopes would be overbuilt by approximately 6 inches and trimmed and track-walked to the final 2H:1V slopes. Staging, borrow and disposal sites would be determined and approved by the USACE in order to ensure that no additional impacts to habitat would occur.

Slope protection would be placed on the new waterside slope. Quarry stone can be placed in the waterside levee toe such that the stone has three points of contact with other stones. The slope protection would be approximately 5 feet thick and extend up the slope approximately 30 feet. Material gradations must be confirmed during final design. The new levee crown would be surfaced with asphalt concrete pavement to match the existing pavement section. It is assumed that a pavement section of 2 inches asphalt concrete over 6 inches of aggregate base would be constructed. All affected levee slopes without rock protection would be seeded.

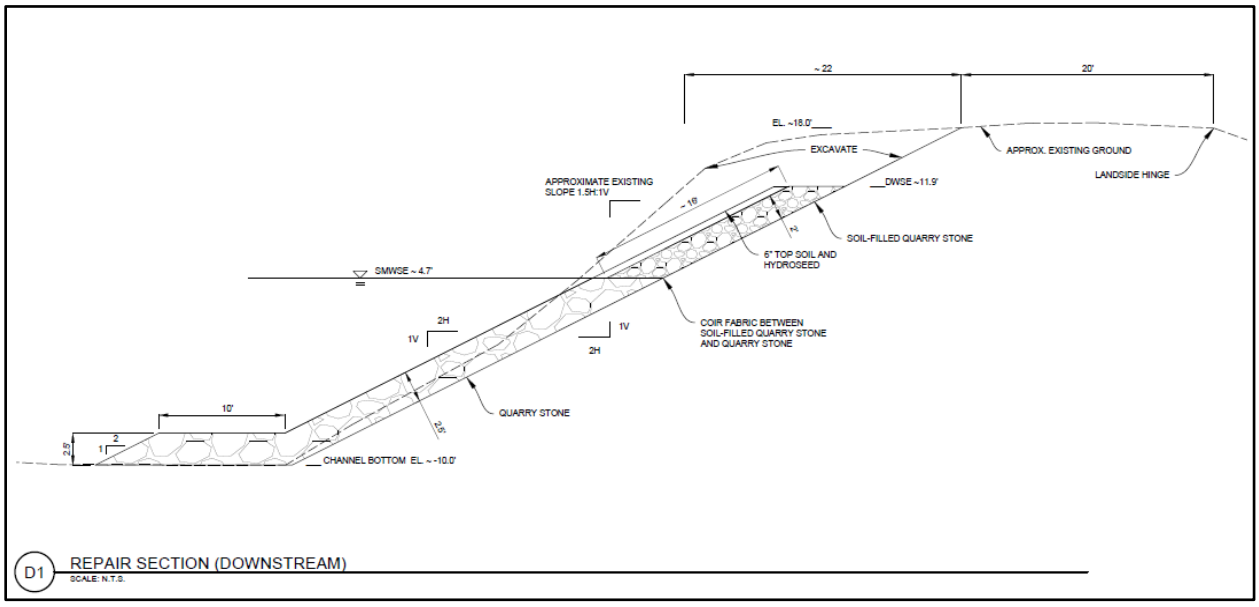


***Figure 1a**. Downstream Construction Design for Site 0281-11.*

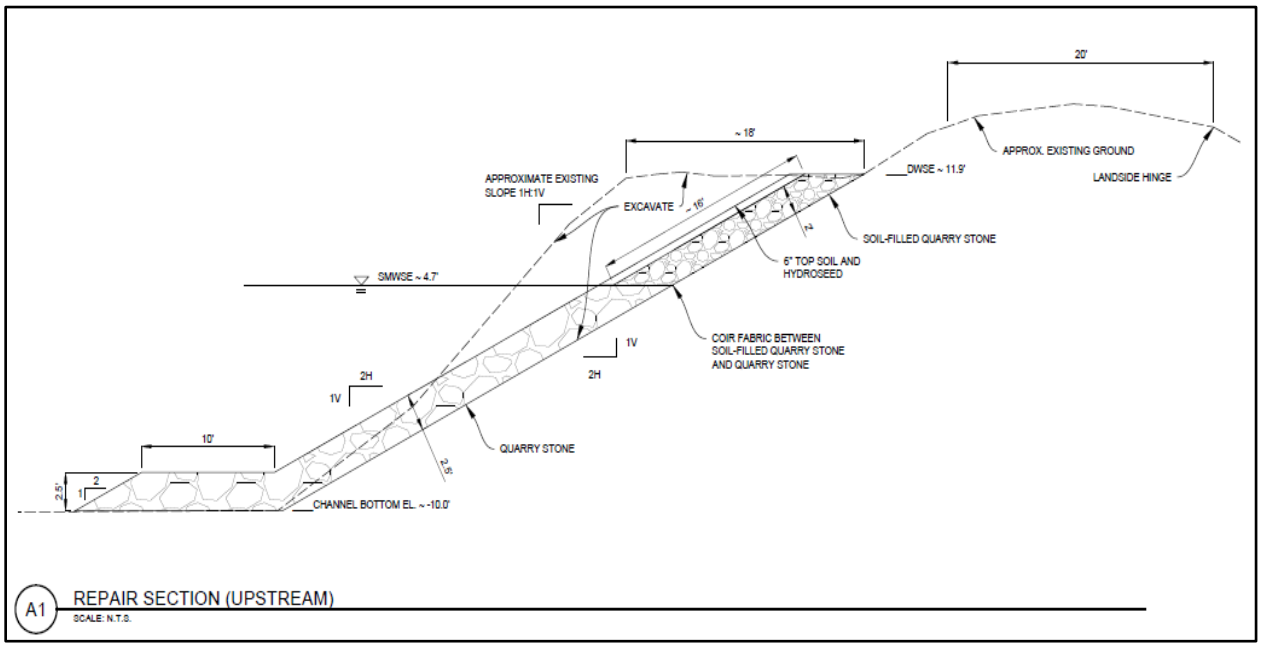


***Figure 1b.** Upstream Construction Design for Site 0281-11.*

1.3.2. Reach 1151 San Joaquin River; Reclamation District (RD) 2075 and 2064

The San Joaquin River and Tributaries Project levee and channel are located along the right bank of the Stanislaus River from high ground to the San Joaquin River and the right bank of the San Joaquin River from the Stanislaus River Confluence to Walthall Slough. The damage sites lie about 4 miles south from the town of Lathrop and 7 miles west from the town of Ripon.

Levee segment Reclamation District (RD) 2075 – McMullin, along which sites 1151-12 and 1151-17 are located, is a non-urban project levee on the right bank of the San Joaquin River about 4 miles southwest of the city of Manteca. The segment extends south from South Hayes Road to Red Bridge Slough.

Site 1151-12: This levee repair was completed in 2018. The USACE installed a rock buttress along the river bank to provide erosion protection and stability, and restored the waterside levee slope to its pre-flood geometry by repairing the wave wash damage. Imported soil and quarry stone was required for the bank repair. The existing levee soil was reused for the wave wash repair but additional imported fill was also required. It is assumed the site is approximately 395 feet long for the bank erosion repair which includes the damaged area plus a transition zone of 10 feet on each side of the damage. It is assumed the wave wash erosion repair site is approximately 650 feet long. It is recommended the repair limits be verified by the USACE in the field. Staging, borrow, and disposal sites were determined and approved by the USACE in order to ensure that no additional impacts to habitat would occur.

> *Bank Erosion Repair*: For the bank erosion repair, after stripping existing vegetation, a rock buttress of variable thickness was placed along the existing bank slope (Figure 2). The rock extended below water level. The total volume of soil-filled quarry stone required to repair the erosion site above the summer mean water elevation is estimated to be approximately 900 cubic yards. The total volume of quarry stone (non-soil filled) to be placed below the summer mean water elevation is estimated to be approximately 6,500 cubic yards. Additional rock will likely be needed to achieve a stable slope below the water level as no bathymetric survey data is available at this time. Therefore, the calculated quarry stone volume below water has been multiplied by three due to uncertainty of the channel and bank geometry.
>
> *Wave Wash Erosion Repair:* For repair of the wave wash damage along the waterside levee slope the site would first be cleared of vegetation. After stripping, the levee slope would be disked/scarified, moisture conditioned, and re-compacted (Figure 3). The existing levee soil can be reused. Imported fill material would be composed of material similar in gradation and engineering properties as that of existing levee fill. Fill material would be placed in lifts not exceeding 8 inches loose thickness and compacted to a minimum of 95% of its maximum dry density within ±2% of optimum water content in accordance with ASTM D 698. The lifts would be keyed into the existing slope. The finished slope would be shaped to match the adjacent undamaged slopes upstream and downstream, track-walked, and then seeded.
>
> For the 650 feet requiring repair, it has been assumed that wave wash erosion extends approximately 15 feet above the existing levee toe. A depth of approximately 6 inches of

imported levee fill is assumed to be required across the repair section to restore the levee geometry. After applying an additional factor of 20% for shrinkage during soil compaction, a total of approximately 230 cubic yards of imported levee fill material would be required. A quantity for aggregate base has been included for repair of damages to the gravel road on the levee crown incurred during construction. Staging, borrow, and disposal sites would be determined and approved by the USACE in order to ensure that no additional impacts to habitat would occur.

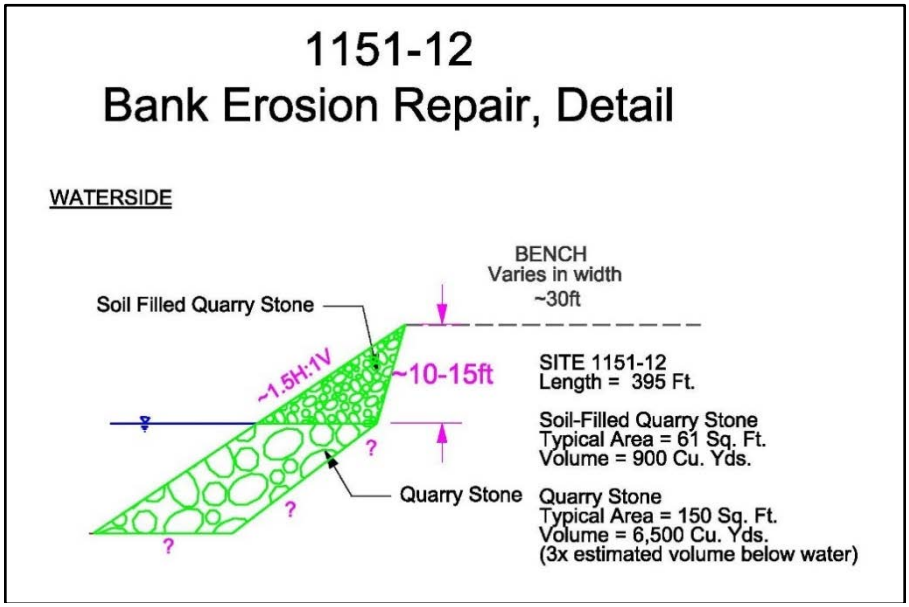


Figure 2a. Construction Designs for Site 1151-12, Bank Erosion Repair.

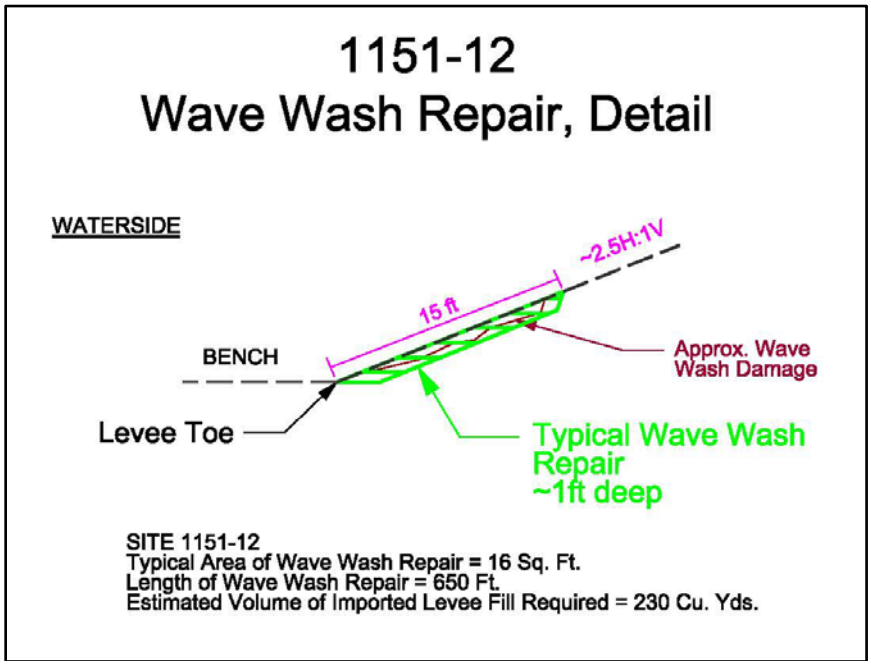


Figure 2b. Construction Designs for Site 1151-12, Wave Wash Repair.

Site 1151-17: The USACE recommends erosion protection (quarry stone) be placed/installed. Imported quarry stone would be needed. The site would initially be stripped of vegetation. The repair extents would be verified by a USACE engineer in the field. Quarry stone and soil-filled quarry stone would be placed to flatten the existing, approximate 1H: 1V bank slope (Figure 4).

A variable thick layer of rock would be placed along the existing bank slope above and below the water level. The total volume of soil-filled quarry stone required to repair the erosion site above the water level is estimated to be approximately 790 cubic yards. The total volume of quarry stone (non-soil filled) placed below the water level is estimated to be approximately 1,190 cubic yards. For estimating purposes, a total site length has been assumed to be 289 feet, which includes the erosion location plus a transition zone of 10 feet on each side of the erosion feature. Because excessive scour of the bank below the water level was not investigated, it is possible that additional rock would be needed to achieve a stable slope below the water level. Therefore, the calculated quarry stone volume below water has been multiplied by three due to uncertainty of the channel and bank geometry. A quantity for aggregate base is included for repair of damages to the gravel road on the levee crown incurred during construction.

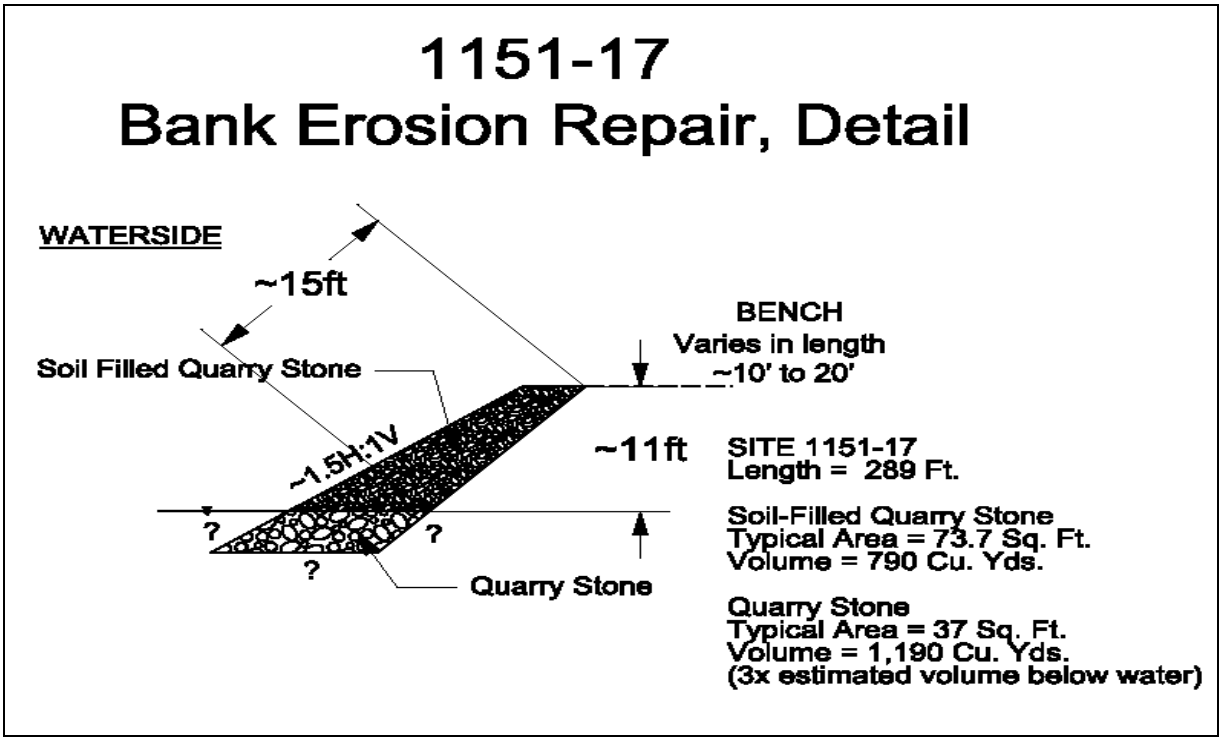


Figure 3. Construction Designs for Site 1151-17.

