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-2018-00238**

**May 22, 2019**

Rain L. Emerson
Chief, Environmental Compliance Branch
South-Central California Area Office
Bureau of Reclamation
1243 N Street
Fresno, California 93721

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Merced River Instream and Off-Channel Habitat Rehabilitation Project.

Dear Mr. Emerson:

Thank you for your letter on November 8, 2018, requesting initiation of consultation with the National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) for the Merced River Instream and Off-Channel Habitat Rehabilitation Project.

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

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

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

Please contact Savannah Bell at savannah.bell@noaa.gov or at (916)930-3721 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-SA00487

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

Merced River Instream and Off-Channel Habitat Rehabilitation Project

National Marine Fisheries Service Public Tracking Consultation Number: WCRO-2018-0238

Action Agency: Bureau of Reclamation

Affected Species and NMFS' Determinations:

| ESA-Listed Species | Status | Is Action Likely to Adversely Affect Species? | Is Action Likely To Jeopardize the Species? | Is Action Likely to Adversely Affect Critical Habitat? | Is Action Likely To Destroy or Adversely Modify Critical Habitat? |
|---|---|---|---|---|---|
| California Central Valley steelhead (*Oncorhynchus mykiss*) | 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**: **May 22, 2019**

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# 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.

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at the Sacramento NMFS office.

## 1.2 Consultation History

On November 8, 2018, NMFS received a letter requesting formal consultation from the Bureau of Reclamation for the Merced River Instream and Off-Channel Habitat Rehabilitation Project (Project).

On November 28, 2018, NMFS requested more information from Reclamation on length of the action agency.

On November 29, 2018, Reclamation replied to request for more information. This was sufficient information to initiate consultation.

NMFS initiated consultation on November 29, 2018, however, the consultation was held in abeyance for 38 days due to a lapse in appropriations and resulting partial government shutdown. Consultation resumed on January 28, 2019

## 1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The overall vision of the Proposed Project is to restore (rehabilitate/enhance) habitat for native fish species particularly during drought conditions, emphasizing spawning and rearing habitat for CV salmonids. The Proposed Project aims to protect, improve, and restore riverine habitat, including benefits to fish, wildlife, vegetation, and water quality, includes several components, and incorporates multiple strategies to meet goals of the USFWS Anadromous Fish Restoration Program (AFRP). These goals include long-term habitat restoration for CV fall-run salmonid populations in the Merced River, including augmenting appropriate spawning substrate for these species, and recovering side channel and floodplain habitats that support juvenile salmonid growth and survival (USFWS 2001). The specific goals and objectives of this restoration project are to: 1) augment, rehabilitate, and enhance productive lower Merced River juvenile salmonid rearing habitat and adult spawning habitat that is resilient to drought conditions, 2) enhance juvenile salmonid access to historic floodplain habitat, 3) reduce main channel habitats potentially conducive to invasive fish species, 4) create additional flooding capacity, improving flood management in wet years, and 5) determine whether the implemented project had the desired effect on target species and overall system health.

### *1.3.1 Project Construction*

The Proposed Project would take place in the Merced River approximately 1,500 feet below Crocker-Huffman Diversion Dam, which is the extent of anadromy, over a two year period. The Proposed Project would re-grade and rehabilitate 6.74 acres of tailings pile upland habitat, 7.49 acres of main channel salmonid rearing and spawning habitat, and 3.35 acres of seasonally inundated juvenile rearing habitat within the Action Area of the Merced River. Pre-project sediment surveys within the site determined that the dredger tailings piles adjacent to the river channel contained large quantities of gravel and cobble that could be obtained by sorting the excavated material. The sorted gravel and cobble could then be used for river channel rehabilitation including salmonid spawning gravel augmentation.

Approximately 65,000 yd3 (~49,696 m3) of native gravel and cobble obtained by excavating and sorting dredger tailings adjacent to the river channel would be used to rehabilitate the channel morphology within the site including gravel bar creation and to create or enhance salmonid spawning riffles. The river rock would be placed in select areas in the main channel to enhance/create 1.7 acres (0.69 ha) of salmonid spawning habitat and increase water surface elevation to facilitate inundation of the floodplain and side channels created through removal of the dredger tailings piles. The enhanced/created spawning riffles would consist of 5 – 10 inch diameter (12.7 – 25.4 centimeter [cm]) cobbles used to build up base layer and stabilize the toe of spawning riffles and 1⁄4 – 5 inch diameter (0.6 – 12.7 cm; per AFRP specifications) gravel that would be placed 2 – 3 ft (0.6 – 0.9 m) deep.

An approximately 2.33-acre perched floodplain area on the north side of the river would be re-graded by 1-10 ft (0.3 – 3.0 m) in elevation, allowing it to inundate at flows greater than 900 cubic feet per second (cfs). A total of 1.22 acres and 1,030 ft (314 m) of side channels would be created on the reclaimed north floodplain. Side channels totaling 1.02 acres and 1,000 ft (304.8 m) would be created on the south side of the river through the remnant point bar. The floodplain and side channel excavation would require no in-channel work, as construction would occur when flows are lower than the features are designed to inundate.

Gravel and cobble would be deposited in-stream and placed by rubber-tired front-end loaders (Caterpillar 950 Loader). To minimize any potential negative effects on salmonids, in-stream gravel placement activities would occur during summer/early fall (15 July to 15 October) when flows are low (approximately 200 cfs) and active salmonid spawning is not occurring.

Construction would occur over two seasons and would require approximately 16 weeks per season, with in-stream construction requiring approximately 10 to 20 days per season. Work would occur Monday – Friday from 7:00 am to 5:00 pm to ensure minimal disturbance to the environment.

The strategy for instream gravel replenishment is based on an understanding of the existing channel bed topography and is intended to re-create channel bedforms to enhance salmonid spawning. Gravel would be placed using designs from the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) developed by the University of California at Davis (Wheaton et al. 2004 a, b, Pasternack 2008, Sawyer et al. 2009), and general rearing habitat components. Any trees removed during restoration activities would be used within the created floodplains and side channels as large woody material habitat elements. The trees would be strategically placed in the floodplains and side channels to provide cover and habitat complexity for rearing juvenile salmonids.

Native trees, such as Fremont cottonwood (*Populus fremontii*), oak (*Quercus* spp.), and willow (*Salix* spp.) with a diameter at breast height (dbh) of at least 12 in (15.2 cm) would be protected with buffers that extend to the canopy edge to avoid ground disturbance within the tree's drip line. To compensate for the removal of riparian shrubs and trees during implementation, the plans would identify tree and shrub species that would be planted, how, where, and when they would be planted, and measures taken to ensure a performance criteria of 70% survival of planted trees for a period of three consecutive years. The tree plantings would be of native tree species compensated for in the following manner:

- Oaks having a dbh of three to five inches would be replaced in-kind, at a ratio of 3:1, and planted during the winter dormancy period in the nearest suitable location to the area where they were removed. Oaks with a dbh greater than five inches would be replaced in-kind at a ratio of 5:1.

- Native riparian trees having a dbh of three to five inches would be replaced in-kind on site at a ratio of 3:1 and planted in the nearest suitable location to the area where they were removed.

After floodplain grading and gravel augmentation activities have been completed the disturbed areas would be revegetated with native riparian plants. Planting would occur in late November, which is the likely beginning of the winter storm season, to maximize survival rates. Exotic species present in the riparian area, including Himalayan blackberry (*Rubus armeniacus*), yellow starthistle (*Centaurea solstitialis*) and milk thistle (*Silybum marianum*), would be eradicated where possible.

The Proposed Project would excavate habitat features on the floodplain and use gravel and cobble sediments to rebuild the river bed. The floodplain design would create side channels where possible, and seek to preserve existing high quality biological resources such as wetlands and riparian trees. Once excavated sediments from the floodplain are sorted they would be used to rescale the current river channel geometry to better match the managed flow regime. The river bed would be graded to create mosaic alluvial river mesohabitat units (e.g. riffles, pools and bars) to increase main channel spawning, rearing, and holding habitat, while concurrently raising low-flow water levels to inundate the newly graded floodplain for off channel rearing habitat. The Proposed Project would increase the area of main channel bar edges, which juvenile salmonids use for rearing, particularly during drought years (Beechie et al. 2005). In drought years, when floodplains, side channels, and other off-channel rearing habitats are generally not inundated, juvenile salmonids use main channel bar edges for rearing (Beechie et al. 2005, Sellheim et al. 2015).

Spawning habitat increases are anticipated from rescaling the channel size to the current flow regime, as well as building riffles using appropriately-sized spawning gravels. Rescaling river geometry to better match the managed flow regime is a common enhancement approach in California’s regulated rivers. The Proposed project seeks to install greater topographic variation in created channel forms beyond a uniform bankfull channel, including riffles, pools and bars. These features would create the hydraulic conditions that vary considerable about average bankfull dimensions that are needed to support geomorphic and ecological processes (Brown et al., 2015; Brown and Pasternack, 2017).