1.3.3. Avoidance and minimization measures (AMMs) for Special Status Fish Species

The following conservation measures would be implemented by the USACE, its local partners, and/or the construction contractor in order to avoid or minimize project effects on CCV steelhead, CV spring-run Chinook salmon, and sDPS North American green sturgeon.

1.3.3.1. Construction AMMs

Coordination with NMFS and USFWS for the in-water work on Sites 0281-11, 1151-12 bank repair, and 1151-17 has identified a number of AMMs and compensatory measures as recommendations to reduce impacts to CCV steelhead, sDPS North American green sturgeon, and CV spring-run Chinook salmon. The following measures would be followed to the greatest extent practicable:

1. To the greatest extent practicable, the general construction work window would start April 1 and conclude November 1.The in-water construction work window would start April 20th and end October 15th, to the greatest extent practicable. In the event that in-water work must be completed after November 1, additional coordination with NMFS would be conducted by USACE.

2. Potential allowable in-water work or general construction outside of the work windows would be pursued if local in-river water temperatures exceed 75 degrees Fahrenheit (°F) or more for at least seven consecutive days before initializing work. Water temperature readings would be taken within 0.25 miles of the boundary of the site's construction footprint. Water temperature readings would be conducted by on-site bio-monitoring staff at each location anadromous fish would be expected to occur, and NMFS would be contacted to confirm the temperature readings and also signal agreement to the new start time. If agreement could not be reached, the USACE would keep to original work windows stated above.

3. The removal and disturbance of existing, native riparian vegetation would be minimized to the maximum extent practicable to access and complete the repairs.

4. Where proposed repairs involve a quarry stone and soil mixture, the mixture would be placed to facilitate re-vegetation at the proposed project areas. The project designs shown in this BA are engineered to meet the needs of the emergency repair, and include soil mixed with quarry stone to allow for potential future planting. Bare earth following repairs will be reseeded with native grass species to prevent erosion and increase soil stabilization.

5. The placement of filter fabric would be kept to a minimum necessary to facilitate construction. The fabric would only be installed as a barrier between the quarry stone and the soil-filled quarry stone in order to prevent excessive sedimentation during construction. The filter fabric would be a natural fiber mesh that would biodegrade quickly; no plastics are to be used.

6. Construction activities would occur during daylight hours (no work would occur earlier than 60 minutes after sunrise or later than 60 minutes before sunset).

1.3.3.2. Dewatering AMMs

Additionally, the following AMMs/best management practices (BMPs) would be followed during construction of all project sites in or near water:

1. The contractor would be responsible for providing erosion and sediment control measures in accordance with federal, state, and local laws and regulations to ensure compliance with water quality standards. This would be accomplished by installing temporary and permanent erosion and sediment control best management practices. These may include, but are not limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, and construction of terraces. Any temporary measures would be removed after the area has been stabilized.

2. A USACE representative would be identified as the point of contact for any contractor who might incidentally take a listed CV spring-run Chinook salmon, CCV steelhead, or sDPS North American green sturgeon, or find a dead, injured, or entrapped listed CV spring-run Chinook salmon, CCV steelhead, or sDPS North American green sturgeon. This point of contact would be identified to all construction employees during an orientation regarding the potential effects on listed CV spring-run Chinook salmon, CCV steelhead, or sDPS North American green sturgeon. The orientation would be conducted by a qualified fisheries biologist and cover specific information on measures to prevent injury to listed fish and what to do if any are found in the project area.

3. NMFS would be notified immediately if one or more listed CV spring-run Chinook salmon, CCV steelhead or sDPS North American green sturgeon are found dead or injured. Follow-up written notification would include the date, time, and location of the dead or injured specimen, a photograph, the cause of injury or death, and the name and agency affiliation of the individual who found the specimen.

4. Water pump intakes would be screened, as specified by NMFS screening specifications. Water pumps would maintain flows to keep approach velocity at the pump screens at 0.2 feet per second or less when working in areas that may support juvenile salmonids or green sturgeon.

5. Where coffer dams are anticipated to be needed during construction within critical habitat for salmonids:

    a. The use of a cofferdam would require the dewatering of a small, isolated area of the river for the work area. The water removed from behind the cofferdams would be returned back into the river. Increases in turbidity levels during construction would be avoided or minimized by use of in-river turbidity curtains to contain and control in-river turbidity.

    b. The USACE and their contractors would implement erosion control measures throughout the construction period to minimize erosion and sediment input into the river. All construction within the existing river would occur during expected low flows. In-channel construction would be done in dry conditions with the use

of cofferdams and dewatering. Following completion of construction, cofferdams would be removed and river flows returned to the natural channel within the project area.

In water-work may still encounter fishes even while adhering to the in-water work window. However, with the sounds and vibrations permeating the water and likely disturbing natural behaviors of the fish, they are expected to vacate the area, if an escape route exists. While cofferdams are constructed, it is possible fish may become entrapped in the area. Therefore, before pumping, a qualified fish biologist will be onsite and clear any enclosed wetted area behind the cofferdam for fish prior to dewatering via pumping. If a listed fish is captured, it will be relocated to a wetted channel connected to a major waterway with as little handling as possible.

1. Before fish relocation begins, a qualified fisheries biologist would identify the most appropriate release location(s). Release locations would have water temperatures within 2 degrees Celsius (°C) of the capture location and offer suitable habitat for released fish, and would be selected to minimize the likelihood that fish would re-enter the work area or become impinged on the exclusion net or screen.

2. The method used to capture fish would depend on the nature of the work site, and would be selected by a qualified fisheries biologist who is experienced with fish capture and handling. Areas of complex habitat may require the use of electrofishing equipment, whereas in other areas fish may be captured through seining or dip netting. Electrofishing would only be performed by properly trained personnel following NMFS guidelines (NMFS 2000). Electrofishing would only be performed if seining and/or dip netting is not feasible.

3. Handling of salmonids would be minimized. When it is necessary, personnel would only handle fish with wet hands or nets.

4. Fish would be held temporarily in cool, shaded water in a five gallon bucket with a lid. Overcrowding in buckets would be avoided by using at least two buckets and no more than 25 fish would be kept in each five gallon bucket. Aeration would be provided with a battery powered external bubbler. Fish would be protected from jostling and noise and would not be removed from the bucket until the time of release. The water temperature in each bucket would be monitored and partial water changes or the addition of ice and stress coat would be conducted as necessary to maintain a stable water temperature (within 2°C of initial water temperature). Fish would not be held for more than a half hour. If water temperature reaches or exceeds NMFS limits (water temperatures of 75°F and greater are assumed lethal for fry and juveniles salmonids (SJRRP 2017*a*)), fish would be released and relocation operations would cease.

5. If fish are abundant, capture would cease periodically to allow release and minimize the time fish are held in containers.

6. Fish would not be anesthetized or measured. However, they would be visually identified to species level, and year classes estimated and recorded.

7. When feasible, initial fish relocation efforts would occur several days prior to the scheduled start of construction. The fisheries biologist would perform a survey on the same day before construction.

8. Reports on fish relocation activities would be submitted to USFWS and NMFS within two days of capturing and handling a listed species, preferable via email.

9. If exceedance of handling take or mortality during relocation/handling exceeds 2%, relocation would cease and NMFS would be contacted immediately or as soon as feasible.

Upon completion of construction, any creek/river banks disturbed by construction activities would be restored to a clean condition. Bare soil would be seeded with native grass species. Additional vegetation may be restored to surrounding habitat conditions to the extent practicable without requiring a vegetation variance. Additional plantings will be negotiated on a site by site basis.

1.3.4. Compensatory mitigation purchase

To fully compensate for impacts to salmonids and green sturgeon resulting from the proposed set of repairs, off-site mitigation credits for salmonids and green sturgeon would be purchased from a NMFS-approved conservation bank. The credit purchase is at a 2:1 ratio for impacts above the ordinary high water mark (OHWM) and 3:1 for impacts to habitat below the OHWM.

At Site 0281-11, quarry stone would be placed below the OHWM and is estimated to impact an area of 0.29 acres. At a 3:1 mitigation, the USACE anticipates 0.87 acres of mitigation for material placement below the OHWM for salmonids.

At Site 1151-12, quarry stone would be placed below the OHWM for the bank repair and is estimated to permanently impact an area of approximately 1.04 acres. At a 3:1 mitigation, the USACE anticipates 3.12 acres of mitigation for material placement below the OHWM for salmonids and green sturgeon.

At Site 1151-17, quarry stone would be placed below the OHWM for the bank repair and is estimated to impact an area of 0.72 acres. At a 3:1 mitigation, the USACE anticipates 2.16 acres of mitigation for material placement below the OHWM for salmonids and green sturgeon.

Table 2. Species Impacts and Mitigation for 2018 Construction and Anticipated 2019 Construction.

Site	Water way	GPS Coordinates	LS/ WS	In-Water Work	Species Impacted	Impact* Acreage	Mitigation*
0281 -11	MS /CR	37.97775, -121.34398 to 37.97759, -121.34417	WS	Yes	Salmonids	0.29	0.87 credits
1151 12[(1)]	SJR	37.73277, -121.29444 to 37.72416, -121.29361[(2)] 37.72527, -121.29444 to 37.72388, -121.29305[(3)]	WS	Yes	Salmonids Sturgeon	1.04	3.12 credits
1151 -17	SJR	37.72833, -121.27472 to 37.72777, -121.27416	WS	Yes	Salmonids Sturgeon	0.72	2.16 credits

*Note: Credits at mitigation banks are valued at one acre per credit. Salmonid impacts are at a 3:1 ratio. Green Sturgeon and Salmonid impacts are combined.
(1) Construction completed in 2018
(2) Bank Repair
(3) Wave Wash Repair
MS/CR: Mormon Slough/Calaveras River SJR: San Joaquin River
LS: Landside WS: Waterside

The purchase of suitable habitat credits from an approved mitigation bank can adequately compensate for effects to multiple species and life-stages. The habitat requirements of Chinook salmon, steelhead, and their various life stages are similar and would be adequately compensated for with a single mitigative action. Although there are large gaps in knowledge surrounding the ecology of the green sturgeon in the project area, habitat suitable for Chinook salmon and steelhead (migration and rearing life stages) may also provide improved habitat conditions for green sturgeon. Mitigation banks with credits dedicated to offset green sturgeon habitat impacts are not currently available, though individual sDPS green sturgeon may access the waterways of mitigation banks approved by NMFS for salmonid species if they connect to the mainstem of a major river used by the sDPS green sturgeon. In the absence of approved mitigation banks for green sturgeon, shaded riverine aquatic habitat or approved Chinook/steelhead mitigation credits would provide a suitable surrogate for compensation of effects to the species. Therefore, considering that impacts to Chinook salmon, steelhead, and green sturgeon can be mitigated through a single, comprehensive action, the USACE plans to purchase 6.15 acres of Chinook salmon/steelhead credits at a NMFS approved mitigation bank at the North Delta Fish Conservation Bank or Liberty Island Mitigation Bank before completion of these repairs or the end of Fiscal Year 2019, whichever comes first. The USACE has every intention to purchase these credits in 2019. However, these banks are subject to credits available which might delay purchasing into 2020.

“Interrelated actions” are those that are part of a larger action and depend on the larger action for their justification. “Interdependent actions” are those that have no independent utility apart from the action under consideration (50 CFR 402.02). The *Endangered Species Act Consultation Handbook* (United States Fish and Wildlife Service & National Marine Fisheries Service 1998) provides NMFS and U.S Fish and Wildlife Service with applicable guidance on how to analyze whether an activity is interrelated to or interdependent with the proposed action:

> As a practical matter, the analysis of whether other activities are interrelated to, or interdependent with, the proposed action under consultation should be conducted by applying a "but for" test. The biologist should ask whether another activity in question would occur "but for" the proposed action under consultation. If the answer is "no," that the activity in question would not occur but for the proposed action, then the activity is interrelated or interdependent and should be analyzed with the effects of the action.

No other actions have been identified as interrelated with or interdependent to the proposed action under consideration.

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

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

2.1. Analytical Approach

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

This 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 for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214; February 11, 2016).

The designations of critical habitat for species described in this opinion use the term primary constituent element or essential features. The new critical habitat regulations (81 FR 7414; February 11, 2016) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean primary constituent element or essential feature, as appropriate for the specific critical habitat.

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

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

- Describe the environmental baseline in the action area.

- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.

- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.

- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.

- If necessary, suggest a Reasonable and Prudent Alternative 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' current "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 current function of the essential PBFs that help to form that conservation value.

Detailed CCV steelhead DPS and critical habitat information:
http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/steelhead/california_central_valley/california_central_valley_steelhead.html

Detailed CV spring-run Chinook salmon ESU and critical habitat information*:
http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/chinook/central_valley_spring_run/central_valley_spring_run_chinook.html

Detailed sDPS North American green sturgeon and critical habitat information:
https://www.westcoast.fisheries.noaa.gov/protected_species/green_sturgeon/green_sturgeon_pg.html

*Designated CV spring-run Chinook salmon critical habitat does not occur within the action area of the proposed project.

Table 3. Description of CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon; their current ESA listings, and summaries of their current status.

Species Population	**Listing Classification and Federal Register Notice**	**Population Status Summary**
Steelhead, *Oncorhynchus mykiss*, CCV DPS	Listed as threatened, January 5, 2006 (71 FR 834)	The 2016 status review of the CCV steelhead DPS concludes that the population's status has remained unchanged since the 2011 review, and that the DPS is likely to become endangered in the foreseeable future throughout all or a significant portion of its range (NMFS 2016a). Indications suggest CCV steelhead have continued to decrease in abundance and the proportion of natural wild fish in the population has shrank over the past 25 years (Good *et al.* 2005). This may be because most wild CCV populations may lack the resiliency to persist for extended periods when subjected to additional stressors, particularly widespread stressors such as climate change. Additionally, these facts negatively influence the overall genetic diversity of CCV steelhead. 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 of CCV steelhead. Since many of these threats and risks are projected to persist, the threatened status of this DPS is also likely to remain classified as threatened.

Species Population	Listing Classification and Federal Register Notice	Population Status Summary
Spring-run Chinook salmon, *O. tshawytscha*, CV ESU	Listed as threatened, June 28, 2005 (70 FR 37160)	Since 2014, the San Joaquin River Restoration Program (SJRRP) has been reintroducing spring-run Chinook salmon incrementally back into the SJR mainstem far upstream of the construction area. These actions are to meet a settlement goal that would also achieve some critical recovery actions identified in the NMFS recovery plan regarding this ESU. According to a final rule under ESA Section 10(j) (78 FR 79622 (December 31, 2013)), these reintroduced CV spring-run Chinook salmon are designated as a non-essential experimental population (NEP) inside of the experimental population area, which is generally in the San Joaquin River from its confluence with the Merced River upstream to Friant Dam (SJRRP 2018). Outside of the NEP/SJRRP's reintroduction area, any spring-run Chinook salmon individuals may be considered part of the spring-run Chinook salmon ESU, i.e., as an ESA-listed threatened species. Since the action area for this proposed action occurs outside of the experimental population area but includes the migration corridor the NEP reintroduced fish must take to reach the ocean or return to the experimental population area, this opinion analyzes the effects of the proposed action on the CV spring-run Chinook salmon ESU. The 2016 status review of the spring-run ESU reported that adult escapement to core spawning creeks had increased since the previous review (NMFS 2016b); however, during 2016 – 2018, adult escapement and juvenile production of these creeks sharply declined in these creeks (California Department of Fish and Wildlife (CDFW) 2018). In 2017, the total number of returning adults held just above the trigger abundance number of the high extinction risk category, and by 2018, Mill and Deer Creeks were believed to be heading towards local extirpation, with less than 500 adults consistently returning. NMFS and CDFW began drafting a CV spring-run Chinook salmon emergency action plan to hopefully prevent this ESU from becoming classified endangered in the next status review (CDFW and NMFS 2018). Then, the Camp Fire erupted in November of 2018, which engulfed the city of Paradise, California, near Butte Creek. The debris and ash resultant from this wildfire is expected to have devastated any spring-run Chinook eggs that were incubating in the Butte Creek stream complex since the fire occurred around and upstream of many important spawning gravel beds, and is expected to result in a total run failure of the 2018 cohort from Butte Creek. In summary, the CV spring-run Chinook ESU is still facing significant extinction risk, and the next status review will be used to determine if they should be moved into a high extinction risk category and be reclassified as an endangered species.

Species Population	Listing Classification and Federal Register Notice	Population Status Summary
North American green sturgeon, *Acipenser medirostris*, sDPS	Listed as threatened, April 7, 2006, (71 FR 17757)	The most recent 5-year status review for sDPS green sturgeon found that some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers in critical habitats (NMFS 2015).The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate (NMFS 2018). Although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices. Lindley *et al.* (2007), in discussing listed CV salmonids, states that an ESU (or DPS) represented by a single population at moderate risk of extinction is at high risk of extinction over a large timescale; this would apply to the sDPS for green sturgeon. Since many of the threats cited in the original listing still exist, the threatened status of the DPS is still applicable throughout its range.