### *1.3.2 Project Monitoring*

A detailed monitoring plan would be implemented with the primary goal of defining the current state of the system before restoration and determining whether the implemented project had the desired effect on target species and overall system health.

The monitoring program consists of four monitoring stages: 1) pre-project site description, 2) implementation, 3) effectiveness, and 4) validation. Pre-project monitoring helps identify the baseline for the project including the identification of deficiencies in ecosystem health and for detecting change over time. Implementation monitoring would determine if the project was constructed according to the design standards. Hydrology, topography and bathymetry, sediment dynamics, and vegetation would be assessed. Effectiveness monitoring would determine if the project was effective in meeting target physical and biological objectives. A range of physical and biological traits would be tracked before and after restoration to assess ecosystem function. Pre-project monitoring is essential for effectiveness monitoring because it establishes an objective baseline of ecosystem function with which to evaluate change caused by project implementation. Finally, validation monitoring would be conducted to substantiate the underlying assumptions of the restoration work and determine if restoration projects, like the Proposed project, recover productive habitat that promotes juvenile salmon salmonid growth and riparian vegetation recruitment. The monitoring efforts described in this plan would improve understanding of restored ecosystem function and the potential of restoring off-channel and floodplain rearing habitat to enhance salmonid populations within streams impacted by dam flow regulation and channel modification. Fish abundance, habitat use, and community composition would be determined at the site of the project and at control sites using field methods described below.

*Hydrology and Geomorphology*

Evaluating the changes in the Action Area's hydrology and geomorphology will be predominantly done using digital elevation models and 2 dimensional hydraulic models. Data needed to parameterize these models include topography and bathymetry surveys, riverbed substrate composition, and water surface elevations. Collecting these data will require in-water wading by staff to conduct survey work with survey-grade GPS equipment. Wading activities will likely be restricted during low-flow periods in late summer (i.e., July through September) when the presence of juvenile and adult salmonids is minimized due to the timing of their life cycles.

*Spawning Surveys*

Information on adult Chinook salmon spawning would be provided by ongoing CDFW escapement surveys in the Merced River and additional coordinated surveys by Crammer Fish Sciences (CFS). The CDFW surveys provide information on abundance and distribution of spawning fall-run Chinook salmon throughout the Merced River. The CFS team would conduct more focused redd and spawning surveys within the Action Area, in coordination with CDFW, which would include redd size and depth measurements and ambient conditions. These data would be used to map Chinook salmon spawning density and redd locations within the sampling sites before and after restoration. This information is critical to addressing hypotheses regarding enhanced spawning habitat productivity. Spawning surveys would be conducted every other week during the fall-run Chinook salmon spawning season (mid-October to January). GPS coordinates would be recorded using a GPS unit (Trimble GeoXT) for individual Chinook salmon redds.

*Snorkel Surveys*

Snorkel surveys would assess juvenile and adult salmonid abundance and use of the enhanced sites. Snorkeling methods would be consistent with other studies (Edmundson et al. 1968, Dolloff et al. 1996, Cavallo et al. 2004, Sellheim et al. 2016). Sample units would consist of transects that are approximately 35 to 75 meters long and distributed throughout the Action Area to capture the available habitat types within the Action Area and at upstream and downstream control locations. Units would be snorkeled by two or three divers moving upstream adjacent to each other for channel margin habitats and downstream for mid-channel habitats. Fish would be observed, identified, and enumerated as divers proceed through each sampling unit. Counts would be compiled for all divers and recorded as a total for each sample unit. Fish would be categorized by species and fork length size classes. Juvenile salmonid snorkel surveys would be conducted monthly from February through May. All surveys would be led by a crew member with training and experience conducting snorkel surveys. To minimize fish disturbance, surveyors attempt to limit fast or sudden movements and wear mud brown colored StreamCount drysuits. During snorkel surveys, two depth and velocity transects would be recorded along each channel margin at one third and two thirds of the unit length to represent conditions within each sample unit. At all locations where individuals or groups of juvenile salmonids are observed to be rearing, GPS coordinates would be taken using a GPS unit and the average water column velocity would be recorded.

*Video Surveys*

Video surveys would be used to assess habitat use, abundance, and behavior of juvenile salmonids in shallow water habitats such as side channels and channel margins. GoPro waterproof video cameras on a camera mount would be deployed within the Action Area and at unrestored control sites. The GoPro would be set to record for a specific amount of time and would then be retrieved. The recorded video would be reviewed in the lab.