Table 4. Description of CCV steelhead and sDPS green sturgeon designated critical habitats, and summary of its current status.

Species Critical Habitat	**Designation Date and Federal Register Notice**	**Critical Habitat Status Summary**
CCV steelhead designated critical habitat	September 2, 2005, (70 FR 52488)	Critical habitat designated for CCV steelhead 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. The geographic extent of CCV steelhead critical habitat includes: • Portions of the southern Sacramento-San Joaquin River Delta (Delta); • The stream reaches of the American, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced Rivers; and • The SJR downstream from its confluence with the Merced River. In summary, the PBFs of CCV steelhead critical habitat include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Many of the PBFs of CCV steelhead critical habitat are degraded and provide limited amounts of high quality habitat. Passage to historical spawning and juvenile rearing habitat has been largely reduced due to construction of dams throughout the Central Valley. Levee construction has also degraded the freshwater rearing and migration habitat and estuarine areas as riparian vegetation has been removed, reducing habitat complexity and food resources and resulting in many other ecological effects. Although the current conditions of CCV steelhead critical habitat are significantly degraded and reduced, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento-SJR watersheds and the Delta are considered to have high intrinsic value for the conservation of the species.

Species Critical Habitat	Designation Date and Federal Register Notice	Critical Habitat Status Summary
sDPS green sturgeon designated critical habitat	October 9, 2009, (74 FR 52300)	Critical habitat for sDPS green sturgeon has been designated in marine, estuarine, and freshwater habitats. In freshwater, the geographical range of green sturgeon designated critical habitat includes: • The Sacramento River from the Sacramento I-Street bridge to Keswick Dam, including the Sutter and Yolo bypasses and the lower American River from the confluence with the mainstem Sacramento River upstream to the highway 160 bridge, • The Feather River from its confluence with the Sacramento River upstream to Fish Barrier Dam, • The Yuba River from its confluence with the Feather River upstream to Daguerre Point Dam, and • The Delta (as defined by California Water Code section 12220, except for listed excluded areas). PBFs include the following for both freshwater riverine systems and estuarine habitats: food resources, water flow, water quality, migratory corridor, depth, and sediment quality. Additionally, substrate type or size is also a PBF for freshwater riverine systems. In addition, the PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. Many of the PBFs of sDPS green sturgeon are degraded and provide limited amounts of high quality habitat. Although the current conditions of green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento and SJR watersheds, the Delta, and nearshore coastal areas are considered to have high intrinsic value for the conservation of the species.

2.2.1. Climate change

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

The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack rather than extending the melting season through the spring into the summer (VanRheenen *et al.* 2004). Factors modeled by VanRheenen *et al.* (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100% in shallow snowpack areas) during critical juvenile anadromous fishes outmigration periods in the CV. Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen *et al.* 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the CV, where snowpack is shallower than in the San Joaquin River watersheds to the south.

Based on an ensemble of climate models, emission scenarios, and reference temperatures from 1951 to 1980, the most plausible projection for warming in the Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005). An analysis of potential CCV steelhead response to climate change is not available, but one has been conducted considering Chinook salmon environmental requirements. Projected warming is expected to negatively affect all runs of CV Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams on nearly all major rivers, if the climate warms to 5°C (9°F) or more, it is questionable whether any CV Chinook salmon populations could persist (Williams 2006).

Although the CCV steelhead DPS will likely experience detrimental effects of climate change similar to those projected for all runs of Chinook salmon, as they are also still blocked from the vast majority of their historic spawning and rearing habitat, the effects of climate change may be even greater for CCV steelhead, in some cases. Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than Chinook salmon (McCullough *et al.* 2001). McCullough *et al.* (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F), and successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (Richter and Kolmes 2005). Stream temperatures that are currently marginal for spawning and rearing are likely to become too warm to support wild steelhead populations, severely curtailing the range of suitable reproductive habitat for this DPS. Additionally, juvenile steelhead need to rear in freshwater streams for one

to two summers prior to emigrating as smolts. In the CV, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F). As stream temperatures warm beyond current conditions due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but potentially at the expense of overall decreases in survival rates due to higher metabolic demands, and greater presence and activity of predators.

Green sturgeon spawn primarily in the summer in the CV; therefore, if water temperatures increase due to climate change, available spawning habitat will be greatly restricted or eliminated. The Anderson-Cottonwood Irrigation District Diversion Dam (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River (71 FR 17757; April 7, 2006). 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 (Heublein *et al.*, in review). It is uncertain, if green sturgeon spawning habitat exists closer to ACID, which could allow spawning to shift upstream in response to climate change effects. Water temperatures adjacent to the ACID may remain tolerable for the embryonic and larval life stages, but temperatures at spawning locations lower in the river may be more negatively affected. Successful spawning of green sturgeon in other accessible habitats in the CV (i.e., the Feather River) is limited, in part, by late spring and summer water temperatures (NMFS 2015). Therefore, similar to salmonids in the CV, green sturgeon spawning in tributaries to the Sacramento River is likely to be further limited if water temperatures increase and higher elevation habitats remain inaccessible.

Besides facing straightforward water temperature increases at critical life stages on a region wide scale, there are additional cascading ecosystem effects that can have immediate disturbances with severe consequences on these populations. For example, increases in the frequency, duration, and/or severity of droughts and heat stress caused by climate change are linked to wide-spread increases in tree mortality beyond what would be expected even in areas that are not normally-water limited (Allen *et al.* 2010). Widespread increases in dead trees in forested areas, as well as increases in other factors associated with climate change, greatly increase the risk for wildfires (Abatzoglou and Williams 2016). Wildfire activity in the Western U.S. has increased, with wildfires having longer durations and wildfire seasons lasting longer than they did before mid-1980s (Westerling *et al.* 2006). Several watersheds critical to listed salmonids in the CCV have experienced large, intense forest fires recently, like the Camp Fire as the most recent and most devastating example. The risk of extinction posed by wildfires has already been predicted in the NMFS Recovery Plan (NMFS 2014), especially for ESUs like that of the CV spring-run Chinook salmon ESU, which is largely limited to a single area and therefore extremely vulnerable to extinction from regional catastrophes.

In summary, observed and predicted climate change effects are expected to be generally detrimental to all anadromous species in the CCV as all rely on an abundant supply of cold water at certain and predictable times of the year to successfully spawn and rear (McClure 2011, Wade *et al.* 2013). Unless environmental impacts due to climate changes are offset by improvements in other factors negatively affecting these species, the populations of CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon are likely to decline over time due to the decreases in the functionality of their aquatic habitats. 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 the amount of time of the projections, the direction of change is relatively certain (McClure *et al.* 2013) and is expected to intensify the extinction risk of the DPSs and ESUs covered in this opinion.

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).

This action area is associated with the individual sites (Site 0281-11/Calaveras River, 1151-12/SJR, and 1151-17/SJR) as described in Section 1.3, including the direct construction areas, the staging areas, any borrow and disposal sites, and any associated haul routes, as well as the waterways impacted by the proposed action. Many of the staging, borrow, and disposal sites have not yet been determined; however, all sites associated with the individual construction sites would be selected in a manner that would avoid additional impacts to species and other resources. The waterways impacted by the proposed federal action include the mainstem of the SJR, Mormon Slough, and the Calaveras River.

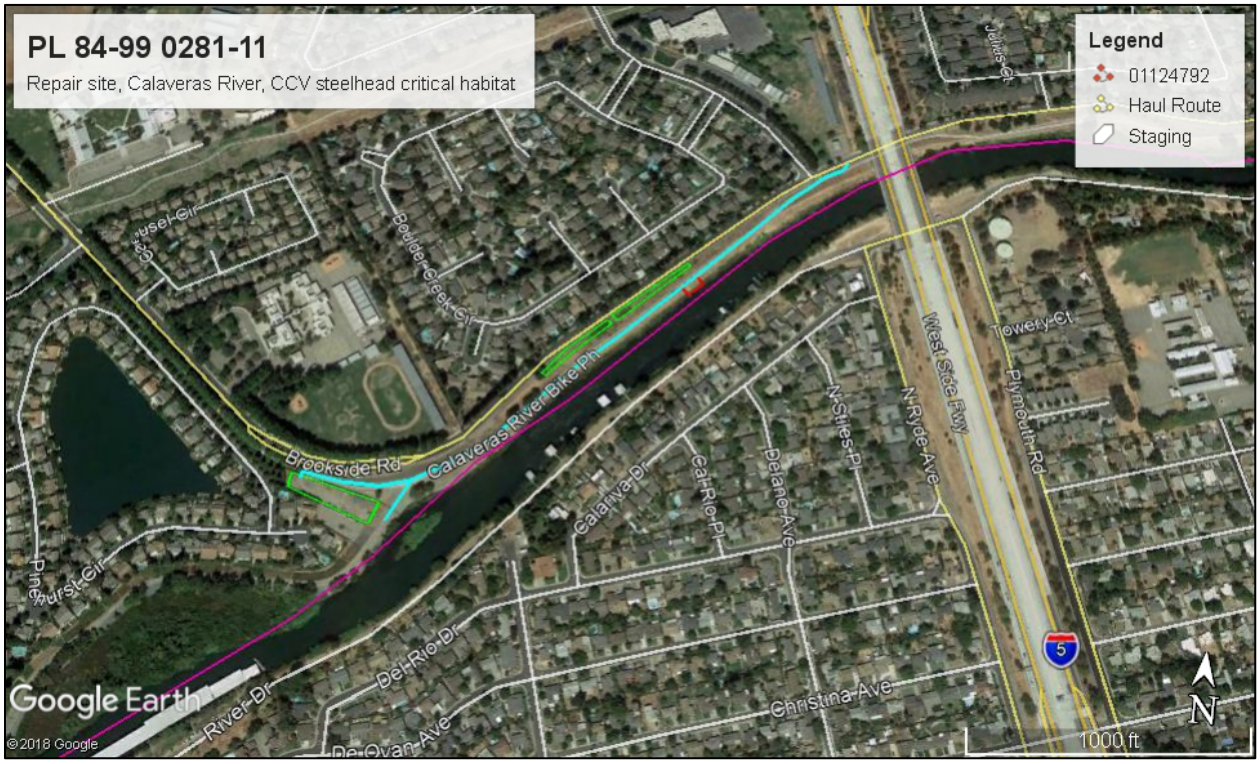


Figure 4. Aerial view of 0281-11 Calaveras/Mormon Slough levee repair site.

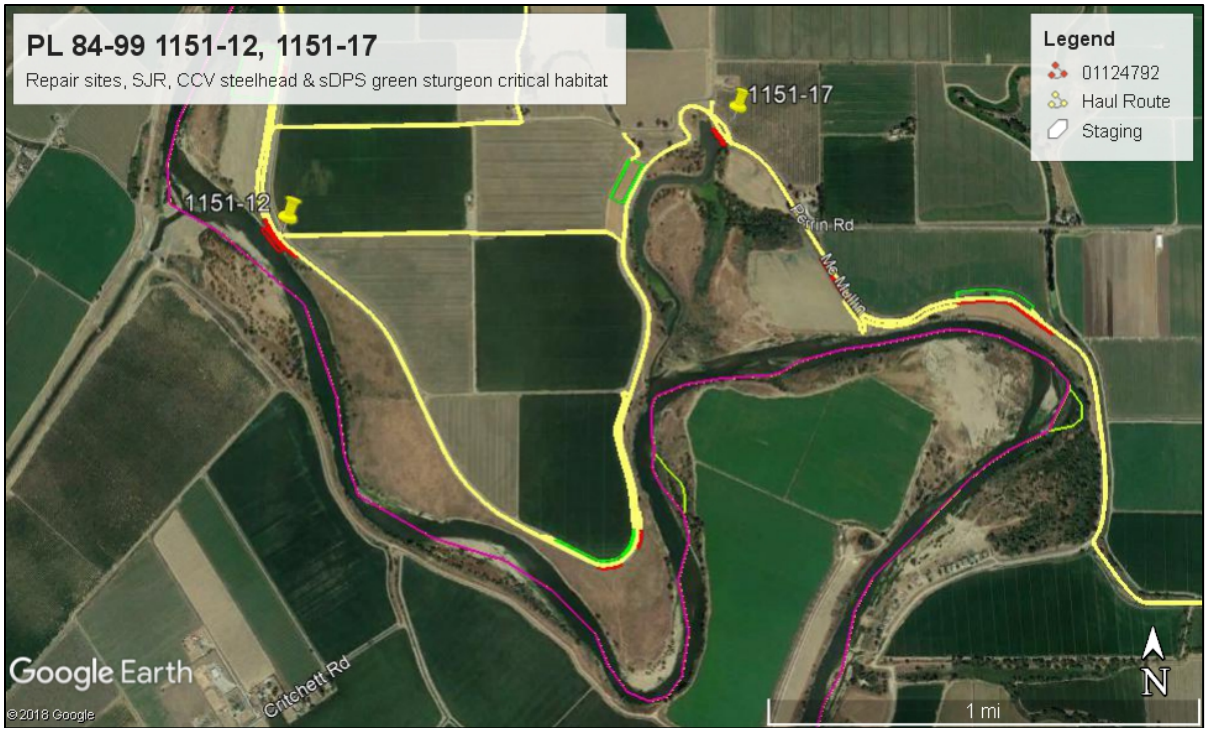


Figure 5. Aerial view of 1151-12 and 1151-17 levee repair sites on the SJR mainstem.

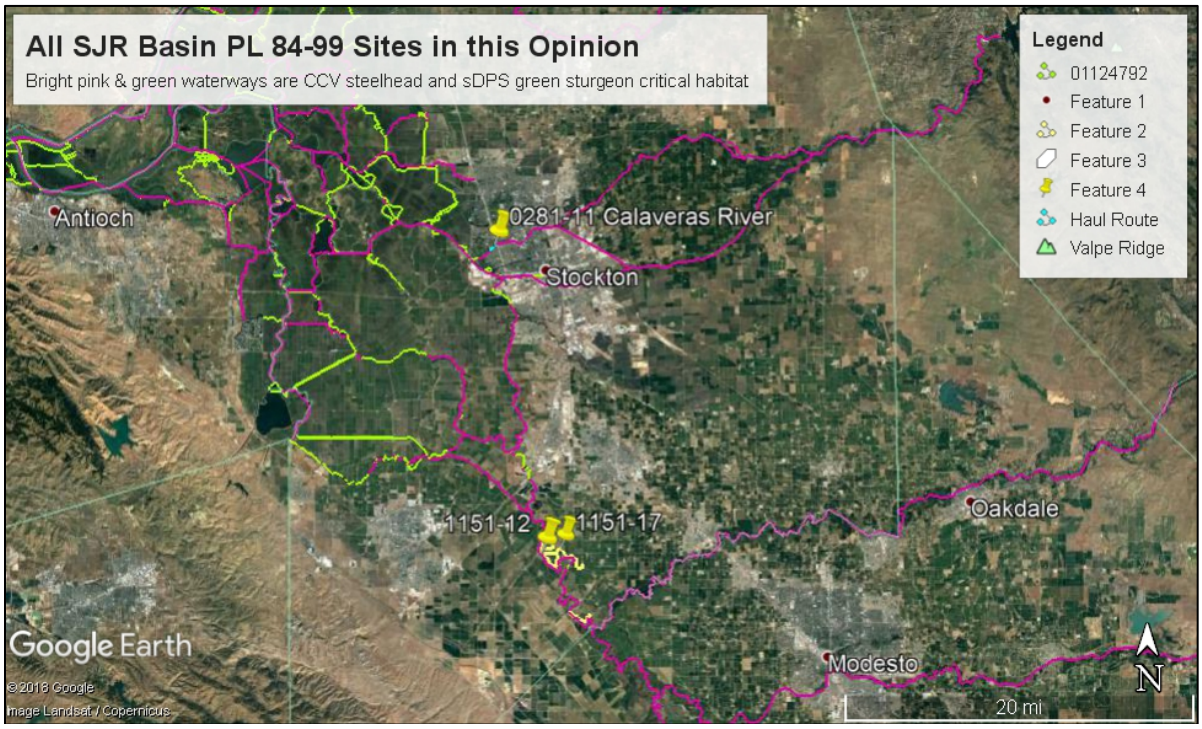


Figure 6. All three PL 84-99 levee repair sites covered in this opinion (yellow pushpins). Pink and green waterways denote CCV steelhead and sDPS green sturgeon designated critical habitats, respectively.

Since the proposed action includes the purchase of mitigation credits from a conservation bank, the action area also includes the areas affected by the two mitigation banks that have service areas relevant to the project and which have been selected to purchases credits from. These include the North Delta Fish Conservation Bank and Liberty Island Mitigation Bank. The North Delta Fish Conservation Bank is an approximately 830 acre site in the Sacramento River Delta/ southern Yolo Bypass, currently pending approval, that will offer riparian, Tule marsh, salmonid preservation, Delta and Longfin smelt credits (Wildlands 2019). The Liberty Island Mitigation Bank is an approximately 186 acre site also in the Sacramento River Delta/southern Yolo Bypass, approved to offer salmonid restoration, salmonid preservation, riparian, Tule marsh, and Delta smelt preservation and Delta and Longfin smelt credits (Wildlands 2010).

2.4. Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

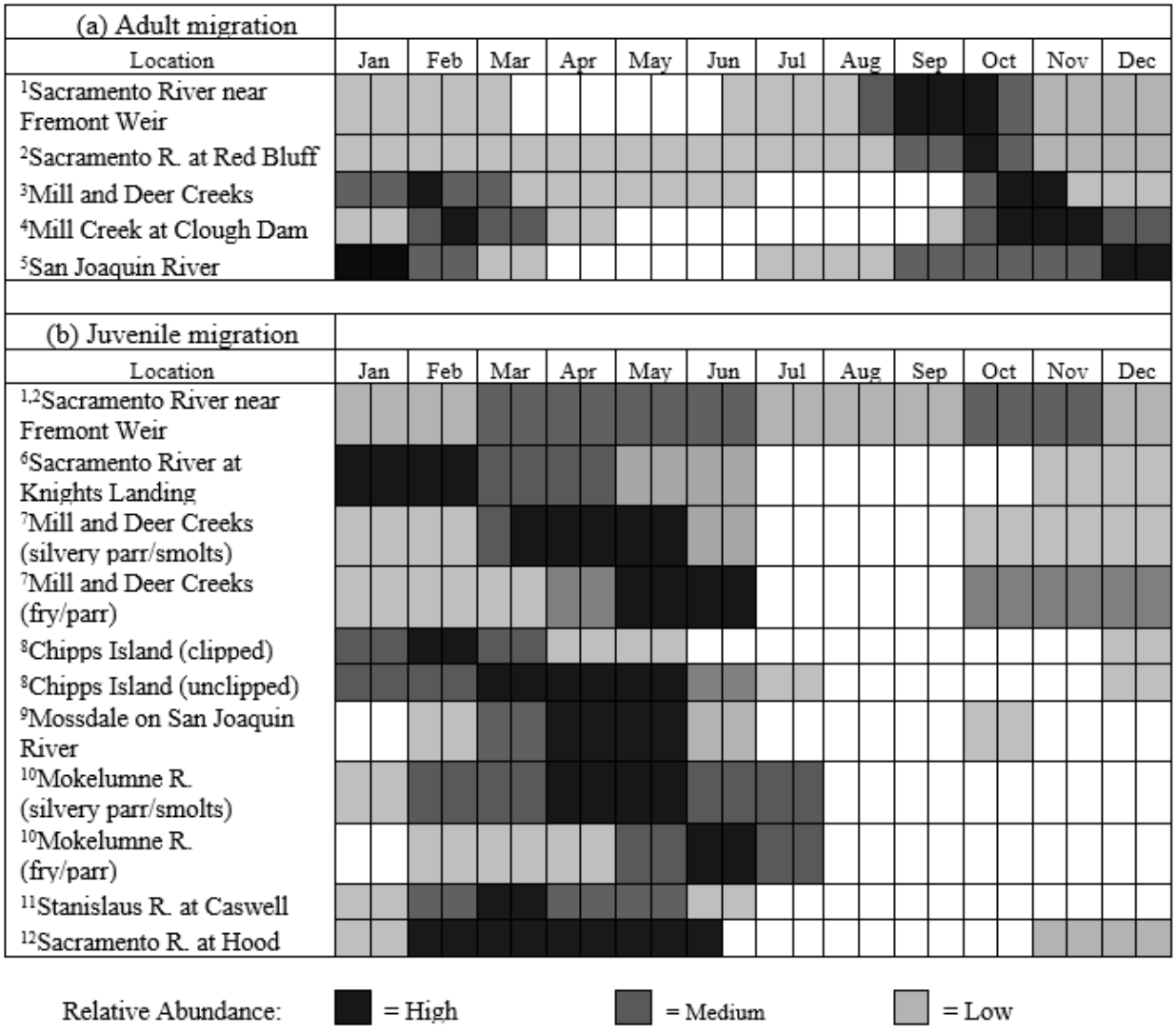
2.4.1. Occurrence of listed species

The federally listed anadromous species that use and occupy the action area are adult and juvenile CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon. The SJR mainstem in the action area is the primary migration corridor for both adult and juvenile life stages spawned below Friant Dam to reach the Delta, which contains important rearing habitat for the juveniles. The Eastside Bypass has potential to act as an auxiliary pathway when water management decisions dictate its use, as juveniles may be pushed out through this pathway from Reach 1 and 2, during flood flow releases.

2.4.1.1. CCV steelhead

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

Adult steelhead enter freshwater in August (Moyle 2002) and peak migration of adults moving upriver occurs in August through September (Figure 7). Adult steelhead will hold until flows are high enough in the tributaries to migrate upstream where they will spawn from December to April. After spawning, most surviving steelhead kelts migrate back to the ocean and reach the Sacramento River during March and April, and have a high relative abundance in the Delta in May. Adult steelhead are present in the Delta from August to May and juvenile steelhead from September to July (Figure 7).



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

Figure 7. The temporal occurrence of (a) adult and (b) juvenile California Central Valley steelhead at locations in the Central Valley. Darker shades indicate months of greatest relative abundance.

Out-migrating juveniles pass the Mossdale Bridge, the closest monitoring location to the construction area, and are observed February through June, with the core of their migration occurring March through the end of May (Figure 7). Larger juveniles in the process of smoltification (parr to smolt stage) have been captured until July on the Mokelumne River (Figure 7).

2.4.1.2. CCV steelhead critical habitat

The PBFs for CCV steelhead critical habitat in the action area include (1) freshwater migration corridors and (2) rearing habitat. The freshwater migration utility in the action area is of fair quality, since flows of the lower SJR are typically of adequate magnitude, quality, and temperatures to support adult and juvenile migration, and is without complete obstacles to migration. Most importantly, this section of CCV steelhead critical habitat serves as a migration corridor for all of the adults and juveniles produced and supported by the SJR and several of its major tributaries.

The rearing habitat offered by this section of the SJR is of poor quality, however, due to the leveed and channelized nature of the SJR mainstem at this location. The floodplain habitat which would otherwise normally exist has been largely removed near the action area due to the high levees, which limits the value of the area for juvenile rearing.

2.4.1.3. CV spring-run Chinook salmon

CV spring run Chinook salmon are considered functionally extirpated from the Southern Sierra Nevada diversity group despite their historical abundance in the SJR basin (NMFS 2016b, c). There have been observations of low numbers of spring time running fish returning to major SJR tributaries that exhibit some typical spring-run life history characteristics (Franks 2014). While the genetic disposition of such fish remains inconclusive, the implementation of the reintroduction of the spring-run Chinook salmon into the upper SJR has begun and has resulted in at least 888 wild-spawned NEP juvenile spring-run Chinook salmon in 2018 (NMFS 2019), in addition to tens of thousands of juveniles released by SJRRP downstream of the Merced/SJR confluence for reintroduction purposes.

These juveniles should be imprinted to the upper SJR mainstem below Friant Dam, and adult returns are eventually expected, especially after multiple fish passage projects are completed and river conditions become more suitable (NMFS 2016b). Typical CV spring-run Chinook salmon life history patterns have adults returning to freshwater basins in March (referencing the Sacramento River basin, Figure 8a). Capitalizing on spring-time run off, adults travel to holding pools, where available, to over summer. When adults begin returning, they may be expected to travel through the action area most likely from March through September (Figure 8a). Adults arrive in an immature state and, during the summer holding period (Figure 8b), ripen until their gonads are ready to spawn in the late summer through late fall (Figure 8c).

Based on known spring-run life history timing in the Sacramento River Basin and limited information on successful spawning of broodstock NEP adults released into the SJR, spring-run juveniles may be expected in the action area November through May (Figure 8b) as they emigrate through the action area. Rotary screw traps placed in the Restoration Area have seen fry and juveniles as soon as December (NMFS 2019), to June in Reach 1A. Again, exact timing of CV spring-run use of the action area would depend on 1) volitional fish passage upstream, 2) in-river water being of adequate quality and temperature, and 3) the variation expected between actual life history stage timing differences between the Sacramento River and SJR basins.

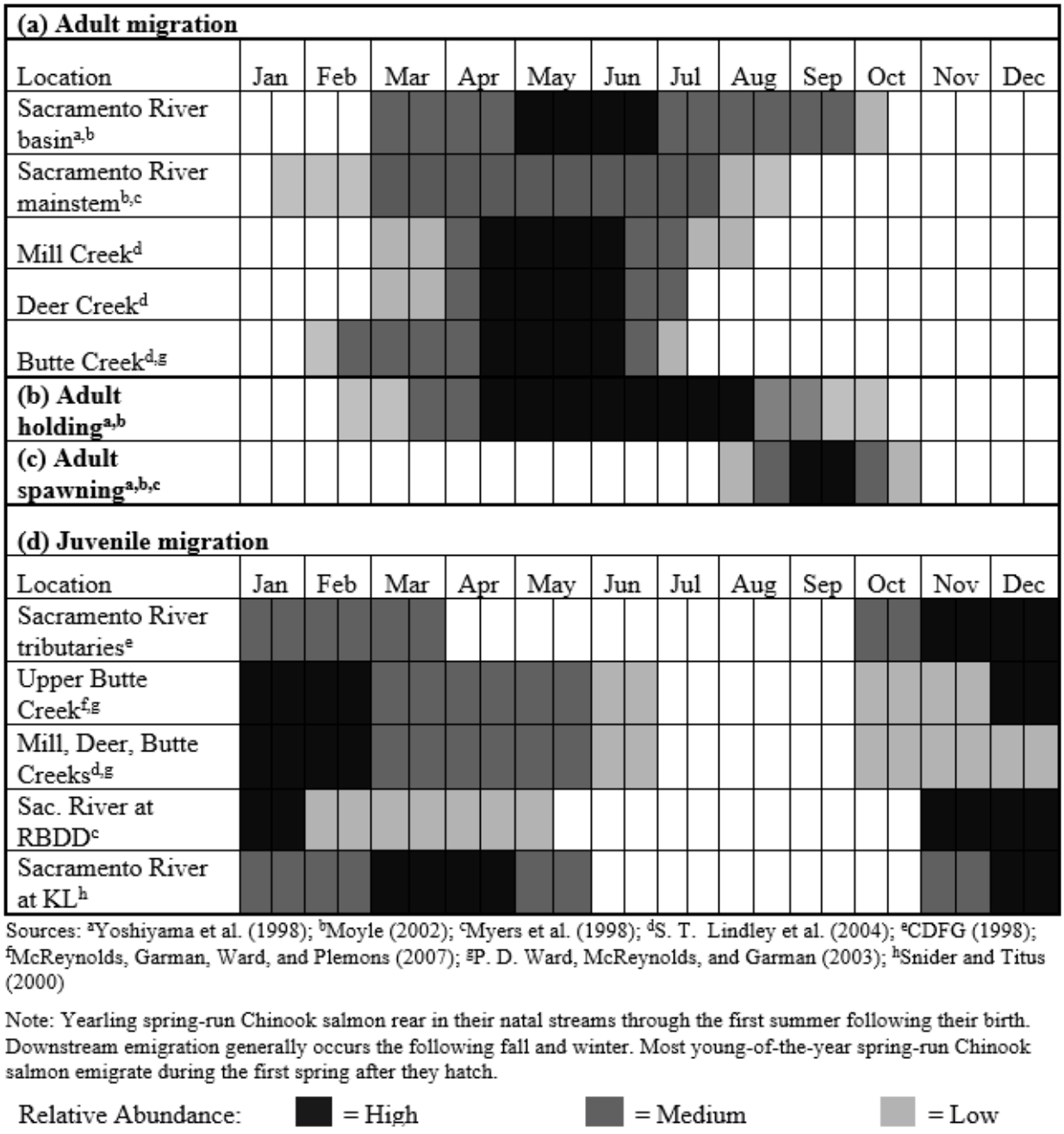


Figure 8. The temporal occurrence of adult (a) and juvenile (b) Central Valley spring-run Chinook salmon in the Sacramento River (used for reference for the SJR). Darker shades indicate months of greater relative abundance.

2.4.1.4. sDPS green sturgeon

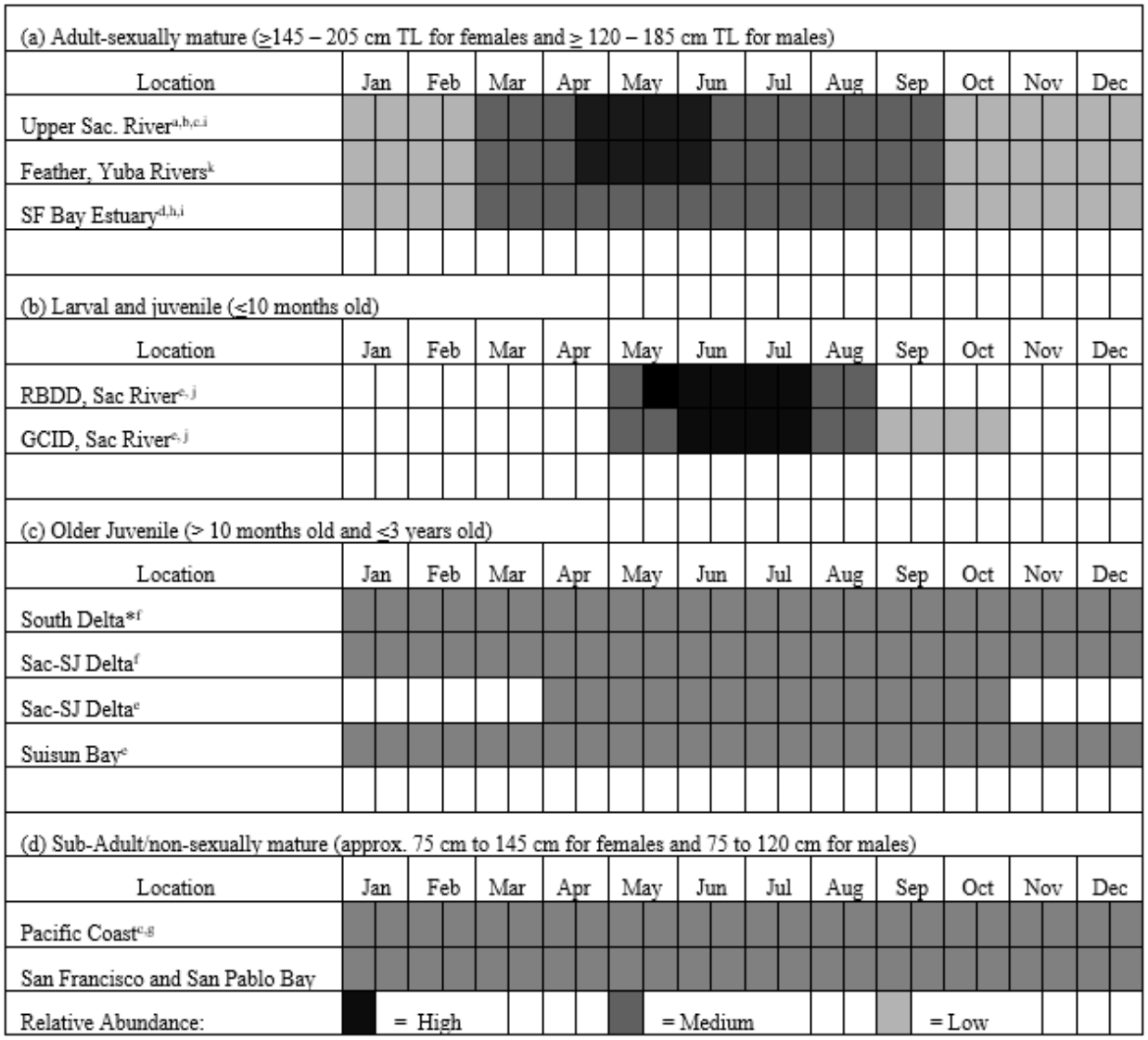
Adult green sturgeon enter the San Francisco Bay starting in February, have been recorded in San Pablo Bay in March (Heublein et al. 2008), and in the Sacramento River system between late February and late July (Moyle et al. 1995). In general, green sturgeon enter the San Francisco Bay estuary in winter and continue upstream to their spawning grounds from mid-winter to late-summer. Spawning occurs from March to July in the Feather River and mainstem Sacramento River (Moyle 2002). 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 SJR (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 SJR (Radtke 1966). Data on 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 green sturgeon show that they are present in the Delta during all months of the year. Adult and juvenile green sturgeon are therefore assumed to be present in the Delta year-round (Figure 9).

Prior to October 2017, all accounts of green sturgeon sightings in the SJR basin were anecdotal at best or misidentification of white sturgeon (Gruber *et al.* 2012, Jackson *et al.* 2016). Late October in 2017, an adult 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 environmental DNA of green sturgeon in the surrounding water (Breitler 2017). This is the first confirmed sighting of a green sturgeon in an SJR tributary, and indicates that adults are able to pass up stream past the location of the proposed action given river flows of suitable quality and amount, though white sturgeon are encountered regularly in the SJR. Since only one adult was located and spawning activities in the SJR basin have never been recorded, the production of juveniles from the Stanislaus is not considered likely in the near future but highlights that recovery for this sDPS may be forthcoming.

While the SJR basin may not produce juvenile 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, salinities, and shelter. Therefore, foraging juveniles, sub-adults, and adults may be found in the SJR mainstem at the location of the proposed action at nearly any time of year, depending on the local water depth, temperature, and quality.

2.4.1.5. sDPS green sturgeon critical habitat

The action area occurs within the extent of sDPS green sturgeon designated critical habitat in freshwater, though this designation ends just north of the confluence of the SJR and the Stanislaus River (NMFS 2018). There are little data regarding the exact services this portion of the critical habitat offers green sturgeon, except that the SJR is believed to have historically supported sDPS green sturgeon populations and therefore they must have used these stream reaches for migration and perhaps also for foraging and rearing to some degree.



* Fish Facility salvage operations

Sources: [a]USFWS (2002); [b]Moyle *et al*. (1992); [c]Adams *et al*. (2002) and NMFS (2005); [d]Kelly *et al*. (2007); [e]CDFG (2002); [f]IEP Relational Database, fall midwater trawl green sturgeon captures from 1969 to 2003; [g]Nakamoto *et al*. (1995); [h]Heublein (2006); [i]CDFG Draft Sturgeon Report Card (2007), [j]Poytress *et al*. (2011, 2012), [k]Alicia Seesholtz, DWR, personal communication

Figure 9. The temporal occurrence of (a) adult, (b) larval, (c) juvenile, and (d) subadult coastal migrant sDPS of green sturgeon. Locations emphasize the Central Valley of California. Darker shades indicate months of greatest relative abundance.

The PBFs of sDPS green sturgeon critical habitat believed to be included within the action area are (1) food resources, (2) adequate water flow regime for all life stages, (3) water quality, (4) adequate water depth for all life stages, and (5) sediment quality. The SJR mainstem in this section is of sufficient depth to support even adult passage, though as stated before only one adult has been observed in the Stanislaus River to date. Spawning in the SJR basin may not be currently possible for green sturgeon given the extent of degradation prevalent throughout the

SJR basin; juveniles are not expected to be produced in the SJR system at this time. However, juveniles produced by the Sacramento River basin could range into this area during their long rearing period in the Delta, and would require habitat supportive for rearing and foraging.

2.4.2. San Joaquin River Basin water resources

The SJR originates from the central Sierra Nevada and drains parts of the Sierra Nevada and Diablo Range of California. The river flows through 531 km of California, first west toward the floor of the CV, then north toward the San Francisco Bay estuary, eventually reaching the Pacific Ocean. Friant Dam, at river kilometer (rkm) 431 of the SJR (measuring from rkm 0 at its confluence with the Sacramento River), forms a complete barrier to upstream anadromous fish passage. However, a number of physical migration barriers (dry riverbeds, diversion dams, seasonally installed weirs) also currently exist between the Merced River confluence (rkm 187.6) and Friant Dam due to the current state of water management on the SJR, and some are targeted by the SJRRP for fish passage improvement.

Since the completion of the Friant Dam/Millerton Reservoir, the entirety of SJR's flow was impounded and directed into the canals for southerly distribution by Friant Dam (except for releases into the SJR mainstem in an effort to manage flood flows and to fulfill a limited amount of riparian water rights of holders downstream). These water management practices resulted in the river typically running dry for a 40 mile stretch annually and only achieving connection to the Delta during flood releases, until recently.

Since 2009, some forms of mandated river restoration flows have reconnected the SJR to the Delta on a semi-regular basis (see section 2.4.3, *Conservation and Restoration Efforts*). A settlement agreement was reached in Natural Resources Defense Council et al. v. Rodgers et al. (2006), in which the parties acknowledged "that the historic operation of Friant Dam has resulted in significant portions of the main stem of the San Joaquin River between Friant Dam and Millerton Lake and the confluence of the Merced River being dry during significant portions of the year in most years, with corresponding impacts on fisheries downstream from Friant Dam." The settlement stipulates that sufficient fish habitat must be provided in the SJR below Friant Dam so that two primary goals are met: 1) Fish populations must be maintained and restored to "good condition" in the mainstem of the SJR from Friant Dam to the confluence of the Merced River, including self-sustained populations of salmon; and 2) Water management must reduce or avoid adverse water supply impacts to all Friant Division long-term contractors that may result from interim and restoration flows provided for in the settlement. Some critical recovery actions identified in the NMFS recovery plan are achieved through the implementation of the settlement goals. The Settlement negotiations included, in part, a regular flow release schedule depending on water year type (Restoration Flows). Partial Restoration Flows, known as Interim Flows, began on October 1, 2009. Restoration Flows began January 1, 2014, but were curtailed in 2014 and 2015 due to extreme drought conditions. The SJR reconnected fully from Friant Dam to the Merced River confluence in August of 2016 and has been reconnected since (SJRRP 2019).

Restoration Flows and other water releases into the SJR main stem are currently implemented in a way that supports the re-introduction of spring-run Chinook salmon and their use of all reaches below Friant Dam for all life stages (SJRRP 2017b). Though the total amount released as Restoration Flows from Millerton is dependent on the forecasted water year type, flow amounts

and release periods were shaped to support the spring-run Chinook salmon spawning period, the spring-run Chinook salmon egg incubation period, fall-run Chinook salmon attraction period, the fall-run Chinook salmon spawning and egg incubation period, general winter base flows, spring rise and pulse flows (when regular increased snowmelt periods would occur naturally, as well as the spring-run Chinook salmon juvenile outmigration period and the spring-run adult attraction period), and summer base flows (including adult spring-run Chinook salmon holding period), until the cycle begins again. Critical water years still require some allocations to sustain the population, but the lower reaches are expected to receive little to no flows and may result in some lower reaches drying up again during the summers of very dry years.

The Calaveras River, a tributary to the SJR, is a relatively small, low elevation CV drainage that receives runoff mainly from winter rainfall (Stillwater Sciences 2004). Flow in the Calaveras River is regulated by New Hogan Dam, located approximately 38 miles upstream from the river's mouth at Stockton. New Hogan Reservoir has a storage capacity of 317,000 acre-feet at gross pool and is operated by the USACE for flood control, water supply, and recreation. Rights to releases below New Hogan Dam are contracted for by the Stockton East Water District and the Calaveras County Water District through the Bureau of Reclamation (Stillwater Sciences 2004). The Mormon Slough levee system provides flood protection from flood flows on the Calaveras River, Mormon Slough, the Stockton Diverting Canal, and Potter Creek to adjacent agricultural lands, the city of Stockton, three mainline railroads, two local railroads, one branch line, US Highway 99, and numerous State highways and County roads.

The flow regime of the Calaveras River has been fundamentally altered since the 1930's, when regulation of the Calaveras River began, first through Hogan Dam and subsequently through New Hogan Dam. Historically, the river's hydrology was characterized by highly variable flows during winter months and rapid attenuation of flows in the summer. Under current flow management, the variability and magnitude of winter flows is strongly reduced, while the magnitude and consistency of summer flows has increased dramatically. Water supplies stored in New Hogan Reservoir are transferred, via the Calaveras River, to downstream locations as far as the town of Bellota, where Stockton East Water District operates a municipal water supply diversion. The effect has been to transform the lower river from a more Mediterranean system, with high intra-year variability, to one that behaves like a typical snowmelt system, with fall and winter precipitation stored and released gradually in the summer months (Stillwater Sciences 2004).

2.4.3. Conservation and restoration efforts

There are many efforts by federal and state agencies to restore aspects of the SJR basin back to its natural physical state and biological functionality. For example, the State Water Resources Control Board (SWRCB) is pursuing new narratives and revisions for the previously existing 2006 Bay-Delta plan (State Water Resources Control Board 2006) that outline Lower SJR flow requirements that would be necessary to support natural populations of native fishes in this system and maintain southern Delta salinities, protecting surface water quality for agricultural beneficial uses (SWRCB, 2016). These recent proposed changes to the existing Bay-Delta plan are an attempt to address the "ecological crisis" occurring in the Delta and CV while also protecting the beneficial uses the limited surface water provides to the communities of California. While ESA-listed salmonids needs are addressed in the Bay-Delta plan (SWRCB 2016), these efforts focus more on restoring the functionality of the available existing habitat.

Other agencies are implementing efforts that are directed more to restoring specific salmonid populations in the SJR basin.

Recovery is the process by which listed species and their ecosystems are restored to the point that the protections provided by the ESA are no longer necessary to ensure their continued existence. Recovering species in the CCV is challenging due to California's large and expanding human population, the associated amount and extent of water use and manipulation, and the continuous development of natural areas (NMFS 2014). In the 2014 Recovery Plan, NMFS established delisting/recovery criteria for the spring-run Chinook salmon ESU and the DPS of CCV steelhead, including that both have at least two robust populations in the Southern Sierra Diversity Group (i.e., the upper SJR tributaries). Though there are many recovery actions that are directed to restoring the marine, estuarine, and freshwater systems that these species depend on, there are a series of actions/efforts that must be completed specific to the SJR basin for these populations to successfully establish and persist. These are identified in full in the 2014 Recovery Plan, and include: implementation of restoration flows in the SJR, re-introduction of spring-run Chinook salmon, channel modifications and reconstructions for improved passage, minimization of fish entrainment and fish loss to diversions, improved management of predation risks, improved wastewater and stormwater treatment and management, spawning gravel augmentation, reestablishment of populations above dams, and development and execution of long-term population monitoring plans, to highlight an important subset. Many of the major actions required for recovery in the SJR are scheduled to be completed by the SJRRP, and habitat-improvement actions that are designed to benefit spring-run Chinook salmon are likely to also benefit CCV steelhead when access is restored.

As previously discussed, the SJRRP is the result of a settlement that was reached in 2006 on an 18-year lawsuit between federal agencies, the Natural Resources Defense Council, and the Friant Water Users Authority (2006, SJRRP 2018). The settlement stipulates that sufficient fish habitat must be provided in the SJR below Friant Dam so that two primary goals are met: 1) Fish populations must be maintained and restored to "good condition" in the mainstem of the SJR from Friant Dam to the confluence of the Merced River, including self-sustained populations of salmon; and 2) Water management must reduce or avoid adverse water supply impacts to all Friant Division long-term contractors that may result from interim and restoration flows provided for in the settlement. Some critical recovery actions identified in the NMFS recovery plan are achieved through the implementation of the settlement goals. Though this settlement and the SJRRP actions are restricted to the restoration area, the SJR mainstem from Friant Dam to the Merced River, the achievement of volitional fish passage from the Delta to the base of Friant Dam would increase the use of the SJR mainstem within the action area of this proposed action by both adult and juvenile salmonid migration. SJRRP restoration projects slated for near-term implementation include (SJRRP 2017a): 1) the Reach 2B and Mendota Pool Bypass (creates bypass around Mendota Dam and increases capacity of Reach 2B to 4,500 cubic-feet-per-second); 2) the Reach 4B and Eastside Bypass Improvement Project (restores the flow capacity of the low-flow channel in the Eastside Bypass and removes fish barriers); 3) the Arroyo Canal and Sack Dam fish screen and fish passage project (adds a fish screen to the Arroyo Canal and modifies Sack Dam for fish passage); and 4) the Gravel Pit Isolation Project (inventories gravel pits of the SJR and ranks priority to which pits most adversely affect reintroduction efforts so they can be addressed in order of impacts). Several of these projects directly address recovery actions outlined in the NMFS recovery plan for the SJR (NMFS, 2014). There are also several

additional projects that target the second goal of the SJRRP, i.e., minimizing effects of water management to water users, but that will not be covered in this section as these actions are unlikely to benefit the conservation or restoration of these species (more information may be found here: http://www.restoresjr.net/projects/). SJRRP-moderated restoration flows that benefit fish passage through, and use of, the SJR basin have already begun, and spring-run Chinook salmon re-introduction efforts are ongoing. Fish passage and levee improvement components are scheduled to begin in 2018 through 2020, and the Department of Commerce is required to report to Congress on the progress made on reintroduction and plans for the future of the reintroduction by the end of 2024.

Conservation 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 conservation bank credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that an ESA 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 conservation 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 conservation 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 conservation banks and also do not reflect their unique circumstances. Specifically, conservation 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 ESA 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 conservation 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.

There are two conservation or mitigation banks approved by NMFS with service areas that include the action area considered in this opinion and which have been identified by USACE as the sites from which they plan to purchase credits. These banks may offer CCV steelhead/salmon credits or credits that would benefit protected salmonids; however, mitigation bank credits are not currently available for sDPS green sturgeon.

- ***North Delta Fish Conservation Bank:*** A combination public/private conservation bank between the Trust for Public Land and RD 2093, in partnership with Wildlands, currently pending release. It is located in the southern Yolo Bypass in the Sacramento Delta on Liberty Island. Its property encompasses approximately 830 acres in total, 225.33 acres of which has been identified as potential salmonid credits (riparian credits and salmonid preservation (USACE 2019)). It has been approved by NMFS to provide credits for impacts to all salmon and steelhead, threatened or endangered. Since all credits are pending release, none have been yet sold and none are currently available for purchase. Green sturgeon entitlement (credits) at this bank is also currently pending (Wildlands 2019).

- ***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. Out of the credits relating to salmonid restoration or preservation, 13.96 acre have been sold/withdrawn from 75.36 potential salmonid credits (restoration, preservation, Tule marsh, and shaded riparian). 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, and the ecological value of the sold credits (increased rearing habitat for juvenile salmonids) are part of the environmental baseline. All features of this bank are designated critical habitat for salmonids as analyzed in this opinion, but not sDPS green sturgeon.

2.5. Effects of the Action

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

2.5.1. Direct and indirect effects to species

2.5.1.1. General construction activities

Construction activities have the potential to introduce noise, vibration, artificial light, and other physical disturbances into the immediate environment in and around the construction zone that can result in the harassment of fish by disrupting or delaying their normal behaviors and use of areas, and in extreme cases causing injury or mortality, directly or indirectly. The potential magnitude of effects depends on a number of factors, including type and intensity of disturbance, the proximity of disturbance-generating activities to the water body, the timing of the activities relative to the use and occurrence of the sensitive species in question, the life stages of the species affected, and the frequency and duration of disturbance periods. In the context of the levee repairs, the use of the area by adult and juvenile salmonids and green sturgeon are expected to be adversely affected by various construction-related effects.

Fish are expected to exhibit avoidance movements near construction activities that will displace them from locations they would normally occupy, due to the noise generated by the operation of construction machinery or movement of soils and rocks during earthwork and riprap placement periods. Depending on the innate behavior that is being disrupted, the direct and indirect adverse effects could be varied. An example of a significant, direct adverse effect would be cessation or alteration of migratory behavior. For juvenile fish, an additional effect may include alteration of behaviors that are essential to their maturation and survival, such as feeding or sheltering. Fish vacating protective habitat due to disturbance may experience increased predation rates and decreased survival rates compared to those left undisturbed. Besides migration pattern alterations, general construction disturbance may increase fish physiological stress and increase risk of mortality.

Another part of general construction activity near waterways is the placement of structures (cofferdams) and movement of materials and soils both below the OHWM and along the river banks/levee tops. Such soil disturbance is likely to mobilize sediment and increase the likelihood of erosion, possibly sending it into associated waterways at elevated rates, unless sufficiently controlled. A turbidity curtain will be installed around the work area, outside of the cofferdam placement, to control in-river turbidity. Numerous landside erosion control BMPs, including the development of a Stormwater Pollution Prevention Plan (SWPPP), will be implemented during construction. Due to the installation of a turbidity curtain and other erosion/sedimentation control measures implemented onsite, project-related soil/sediment mobilization is expected to be sufficiently controlled, and direct adverse effects to listed fishes from in-water turbidity increases are not expected.

The proposed in-water work window is from April 1st through October 15th. While the summer months of the proposed work window would generally be expected to be a time period during which the possibility of encountering listed fishes in the nearby waterways due to their natural life history patterns and use periods would be low, April through June can be the peak migration timing, depending on seasonal variation. Spring-run Chinook salmon adults may still be returning to the upper SJR through the end of June, steelhead juveniles may be out-migrating to the Delta until July, and adult green sturgeon may be using the waterways throughout the entire work window, if water flows and temperatures remain suitable in the action area. The daily work window of 60 minutes after sunrise to 60 minutes before sunset further minimizes impact of construction activities on peak fish movement periods in the nearby waterways. However, these two avoidance tactics do not completely remove the potential for listed anadromous fishes to occur in the action area while construction is ongoing.

Regarding the 75°F water temperature-work window exemption, steelhead, spring-run Chinook, and green sturgeon would not be expected to occupy waters above 75°F when such high temperatures persist in the area for an extended period, such as a full week; therefore, water temperature monitoring to adaptively avoid fish presence would be the best way to minimize construction effects on listed fishes, when practicable. Any harassment and adverse effects associated with general construction activities will persist in the action area only as long as construction is ongoing.

2.5.1.2. Vibratory pile driving

The levee repairs will require the use of vibratory pile driving to install temporary cofferdams into the wetted channel and bank/levee soils to enable in-the-dry construction and riprap placement. When the levee repair is complete, vibratory pile driving will also be used to remove the temporary cofferdam sheet piles.

Pile driving near or in water introduces underwater pressure waves into the water column. 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 water pressure, which translates to rupturing or hemorrhaging tissue in the bladder when the air in swim bladders expand and contract in response to the pressure oscillations if the pressure waves reach sufficient magnitude (Gisiner 1998, Popper *et al.* 2006). When fish are

exposed to sound exposure levels (SEL) of varying ranges, behavioral changes are often observed (Wardle *et al.* 2001, Slotte *et al.* 2004, Popper and Hastings 2009).

Based on recommendations from the Fisheries Hydroacoustic Working Group (FHWG), NMFS uses an interim dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (Caltrans 2015, 2019). The interim thresholds of underwater sound levels denote the expected instantaneous injury/mortality, cumulative injury, and behavioral changes in fishes. Impact pile driving is normally expected to produce underwater pressure waves at 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. NMFS uses a 150 decibel (dB) root-mean-square (RMS) threshold for behavioral responses in salmonids and green sturgeon. Though the dB value is the same, the 150 dB RMS threshold for behavioral effects is unrelated to the 150 dB effective quiet threshold.

Table 5. Expected maximum unattenuated hydroacoustic sounds based on the size of pile and method of placement, according to the similar case studies in the FHWG pile driving compendium (Caltrans 2012).

Pile Type	Driver Type	Pile Location	Reference Distance	Peak (dB)	SEL (dB)	RMS (dB)
24-inch AZ steel sheet pile	Vibratory	In water, ~15 meters	10 meters	175-182	160-165	160-165

Table 6. Threshold distances to in-water adverse effects using maximum dBs from Table 4, modulated by strikes per day, when fish weight >2 grams, calculated by the NMFS pile driving calculator (NMFS 2008).

Strikes per Day	Peak (dB) ≥ 206	Cumulative SEL (dB) ≥187	RMS (dB) ≥150
1,000	0 meters	34 meters	100 meters

The background RMS sound pressure levels, or effective quiet, is assumed to be 150 dB RMS and the acoustic impact area is the area where the predicted RMS SELs generated by pile driving exceeds the behavioral 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 equal to 150 dB RMS, the distance fish are expected to be adversely affected during pile driving is out to 100 meters (Table 6) from the location of the pile being driven, assuming a transmission loss constant of 15 (NMFS calculation sheet). Adverse effects experienced by fish within the 100 meter area include startle and stress responses that will cause avoidance of the action area, disruption of migration and rearing behaviors, and a temporary decrease in a juvenile fish's ability to detect and avoid predators.

Therefore, CV spring-run Chinook salmon, sDPS green sturgeon, and CCV steelhead are expected to be adversely affected by vibratory pile driving when they use the action area during which vibratory pile driving is scheduled. The incidental take of listed fishes through harassment may result in the temporary disturbance of normal behaviors and migratory patterns, but may

also cause indirect mortalities of juveniles through increased predation opportunity and of adults through exposure to higher water temperatures and stress from delayed migration.

Repair site 0281-11 vibratory pile driving timing

From Table 1, repair site 0281-11 in Mormon Slough/Calaveras River, in-water vibratory hammering started April 22, 2019 and continued for 10 days to install the cofferdam. Regarding CCV steelhead, March through June is peak juvenile emigration season. These 10 days of in-water vibratory pile driving likely prevented juveniles originating from the Calaveras River from emigrating on their normal schedule. While vibratory pile driving is not associated with direct injury to fishes over two grams in weight, it is possible that this delay caused more juveniles to experience mortality through predator or experience decreases to their fitness due to increased stress from the elevated underwater sounds than what would otherwise be normal for this area. It is also likely that juvenile steelhead did not rest or forage near the work area during any vibratory pile driving activities, which could be detrimental to their overall fitness and survival. These adverse effects were somewhat decreased by the project's adherence to the daily work window and avoidance of work during the nighttime and crepuscular time periods when juvenile steelhead display downstream movement. In this way, project activities did not completely block CCV steelhead juvenile migration out of the Calaveras River during the 10 days of vibratory pile driving. CCV steelhead adults are not expected to be migrating up in spring, and would not be adversely affected by this early season pile driving work.

Regarding CV spring-run Chinook salmon, adults would have only been affected by the early in-water vibratory pile driving activities if they had accidentally strayed into the Calaveras River while trying to travel up the San Joaquin River. The elevated underwater sounds created by in-water vibratory pile driving is only expected to affect up to 100 meters from the location of the pile driving, and not into the San Joaquin River mainstem, though the repair site is relatively close to their confluence. Juvenile CV spring-run Chinook salmon are expected to be adversely affected by the vibratory pile driving. Data from SJRRP shows that NEP spring-run Chinook salmon juveniles are captured by the fish collection facilities upstream of this repair location until the end of April. Since juveniles forage and rear while emigrating out of the system, and this location is close to the Delta, it is likely that 10 days of in-water pile driving caused these juveniles to avoid the area, potentially decreasing their overall fitness.

Regarding green sturgeon, individuals may be expected to use the Delta and waterways near the Delta at any time for foraging. Disturbance of foraging and feeding due to pile driving noise would likely result in a reduction of daily caloric intake temporarily, thereby reducing the overall fitness of affected individuals as long as vibratory pile driving persists. However, the number of individual sturgeon using the affected area on any one day is expected to be low since it is far away from higher quality foraging habitat and their spawning rivers, and once fish leave the area impacted by underwater sound, they are likely to resume feeding behaviors. There is no sDPS green sturgeon spawning in the Calaveras River or in the San Joaquin River at this time, so interruption of adult migration or impacts to larvae are not expected.

It is expected that it will take another 10 days to remove the cofferdam also using vibratory pile driving by October 15, 2019. Since the removal is during a naturally low fish use period in the

fall, when river flows are lower, there is a low probability of encountering a CV spring-run Chinook salmon, CCV steelhead, or sDPS green sturgeon during those 10 days of removal.

Repair site 1151-12 vibratory pile driving timing

Repair site 1151-12 started in-water construction October 11, 2018, and continued to November 5, 2018 (Table 1). NMFS assumes that the number of days that in-water vibratory pile driving occurred was similar to repair 0281-11, and took approximately 10 days to install a cofferdam and 10 days to remove the cofferdam. Since this period was during a naturally low fish use period in the fall, there was a low probability of encountering a CV spring-run Chinook salmon, CCV steelhead, or sDPS green sturgeon, even during 20 days of in-water vibratory pile driving. In addition, this location is much further south and up the San Joaquin River, further reducing the probability that a green sturgeon was encountered during in-water vibratory work.

Repair site 1151-17 vibratory pile driving timing

Repair site 1151-17, which started in-water vibratory hammering June 1, 2019, is assumed to have required 10 days of in-water pile driving to install and also 10 days to remove the temporary cofferdams. In-water work at this site adhered to an in-water work window recommended by NMFS staff for avoiding almost all of fish use of the San Joaquin River. CV spring-run Chinook salmon use of this location is expected to have concluded by the start of the work window; therefore, no adverse effects to CV spring-run Chinook salmon are expected to have occurred. A few individual CCV steelhead or sDPS green sturgeon may have been in the action area; however, the total number affected would have been greatly curtailed due to normal summer water temperatures at this location. The daily work schedule is expected to have further reduced adverse effects to any individuals present by allowing normal behaviors and uninterrupted movement for long periods of time (i.e., crepuscular and night time).

2.5.1.3. Cofferdam installation and dewatering

As described above, temporary cofferdams will be or have been installed on the leveed bank in or near the water line using vibratory pile driving to isolate and dry areas before construction. Any contained or ponded water will be pumped out so that the soils below the OHWM may be accessed and dried for construction. Pumped water will be returned directly to the waterbody it was pumped from, and water will be discharged from the pump into an area behind the turbidity curtain placed around the work area so that water quality impacts to the local in-river turbidity are controlled.

If water temperature remains suitably low during the in-water work periods, there is a small possibility that juvenile salmonids may become entrapped or stranded in the cofferdam/turbidity curtain enclosure, requiring ‘fish rescue’ before the area is pumped to ensure their survival and minimize USACE’s take of listed fishes. Staff will be available onsite to capture, transport, and release any juvenile salmonids in cofferdams before dewatering begins. Capture may occur through seining, dip netting, or electrofishing, and handling of salmonids would be minimized to the extent practicable and necessary to identify individuals to species. Fish would be held in a shaded bucket with aerators and monitored for unsuitable temperature changes, with ice and Stress Coat added as necessary to improve water quality conditions.

During fish rescue activities, any juvenile CCV steelhead and CV spring-run Chinook salmon captured will likely experience stress, shock, and suffer mild injuries, even if seasoned fisheries biologists perform the fish rescue. Some juveniles may be outright killed during capture, handling, or transport, while others may be disoriented at release, leaving them more susceptible to predation, or develop serious infections from small wounds inflicted during handling that increase their mortality risk later on. The rate of short-term juvenile salmonid mortality due to capture and handling is expected to be 2 to 10% of the total number of juvenile salmonids captured and relocated using electrofishing (Habera *et al.* 1996, Ainslie *et al.* 1998). Adverse effects to adult salmonids due to fish rescue are not expected as it would be extremely unlikely to trap one in cofferdams of these size; therefore, fish rescue would not be required for adults.

2.5.1.4. Site preparation and vegetation removal

Site preparation is required for the levee repairs, and will likely to occur early in the work window periods. It includes some vegetation removal and soil excavation. Beyond the disruption of normal fish behavior as associated with general construction described previously, the decreases in riparian vegetation will create physical changes in the environment, which cumulatively are expected to decrease the functionality of the riparian habitat and negatively affect the survivorship of juvenile salmonids using the area (Bjornn and Reiser 1991). Changes in vegetative cover can influence the macroinvertebrate prey assemblage, through alterations in shading, water temperatures, and nutritive inputs, to an aquatic habitat and result in a prey web less supportive of juvenile salmonid growth (Meehan *et al.* 1977). Removal of riverine vegetation near or at the water line reduces the natural cover that was previously available on site and reduces the general habitat complexity that would otherwise be beneficial to salmonid freshwater rearing and juvenile freshwater migration. In these particular reaches of the SJR and Calaveras River, vegetative cover is already sparse on the leveed banks due to long-term anthropogenic management and systematic removal, so the current habitat complexity is very low.

USACE does not propose to plant any riparian vegetation onsite as “little to no vegetation of significance” will be removed, and there will be no tree removals at these three sites. However, any bare topsoil will be seeded with native grasses to control onsite erosion after construction is complete and, while USACE won’t be planting trees, repairs involving a quarry stone/soil mixture may eventually re-vegetate naturally over time. However, this process is expected to be extremely slow since the construction areas are currently sparsely vegetated in these reaches of the SJR and Calaveras River due to past land and waterway management decisions. Overall, the small amount vegetation removal associated with this project is unlikely to increase or decrease the functionality of the critical habitat in the action area from its already depressed baseline status.

2.5.1.5. Placement of riprap and hard bank stabilization measures

Riprap/revetment will be removed and then replaced to protect and stabilize the already leveed banks of the SJR and Calaveras River.

When hard revetment or riprap is installed on stream banks, it removes the marginal shallow water habitat at the water/land interface that provides refugia and feeding opportunities for

rearing salmonids, reduces the total amount of riparian vegetation that can be established this zone, changes the prey base through alteration of the benthic substrate type and local water dynamics, and often provides ambush habitat for (often) non-native piscivorous fishes. In addition, the act of bank stabilization is expected to prevent normal stream processes from occurring, such as natural channel braiding, and erosion and deposition cycles, which would otherwise eventually create the habitat complexity that supports rearing salmonids. Instead, the repair and replacement of any riprap/hard revetment will perpetuate the channelization of the SJR and Calaveras River into the future and continue the depression of the functionality of available critical habitat.

Therefore, the habitat changes associated with the repair and replacement of riprap/hard revetment are expected to have a negative impact on juvenile CCV steelhead and spring-run Chinook salmon survivorship and growth in the action area over the long term. These adverse effects will persist as long as riprap/revetment remains and serves as bank stabilization method of choice for these levees.

Adult CCV steelhead and CV spring-run Chinook salmon are not expected to be negatively affected by the placement of riprap, as they are not reliant on margin habitat for foraging or refuge, though its placement discourages the establishment of large, overhanging trees that would otherwise be beneficial to migrating adult salmonids by providing a resting location.

sDPS green sturgeon are also expected to experience negative effects and decreased fitness from the placement of riprap/hard revetment through decreases in local benthic prey abundance. Green sturgeon are bottom feeders heavily reliant on prey items that live on or in soft sediments, and increases in hard surfaces below the water line effectively decreases the amount of area available for them to forage and feed.

2.5.1.6. Mitigation credit purchase

USACE intends to offset the long-term negative effects to critical habitat functionality associated with the levee repair project by purchasing mitigation credits from a NMFS-approved bank that offers salmonid credits, which also contains the action area in the banks service area. This purchase will ensure that the CCV steelhead DPS and CV spring-run Chinook salmon ESU will receive benefits through the restoration and preservation of accessible riparian habitat and rearing habitat elsewhere in their critical habitat range though the repair project will cause negative impacts locally. There remains some question whether the sDPS of green sturgeon will benefit to the same degree as salmonids might from any mitigation credit purchase that target salmonid habitat offsets. Since green sturgeon have historically used many of the same waterways as steelhead and Chinook salmon, and the banks (one pending) are also located in green sturgeon designated critical habitats, individual green sturgeon are also expected to experience some amount of positive increase in freshwater habitat functionality from these mitigation credit purchases.

These benefits to individuals of each listed species are expected to be provided in perpetuity. The banks that serve the action area all have adequate mechanisms in place to track credits and debits to ensure that more debits are not sold than credits that are available. A non-wasting endowment fund to pay for long-term management of the bank sites also ensures credit values are maintained

in perpetuity and therefore the properties are expected to be permanent habitat improvements that provide benefits to protected anadromous fishes. To document this, each bank must submit a Mitigation Banking Instrument to USACE when they are developed. A description of these tracking mechanisms can be found in the respective banking instruments for the North Delta Fish Conservation Bank (Wildlands and Reclamation 2013), and Liberty Island (Wildlands 2010). The Mitigation Banking Instrument also specifically identifies that NMFS has jurisdiction over certain living marine resources that may occur within the property for the bank to be considered NMFS approved, such as the ones identified in this opinion.

2.6. Cumulative Effects

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

The CCV cities in general, but especially Merced, Chowchilla, Madera, and Fresno, anticipate increases in human population growth and urban development (Fresno Council of Governments 2012). Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. Increased human population growth would also place additional burdens on resource allocations, including natural gas, electricity, and water resources, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. For instance, more freshwater demands for public drinking water, urban landscaping, and recreation is expected to remove surface water directly from natural waterways or to tap into groundwater supplies, which would lower the water table, reducing the amount of water in rivers available for fish use. Some of the water is returned, however often with increased contaminant and nutrient loads, and at greater water temperatures through stormwater and wastewater discharges because these sources are often inadequately treated to water quality levels that would not adversely affect fishes or the functionality of their habitats. Increasing demands for these resources would also require building additional public infrastructure to enable their delivery and processing (such as power stations, wastewater treatment plants, and maintenance yards), which would also have indirect and possibly direct impacts to the critical habitats of listed fishes through riverine and upland habitat occupation and alteration. These adverse effects would be ubiquitous for all species and habitats affected by the increase in human population growth. Some of these actions, particularly those which are situated away from waterbodies, would not require Federal permits, and thus would not undergo review through the ESA section 7 consultation processes with NMFS.

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

2.7. Integration and Synthesis

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

All the species discussed in this opinion are threatened under the ESA, and the most recent 5-year status reviews conclude that their threatened status is still applicable (NMFS 2015, 2016b, a). Through recovery and SJRRP reintroduction efforts (SJRRP 2017a, NMFS 2019), CV spring-run Chinook salmon are expected to use the action area. However, despite recovery efforts, CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon remain threatened and at risk of endangerment in large part because of anthropogenic barriers blocking them from accessing a majority of their habitat, and the widespread degradation and destruction to the freshwater habitats that remain accessible. These threats currently persist and are expected to exacerbate as human populations in the CV increase, causing cascading effects such as increases in land development, freshwater demands, and urbanization, which are expected to decrease available surface water flows and negatively affect water quality. These changes are likely to suppress the recovery potential of these populations, based on the effective scale of adverse habitat changes compared to recovery actions and negative synergy with climate change effects.

Direct and indirect adverse effects of this proposed action to individuals of each species are expected to occur. The in-water construction of one site in particular, the 0281-11 Mormon Slough/Calaveras site, occurs during peak migration of juvenile CCV steelhead, in particular, and is expected to interfere with their normal use of the area. The total number of individual listed fish expected to experience decreased fitness and overall survival is expected to be low, however, because these populations all have estimated low abundances. Also, their exposure to elevated underwater sounds is somewhat moderated by adoption of a daily work schedule that allows fish to use the area at sunset, night, and sunrise. Overall, the number of individual fish from each population expected to experience direct adverse effects from the proposed action is small, and many of the adverse effects are expected to cease once the levee repair construction is complete.

The repair of the levees and replacement of the riprap and hard revetment in the designated critical habitats of CCV steelhead and sDPS green sturgeon effectively removes functional acreage in perpetuity, though the total amount removed is relatively small and is the same amount considered degraded due to previous levee establishment considered in the environmental baseline (as PL 84-99 stipulates the levee repairs cannot better or be substantially different from before the leveed area required repair). These levees are currently sparsely vegetated, and are likely to remain sparsely vegetated into the future. The critical habitat functionality of the area overall is fair; it is poor when considering its salmonid rearing value (lack of floodplain habitat, in-stream large woody debris, aquatic vegetation, and habitat

complexity) but adequate for migration purposes (no physical blockages). The action area's functionality as green sturgeon foraging habitat is unknown but is expected to remain the same as the status quo after the repairs are complete. Unfortunately the status quo quality of a majority of the designated critical habitat in the lower SJR and Calaveras River (i.e., the action area) is contributing to the endangerment of these species and is suppressing their populations' recovery potentials. Proposed actions that maintain the status quo of the ubiquitous leveed river systems that were historically vast floodplains will only perpetuate the degraded nature of the habitat used by CCV steelhead, sDPS green sturgeon, and CV spring-run Chinook salmon.

USACE's mitigation credit purchase is expected to provide some benefits to the CCV steelhead DPS and the CV spring-run Chinook salmon ESU by improving riverine or floodplain habitat conditions elsewhere through restoration and ensuring their preservation into the future. The sDPS of North American green sturgeon are also expected to benefit to a lesser degree from these purchases, as long as sturgeon may access the waterways of the mitigation bank. It is fitting that the benefits offered to these populations will exist in perpetuity as the negative effects of riprap/hard revetment will also affect these populations as long as they exist in critical habitat without onsite countermeasures that consider natural functions and processes.

Adding together all of the adverse and beneficial effects associated with this proposed action, the environmental baseline, and the cumulative effects; and taking into account the status of the species and critical habitat in the action area, the proposed levee repairs are not expected to appreciably reduce the likelihood of survival or recovery of the listed species examined in the opinion because it is anticipated only a few individuals of each population will experience severe adverse effects from the implementation of the proposed action. The adverse effects to CCV steelhead and sDPS green sturgeon critical habitats caused by the proposed action are expected to be similar to those experienced through the current degraded state of the region, and since the proposed action is designed to perpetuate the status quo, it is not expected to measurably diminish the value of critical habitats. Though adverse habitat effects will continue into the future, the potential reduction in numbers is anticipated to be small compared to the total populations over their entire range.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and their critical habitats, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS's biological opinion that the proposed action is not likely to jeopardize the continued existence of CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon or destroy or adversely modify the designated critical habitats of 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:

- Harassment: CCV steelhead juveniles, CV spring-run Chinook salmon adults, and adult sDPS green sturgeon are expected to be harassed through impairment or alteration of essential behavior patterns relating to migration, rearing, feeding, and sheltering during general construction and vibratory pile driving. A low number of individual fish are expected to be using these waterways during these activities. While individual fish will be present in the action area, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken per species as a result of these activities. This is due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, variability of individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates those elements of the proposed action that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring. Therefore, a surrogate of the extent of the waterway experiencing elevated underwater sound will be used to express the incidental take of listed fish anticipated from general construction and vibratory pile driving. Noise and vibrations associated with general construction are expected to extend to a shorter distance when compared to in-water vibratory pile driving effects (RMS (dB) ≥150) out to a 100 meter radius from the construction/pile driving location and throughout the water column (from the surface to the river bottom). Elevated underwater sounds (RMS (dB) ≥150) created by pile driving that would result in incidental take of listed fish are not expected to occur outside of a 100 meter radius beginning from the pile driving location in the waterway. Underwater sound exceeding 150 dB_{RMS} beyond 100 meters from the pile driving location will be considered exceeding this ecological surrogate for the amount or extent of incidental take anticipated from vibratory pile driving.

- Trap/capture/collection/wound/kill: CCV steelhead and CV spring-run Chinook juveniles are expected to be trapped, then captured/collected during "fish rescue" activities before pumping water from the cofferdam to allow in-the-dry construction (sDPS green sturgeon are not expected to be captured within the cofferdam due to larger adult/sub-adult sizes and would not require fish rescue measures). It is also expected that CCV steelhead and CV spring-run Chinook juveniles would be wounded or killed during the course of the fish rescue described above, despite best intentions. Netting, electrofishing, and handling

may out right kill a juvenile accidentally (including via shock and stress), or minor wounds may negatively affect an individual's ultimate survivorship through increased susceptibility to predation or infection after release. A low number of salmonid juveniles are expected to use the waterways during these activities. While individual fish will be present in the action area, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken per species as a result of these activities. This is due to the variability associated with the response of listed species to the effects of the proposed action, the varying population size of each species, 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, the number of juveniles that experience mortality over the course of fish capture, handling, and relocation should be no more than 2% of the total number of juvenile salmonids encountered during these activities, given that the staff that execute the fish rescue are sufficiently trained and skilled enough to properly handle salmonids. Therefore, the incidental take associated with cofferdam dewatering and "fish rescue" is anticipated to result in no more than 2% mortality of the total number of juvenile salmonids encountered during these activities, and exceeding this level of mortality for these activities will be considered exceeding the amount or extent of incidental take anticipated from dewatering and "fish rescue."

- Harm: Harm is expected to CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon through localized habitat degradation, perpetuated by the repair of the levee system using hard bank stabilization tactics known to degrade the migration, rearing, feeding, and sheltering functionality of the habitat. Harm will persist over the long-term. While individual fish will be present in the action area, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken per species as a result of the proposed action. This is due to the variability associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. The amount of area affected by the repairs is used in the ratio estimating the amount of conservation credits required to offset the unavoidable negative impacts of the proposed action on listed species from localized habitat degradation. Therefore, an ecological surrogate of area repaired will be used to express the incidental take of listed fish anticipated by localized habitat degradation. The ecological surrogate for localized habitat degradation is the acreage of the footprint presented in USACE's project description for each of the repair sites described in this opinion. If the actual foot print of the repairs exceeds the acreage presented in USACE's project description for any of the repair sites described in this opinion, then the proposed action will be considered exceeding the ecological surrogate for the amount or extent of incidental take anticipated from localized habitat degradation. This ecological surrogate will function as an effective reinitiation trigger, because this opinion applies to a batch of several repair sites. The proposed action will be considered exceeding the ecological surrogate and reinitiation of consultation will be required if the actual foot print of the repairs exceeds the acreage presented in USACE's project description for any of the repair sites described in this opinion.

If any incidental take level or ecological surrogate described above in this section is exceeded, USACE must halt onsite construction activities and contact NMFS within 24 hours to reinitiate this consultation before proceeding.

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" (RPMs) 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 USACE, its applicant, or their contractors, to minimize the extent of take of CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon, related both to direct and indirect adverse effects of the action, as discussed in this opinion.

2. Measures shall be taken by USACE, its applicant, or their contractors, to reduce the extent of degradation and alteration to the critical habitats of CCV steelhead and sDPS green sturgeon, related both to direct and indirect adverse effects of the action, as discussed in this opinion, because that degradation and alteration of critical habitats is expected to decrease the survival and success of these species in the action area and result in incidental take of these species associated with the proposed action.

3. The USACE, its applicant, or their contractors shall prepare and provide NMFS with updates, reports, and monitoring plans concerning the proposed levee repairs, as they relate to:

    a. The implementation and performance of onsite AMMs and BMPs that help to achieve RPMs 1 & 2.

    b. Incidental take limits:

        i. Fish rescue plans and resulting take (number captured, injured, killed).

        ii. Onsite observations of CCV steelhead, CV spring-run Chinook salmon, or sDPS green sturgeon.

    c. The invoice associated with the mitigation bank purchases concerning NMFS species made by USACE or its applicants for this project.

2.9.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and USACE or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM 1:

    a. The general construction work window shall be limited to April 1st through November 1st.

        i. Per section 1.3.3.1 AMM 2, in-water or general construction outside of the above work windows may proceed if local in-river water temperatures exceed 75°F for at least seven consecutive days and USACE confirms the water temperature readings with NMFS staff before beginning work.

    b. Daily construction work hours shall be limited to 0800 to 1800 hours or one hour after sunrise to one hour before sunset.

    c. Before fish rescue occurs, USACE or its contractors shall draft a fish rescue plan that identifies:

        i. appropriate release locations for each repair site,

        ii. the target water temperatures for holding containers,

        iii. the qualified fish biologists that will be conducting the fish capture/rescue,

        iv. the methods that will be used to capture the fish,

        v. the other gear that will be used in association with the fish rescue besides the capture equipment (i.e., number and size of buckets, nets, aerators, water thermometers, etc.), and

        vi. the maximum holding time allowable before fish release.

    d. USACE or its contractors shall submit the fish rescue plan to NMFS at least 5 days before fish capture/rescue activities begin.

    e. During the fish rescue/relocation, the contracted fish biologist shall keep track of and report the number of each listed species of fish handled, their approximately life stage, and observations of injuries or mortalities.

    f. The fish rescue plan shall reference and incorporate NMFS electrofishing guidelines (NMFS 2000):

https://www.westcoast.fisheries.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf

g. Dewatering pump intakes shall be screened with mesh and checked periodically during dewatering for juvenile salmonids that may become impinged.

h. Water pumps shall maintain flows of 0.2 feet per second or less when dewatering areas suspected of containing listed fishes.

i. A USACE representative shall be designated as the point of contact for the project in case take of CV spring-run Chinook salmon, CCV steelhead, or sDPS green sturgeon occurs. This representative shall be identified to all onsite construction employees during an orientation conducted by a qualified fish biologist.

j. USACE shall notify NMFS within 24 hours if any CV spring-run Chinook salmon, CCV steelhead, or sDPS green sturgeon are found dead or injured, including during fish rescue/relocation.

   i. Notification shall include the date, time, location, and a photograph of the fish, with the name and agency/affiliation of the individual who found the fish.

   ii. If the fish is dead, its carcass shall be retained with associated information until transfer to a NMFS representative can be made. The carcass shall be preserved to the extent possible immediately (e.g., bagged in a cooler with abundant ice, refrigerated, or frozen, as the situation allows).

   iii. If mortality associated with fish rescue/relocation exceeds 2% of the total number of listed species of fish handled, USACE shall immediately contact NMFS and all capture activities shall cease, except:

      1. If fish are believed to be entrapped or are still being held before release, equipment shall be used to reconnect the ponded area to the river and all held fish shall be immediately released into the river to limit the occurrence of additional fish mortalities.

2. The following terms and conditions implement RPM 2:

   a. Vegetation removal and disturbance shall be minimized to the extent practicable, and no trees shall be removed.

   b. Disturbed and bare topsoil shall be reseeded with native grasses to reduce erosion after levee repair is complete.

   c. Soil mixtures shall be placed to facilitate re-vegetation at the levee repairs sites.

   d. Placement of filter fabric shall be kept to a minimum and filter fabric shall be a natural, biodegradable mesh fiber, not made of plastic.

e. Riprap and hard slope protection installation shall be not exceed the spatial extent that existed at the repair locations before the levees were damaged.

f. An in-river turbidity curtain shall be installed and assessed regularly to ensure its ability to control and contain project-related sediment disturbance and mobilization during pile driving, cofferdam installation and removal, and rock/slope protection placement, and dewatering activities.

g. USACE and its contractors shall follow and remain in compliance with all federal, state, and local laws and regulations relating to erosion and sediment control, including:

i. Installing and checking temporary and permanent erosion/sediment control BMPs onsite (temporary measures shall be removed after the area is stabilized and construction is complete).

ii. Creating a SWPPP to control and treat project-created stormwater during the construction period, keeping the SWPPP onsite, and referencing periodically to the SWPPP to ensure proper execution onsite.

3. The following terms and conditions implement RPM 3:

a. Reports on fish rescue/relocation efforts shall be submitted to NMFS within 48 hours of capturing and handling a listed species if no fish mortalities or injuries occur. If fish mortalities or injuries occur, notifications shall be made to NMFS as provided in term and condition 1.j.

b. USACE or its applicants shall provide NMFS with the invoice(s) associated with the mitigation bank purchase(s) of compensatory credits proposed to offset the impacts of the levee repairs when transactions are complete.

c. Updates, reports, and monitoring plans relating to RPM 3a shall be provided to NMFS by the end of the fiscal year in which the levee repair was complete.

d. Reports and updates shall be sent to:

Erin Strange
San Joaquin River Basin Branch Chief
NOAA Fisheries
650 Capitol Mall, Suite 5-100,
Sacramento, California 95814
erin.strange@noaa.gov

2.10. Conservation Recommendations

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

- Adhere to a work window between **June 1st through October 15th** to avoid most interactions with CCV steelhead, CV spring-run Chinook, and sDPS green sturgeon that may use these areas. Doing so will help avoid overlapping project construction activities with peak fish use time periods of the action area.

- Place large wood material/debris below the OHWM within project jurisdiction footprint to create shade and resting areas anchored in the river beds of the SJR and Calaveras River, increasing local habitat heterogeneity. Doing so would likely increase the survival of out-migrating juvenile salmonids that use these waterways and increase the value of their critical habitat.

- Fill voids in riprap/revetment placed below the OHWM with native gravels to reduce or prevent the creation of habitat conducive to ambush predation on juvenile salmonids. Doing so would likely increase the survival of out-migrating juvenile salmonids that use these waterways and avoid decreasing the value of their critical habitat.

- Plant native riparian vegetation (e.g., willows) in the revetment at and above the OHWM to increase bank stabilization, river margin shading, and leaf litter inputs. Doing so would likely increase the value of salmonid critical habitat by increasing local habitat heterogeneity and increase local salmonid prey abundance, promoting listed salmonid recovery over the long term.

- Prioritize and continue to support actions that set levees back from rivers and, in instances where this is not technically feasible, land-side levee repairs should be pursued instead of waterside repairs. Setting back levees, or allowing rivers to naturally widen by only performing landside repairs, would increase the availability of floodplain habitat, which is currently limited but an important component of CCV steelhead critical habitat. Doing so would increase the recovery probability of the CCV steelhead DPS and CV spring-run Chinook salmon ESU through improved juvenile rearing conditions.

- Purchase compensatory mitigation credits to address impacts to sDPS green sturgeon foraging habitat, when they become available. Placement of hard revetment below the OHWM decreases sturgeon feeding areas in their critical habitat. There are several conservation or mitigation banks approved by NMFS with service areas that include the action area considered in this opinion; however, mitigation bank credits are not currently available for sDPS green sturgeon.

2.11. Reinitiation of Consultation

This concludes formal consultation for the 2018/2019 SJR PL 84-99 Emergency Levee Repair Sites.

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

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT 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. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the Action Agency to conserve EFH.

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

3.1 Essential Fish Habitat Affected by the Project

The geographic extent of Pacific Coast 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 18040011 Upper Calaveras and 18040003 San Joaquin Delta HUCs 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) as complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation. The HAPCs that would be adversely affected by the proposed action include: complex channel and floodplain habitat.

3.2 Adverse Effects on Essential Fish Habitat

3.2.1 Floodplain alteration

(Pacific Coast salmon EFH, Complex Channel & Floodplain HAPC)

Many river valleys in the west were once marshy and well vegetated, filled with mazes of floodplain sloughs, beaver ponds, and wetlands. Salmon evolved within these systems. Juvenile salmon can spend large portions of their fresh water residence rearing and over-wintering in floodplain environments and riverine wetlands. Spring-run Chinook salmon may spend up to a year rearing in freshwater and will rely on floodplains for refuge during flood conditions, and access to such floodplain refuge improves overall growth and fitness of Chinook salmon (Sommer *et al.* 2001). Salmon survival and growth are often better in floodplain channels, oxbow lakes, and other river-adjacent waters than in mainstream systems (National Research Council 1996). Additionally, floodplains and wetlands provide other ecosystem functions important to salmonids such as regulation of stream flow, stormwater storage and filtration, and

often provide key habitat for beavers (that in turn may provide instream habitat benefits to salmon from their active and continual placement of wood in streams).

The construction areas/sites for this project no longer offer substantial floodplain habitat HAPCs since the SJR has been leveed for flood protection prior to this proposed project, and this levee repair project will perpetuate these adverse effects into the future.

3.2.2 Bank stabilization and protection actions

(Pacific Coast salmon EFH, Complex Channel & Floodplain HAPC)

The alteration of riverine and estuarine habitats due to bank and shoreline stabilization, and protection from flooding events, can result in varying degrees of change in the physical, chemical, and biological characteristics of the existing shoreline and riparian habitats that support Pacific salmon. Armoring of shorelines to prevent erosion and maintain or create shoreline real estate simplifies habitats, reduces the amount of complex freshwater and intertidal habitats by design, and affects nearshore processes and the ecology of a myriad of species (Williams and Thom 2001). The physical, chemical, and biological processes driving the riverine ecosystem are often not correctly considered in bank stabilization and shoreline protection project designs (Beechie *et al.* 2010) and frequently result in alterations of stream flows and temperatures and reduction of the heterogeneity of rearing habitat, while also eventually requiring routine repairs. These physical changes can also decrease the effectiveness of salmon habitat restoration efforts (Beechie *et al.* 2005).

These levee repairs and placement or replacement of riprap and hard armoring on the leveed bank will cause negative associated effects to habitat functionality and individual salmon and are discussed in Section 2.5 of the biological opinion and above. Though the Calaveras River and SJR mainstem banks to be riprapped under this proposed action are already leveed, the addition and replacement of hard stabilization methods already in use make it unlikely that this area will ever be set-back or restored to be more beneficial to Chinook salmon rearing.

See section 2.5 of the ESA portion of the opinion for more details on the potential adverse effects of this project.

3.3 Essential Fish Habitat Conservation Recommendations

The species managed under the Pacific Coast salmon that may be affected by this project are: Chinook salmon, *O. tshawytscha*, including fall-run, late fall-run, and spring-run. Fall-run and late-fall run Chinook salmon are known to migrate and spawn throughout the SJR basin, and spring-run Chinook salmon are being reintroduced to the SJR below Friant Dam by the SJRRP. Either run may use these areas as rearing juveniles, and adults will be migrating past these sites to spawning grounds upstream. Juveniles from both runs are known to grow and rear in the lower SJR/Delta. The EFH of Chinook salmon is adversely effected by the proposed project through the pathways identified above: floodplain alteration and bank stabilization/levee protection.

Floodplain Alteration effects: As previously stated, much of the floodplain rearing habitat in the CCV has already been highly altered and its functionality has been greatly reduced. As such, the preservation and enhancement of any remaining floodplain is crucial to maintain the ability of

Pacific Coast salmon to naturally rear in the CCV. In general, to support the floodplain HAPC, USACE should promote the restoration of degraded floodplains and wetlands, including in part, reconnecting rivers with their associated floodplains and wetlands. Some of these concerns are addressed through ESA consultation RPM's 1-3. In addition, the following EFH Conservation Recommendations (CRs) are intended to address the adverse effects of floodplain alteration:

1. Protect existing riparian vegetation, and wherever practicable, establish new vegetated zones of appropriate width at and above the OHWM on all permanent and ephemeral streams that include or influence EFH and are affected by the proposed action. To address the impacts of this project in particular, plant new individuals of appropriate native species like willows in the riprap and disturbed areas to increase bank cover and shade at the water line and above (Complex Channel and Floodplain HAPC).

2. While repairing the levees in the action area, attempt to set back the levees wherever possible to begin reclaiming historical floodplain areas and allow for natural stream processes to shape natural riverine habitat. (Floodplain HAPC).

Bank Stabilization effects: The placement of riprap associated with this project is likely to reduce the remaining suitable rearing areas for Pacific Coast salmon by introducing hard artificial elements while simultaneously preventing future restoration of the immediate area and creating piscivorous predator ambush habitat. Some of these concerns are addressed through ESA consultation RPM's 1-3. In addition, the following EFH CRs are intended to address the adverse effects of bank stabilization:

3. Use vegetative or "soft' bank erosion control methods such as beach/shoreline nourishment, vegetative plantings, and placement of large woody debris to help anchor the levee rather than the currently proposed shoreline modifications, as feasible. Hard bank protection should be used as a last resort and the following options should be explored before selection (tree revetments, stream flow deflectors, and vegetative riprap). Develop design criteria based on site-specific geomorphological, hydrological and sediment transport processes appropriate for the stream channel for any stabilization, protection and restoration projects (Complex Channel and Floodplain HAPC).

4. Replace lost in-stream fish habitat in homogenous river stretches in the construction areas by providing root wads and deflector logs below the stabilized bank, and by planting shaded riverine aquatic cover vegetation, as part of bank revitalization during the stabilization actions in a way that reduces the likelihood of scour caused by long-term stormwater discharge (Complex Channel HAPC).

5. Fill voids in riprap with smaller boulders and/or gravel to fill up the potential ambush habitat created by placing riprap (Complex Channel and Floodplain HAPC).

Full implementation of these EFH CRs will help avoid or offset the expected negative impacts described in section 3.2 above for the SJR PL 84-99 levee repairs proposed by the USACE for completion in 2018 – 2020, and would protect approximately 17.5 acres of designated EFH for Pacific Coast salmon.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, USACE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH CR. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS's EFH CRs unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the CRs, 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 CRs accepted.

3.5 Supplemental Consultation

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

4. FISH AND WILDLIFE COORDINATION ACT

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

The following recommendations apply to the proposed action:

- Examine alternative methods of river bank stabilization to riprap and hard armoring, proven to both control erosion along shorelines and also reduce or eliminate negative effects on wildlife, especially fish. Consider the adverse effects of hard armoring on fish and wildlife as much as the effectiveness and long-term functionality of potential repair designs. In addition, consider that traditional repair tactics have failed in those locations to the point of requiring repair.
- Begin incorporating more natural bank stabilization methods into practice for levee repair actions, such as those described in "Engineering with Nature: Alternative Techniques to Riprap Bank Stabilization" (FEMA 2009). Many of these methods focus on maintaining their integrity by using plantings and sediment deposition to reinforce their functionality in the long-term.
- If authorizing laws or agency policies curtail or prohibit the adoption and use of alternative bank stabilization methods, begin the process of seeking authority or amending or modifying policies to include a vetting and adoption process for new, viable engineering techniques to enable their employment when appropriate, so that fish and wildlife conservation may receive equal consideration in USACE levee repair deliberations.

Adopting more natural bank stabilization methods as opposed to traditional hard armoring techniques is expected to control and minimize bank erosion, stream migration, and flooding near human populations and properties while decreasing the negative environmental effects by allowing for more natural riverine processes, decreasing water speed along the armored reach, filtering pollutants from surface runoff, trapping and holding sediments to the point of actually rebuilding banks, and increasing the functionality of aquatic shoreline habitats.

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

This concludes the FWCA portion of this consultation.

5. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The 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.

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is USACE. Other interested users could include the citizens of affected areas or others members of the public interested in the conservation of the affected ESUs/DPSs. Individual copies of this opinion were provided to the USACE. The document will be available on-line through the NOAA Institutional Repository after approximately two weeks. The format and naming adheres to conventional standards for style.

5.2 Integrity

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

5.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

6. REFERENCES

Abatzoglou, J. T. and A. P. Williams. (2016). Impact of anthropogenic climate change on wildfire across western US forests. Proc Natl Acad Sci U S A 113(42):11770-11775.

Ainslie, B. J., J. R. Post, and A. J. Paul. (1998). Effects of Pulsed and Continuous DC Electrofishing on Juvenile Rainbow Trout. North American Journal of Fisheries Management 18(4):905-918.

Allen, C. D., A. K. Macalady, H. Chenchouni, D. Bachelet, N. McDowell, M. Vennetier, T. Kitzberger, A. Rigling, D. D. Breshears, E. H. Hogg, P. Gonzalez, R. Fensham, Z. Zhang, J. Castro, N. Demidova, J.-H. Lim, G. Allard, S. W. Running, A. Semerci, and N. Cobb. (2010). A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. Forest Ecology and Management 259(4):660-684.

Beechie, T. J., C. N. Veldhuisen, E. M. Beamer, D. E. Schuett-Hames, R. H. Conrad, and P. DeVries. (2005). Monitoring treatments to reduce sediment and hydrologic effects from roads. Pages 35-65 *in* Monitoring streams and watershed restoration, P. Roni, editor. American Fisheries Society, Bethesda, Maryland.

Beechie, T. J., D. A. Sear, J. D. Olden, G. R. Pess, J. M. Buffington, H. Moir, P. Roni, and M. M. Pollock. (2010). Process-based Principles for Restoring River Ecosystems. BioScience 60(3):209-222.

Bjornn, T. C. and D. W. Reiser. (1991). Habitat Requirements of Salmonids in Streams. Page 56p *in* Influences of Forest and Rangeland Management of Salmonid Fishes and their Habitat, W. R. Meehan, editor. American Fisheries Society.

Breitler, A. (2017). Fish out of (normal) water: Rare sturgeon seen in Stanislaus River. Recordnet.com.

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

California Department of Fish and Wildlife (CDFW). (2018). Grandtab: Chinook Salmon Escapement - Spring Run. F. B. A. Assessment.

CDFW and NMFS. (2018). DRAFT Emergency Action Plan for Central Valley Spring-run Chinook Salmon in Mill and Deer Creeks. Joint Effort between the California Department of Fish and Wildlife and the National Marine Fisheries Service California Central Valley Office, 91 pp.

California Department of Transportation (Caltrans). (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.

Caltrans. (2015). Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Division of Environmental Analysis, California Department of Transportation. CTHWANP-RT-15-306.01.01., Sacramento, California.

Caltrans. (2019). Hydroacoustics. http://www.dot.ca.gov/env/bio/hydroacoustics.html.

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.

Dettinger, M. D. (2005). From climate-change spaghetti to climate-change distributions for 21st Century California. San Francisco Estuary and Watershed Science 3(1):Article 4.

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

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

Federal Emergency Management Agency (FEMA). (2009). Engineering with Nature: Alternative Techniques to Riprap Bank Stablization. D. o. H. S. Federal Emergency Management Agency, 36 pp.

Franks, S. (2014). Possibility of Natural Producing Spring-Run Chinook Salmon in the Stanislaus and Tuolumne Rivers (Unpublished). Sacramento, CA, Central Valley Office.

Fresno Council of Governments. (2012). San Joaquin Valley Demographic Forecasts 2010 to 2050.

Gisiner, R. C. (1998). Workshop on the effects of anthropogenic noise in the marine environment proceedings 10 - 12 February 1998. Page 145p. Office of Naval Research.

Good, T. P., R. S. Waples, and P. Adams. (2005). Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Department of Commerce, 598 p pp.

Gruber, J. J., Z. J. Jackson, and J. P. Van Eenennaam. (2012). 2011 San Joaquin River sturgeon spawning survey. U. F. a. W. Service, 28 pp.

Habera, J. W., R. J. Strange, B. D. Carter, and S. E. Moore. (1996). Short-Term Mortality and Injury of Rainbow Trout Caused by Three-Pass AC Electrofishing in a Southern Appalachian Stream. North American Journal of Fisheries Management 16(1):192-200.

Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, and S. T. Lindley. (2008). Migration of green sturgeon, Acipenser medirostris, in the Sacramento River. Environmental Biology of Fishes 84(3):245-258.

Jackson, Z. J., J. J. Gruber, and J. P. Van Eenennaam. (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.

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

McClure, M. (2011). Status review update for Pacific salmon and steelhead listed under the ESA: Pacific Northwest. . Climate Change. In M.J. Ford (Ed.), 281 pp.

McClure, M. M., M. Alexander, D. Borggaard, D. Boughton, L. Crozier, R. Griffis, J. C. Jorgensen, S. T. Lindley, J. Nye, M. J. Rowland, E. E. Seney, A. Snover, C. Toole, and V. A. N. H. K. (2013). Incorporating climate science in applications of the US endangered species act for aquatic species. Conserv Biol 27(6):1222-1233.

McCullough, D. A., S. Spalding, D. Sturdevant, and M. Hicks. (2001). Summary of technical literature examining the physiological effects of temperature on salmonids - Issue Paper 5., United States Environmental Protection Agency. Report No. EPA-910-D-01-005.

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

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

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

National Research Council. (1996). Upstream: Salmon and Society in the Pacific Northwest. National Academy of Sciences, Washington, D. C.

Natural Resources Defense Council, et al., v. Kirk Rodgers as Regional Director of the United States Bureau of Reclamation, et al. (2006). Notice of Lodgment of Stipulation of Settlement and Stipulation of Settlement filed in United States District Court, Eastern District of California, Sacramento Division.

NMFS. (2000). Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act. N. M. F. S. Department of Commerce, 5p pp.

NMFS. (2008). NMFS Pile Driving Calculations Excel. http://www.dot.ca.gov/env/bio/docs/bio-nmfs-pile-driving-calculations.xls.

NMFS. (2014). Recovery plan for the Evolutionarily Significant Units of Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon and the Distinct

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

NMFS. (2015). 5-year review: Summary and evaluation of the southern Distinct Population Segement of the North American green sturgeon (Acipenser medirostris). National Marine Fisheries Service. West Coast Region, 42p pp.

NMFS. (2016a). 5-year review: Summary and evaluation of California Central Valley steelhead Distinct Population Segment. National Marine Fisheries Service. West Coast Region.

NMFS. (2016b). 5-year review: Summary and evaluation of Central Valley spring-run Chinook salmon Evolutionarily Significant Unit. National Marine Fisheries Service. West Coast Region.

NMFS. (2016c). Endangered Species Critical Habitat Maps: Central Valley spring-run Chinook Salmon. http://www.westcoast.fisheries.noaa.gov/publications/gis_maps/maps/salmon_steelhead/critical_habitat/chin/chinook_cvsr.pdf.

NMFS. (2018). Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (Acipenser medirostris). Sacramento, CA, Central Valley Office.

NMFS. (2019). FY 2019 San Joaquin River Spring-run Technical Memorandum - Final. Sacramento, California.

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

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

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

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

Radtke, L. D. (1966). Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta with observations on food of sturgeon. 136.

Reclamation. (2015). Sacramento and San Joaquin Basins Study, Report to Congress 2015. Prepared by CH2M Hill, Contract No.R12PD80946, US Department of the Interior, Bureau of Reclamation, Mid-Pacific Region.

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

SJRRP. (2017a). Fisheries Framework: Spring-run and Fall-run Chinook Salmon., 107 pp.

SJRRP. (2017b). Restoration Flow Guidelines Version 2.0. San Joaquin River Restoration Program.

SJRRP. (2018). Background and History: San Joaquin River Restoration Settlement. http://www.restoresjr.net/about/background-and-history/.

SJRRP. (2019). Restoration Flows. http://www.restoresjr.net/restoration-flows/.

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.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. (2001). Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58(2):325-333.

State Water Resources Control Board. (2006). Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. California Environmental Protection Agency, 60p pp.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. (2004). Changes in snowmelt runoff timing in western North America under a 'business as usual' climate change scenario. Climatic Change 62:217-232.

Stillwater Sciences. (2004). Lower Calaveras River Chinook salmon and Steelhead limiting factors analysis. First Year Report (Revised).

SWRCB. (2016). Draft revised substitute environmental document in support of potential changes to the water quality control plan for the Bay-Delta: San Joaquin River flows and southern Delta water quality. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2016_sed/.

United States Fish and Wildlife Service & National Marine Fisheries Service. (1998). Endangered Species Act Section 7 Consultation Handbook. Fish and Wildlife Service and the National Marine Fisheries Service.

USACE. (2019). Regulatory In-lieu Fee and Bank Information Tracking System: North Delta Fish Conservation Bank. https://ribits.usace.army.mil/ribits_apex/f?p=107:10:15788110069445::NO::P10_BANK_ID:3013.

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

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

Wardle, C. S., T. J. Carter, G. G. Urquhart, A. D. F. Johnstone, A. M. Ziolkowski, G. Hampson, and D. Mackie. (2001). Effects of seismic air guns on marine fish. Continental Shelf Research 21(8-10):1005-1027.

Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. (2006). Warming and earlier spring increase western U.S. forest wildfire activity. Science 313(5789):940-943.

Westervelt Ecological Services. (2008). Bank Enabling Instrument Bullock Bend Mitigation Bank. 38p pp.

Westervelt Ecological Services. (2009). Bank Enabling Instrument: Cosumnes Floodplain Mitigation Bank. 40p pp.

Wildlands and Reclamation. (2013). North Delta Fish Conservation Bank Conservation Bank Enabling Instrument. 43p pp.

Wildlands, Inc. (2006). Central Valley Anadromous Salmonid Umbrella Conservation Bank Agreement. NOAA's National Marine Fisheries Service, 23p pp.

Wildlands. (2010). Liberty Island Conservation Bank Agreement. NMFS, USFWS, and CDFW, 48p pp.

Wildlands. (2019). Wildlands Mitigation Projects: North Delta Fish Conservation Bank. https://www.wildlandsinc.com/banks/north-delta-fish-conservation-bank-ls/.

Williams, G. D. and R. M. Thom. (2001). Marine and Estuarine Shoreline Modification Issues White Paper. Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation.

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