*Juvenile Salmonid Seine Sampling*

A crew of two to four members would conduct beach seining for juvenile salmonids following the methods of Merz et al. (2015). Typically, three 50-m long seine hauls are performed at each sampling location, and up to 12 locations would be seined. A 4 ft x 50 ft beach seine with 0.125-inch mesh attached to 1 inch x 5 ft wood poles would typically be used; however, seine length and mesh size would vary depending on monitoring objectives and site-specific habitat characteristics. Lead weights would be used along the bottom line of the seine to keep in contact with the bottom, and floats would be attached to the top line to keep it near the waters' surface. Once the lead line approaches the shore it would be withdrawn up the shore so that fish are corralled in the bag of the seine and the lead line is on the shore. Fish from each beach seining haul would be stored in separate buckets filled with river water. Water in the buckets would be monitored to ensure that temperature remains within 2°C of the river water and dissolved oxygen (DO) is above 5 mg/l. Water would be replaced and aerators used, as necessary. Fish would be released at the capture location after all seine passes at the location have been performed and the fish have been processed and have recovered from processing. No seining would occur if water temperatures exceed 18°C. All non-target fish would be identified to species, enumerated, and released. All salmonids with a fork length greater than 50 mm would be anesthetized, measured, and weighed, while salmonids with a fork length less than or equal to 50 mm would only be anesthetized and measured.

*Fyke-Net Sampling*

Fyke-net sampling would only be performed during periods when the floodplain and/or side channels are inundated during the time period when juvenile salmonids would be present. Therefore, fyke nets would be deployed sometime between February and May. Floodplains are typically only inundated for several days to four weeks during flow events on the Merced River. The fyke net would be "fished" continuously during the period of floodplain/side channel inundation and then removed when the floodplain/side channel was no longer inundated. The fyke-net sampling would be used to test hypotheses related to whether floodplains and side channels provide habitat that is utilized by juvenile salmonids and other native fish, whether salmonids rearing on the floodplain experience measureable growth and whether stomach content is greater in the floodplain relative to the main channel. A 4-ft x 5-ft fyke made of 0.25 inch nylon mesh or a 3-ft x 4-ft fyke made of 0.125 inch nylon mesh, both with 25-ft wings, would be used for trapping. The cod end of the fyke net would be connected to a live box that is 4 ft long, 2.5 ft wide, and 2.5 ft high. A velocity break would be inserted into the live box to ensure that captured fish are not impinged on the back of the live box. The fyke net would be placed in the floodplain spanning an exit channel or in the exit to one of the side channels, and the wings would be extended as necessary by adding additional 0.25 or 0.125 inch nylon mesh to cover the width of the floodplain exit or side channel. The live boxes would be checked at twice a day, typically in the morning and afternoon to process fish in the live boxes and to clean debris from the traps and live boxes. During each trap check, the fyke trap would be cleaned of debris and all fish in the live box would be netted out using aquarium nets and placed in five-gallon buckets of fresh river water. Larger, piscivorous fish would be placed in separate buckets from juvenile salmonids and other smaller fish to prevent predation. Bucket water would be monitored to ensure that temperature remains within 2°C of the river water and DO is above 5 mg/l. Water would be replaced and aerators used, as necessary. All non-target fish would be identified to species, enumerated, and released. All salmonids with a fork length greater than 50 mm would be anesthetized, measured, and weighed, while salmonids with a fork length less than or equal to 50 mm would only be anesthetized and measured. After processing, the fish would be immediately placed in a recovery bucket with a battery powered aerator. Once all fish in the recovery bucket are behaving normally, they would be released immediately downstream of the live box.

### *1.3.3 Interrelated actions*

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

# 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).

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

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.

- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a RPA 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.

The descriptions of the status of species and conditions of the designated critical habitats in this BO are a synopsis of the detailed information available on NMFS' West Coast Regional website.

The following federally listed species ESUs or DPSs and designated critical habitat occur in the action area and may be affected by the proposed action (Table 1):

Table 1. ESA Listing History

| Species Name | ESU or DPS | Current Final Listing Status | Critical Habitat Designated |
|---|---|---|---|
| steelhead<br>(*O. mykiss*) | California Central Valley DPS | 1/5/2006<br>71 FR 834<br>Threatened | 9/2/2005<br>70 FR 52488 |

### *2.2.1 Species Listing and Critical Habitat Designation History for CCV Steelhead*

CCV steelhead were originally listed as threatened on March 19, 1998 (63 FR 13347). Following a new status review (Good et al. 2005) and after application of the agency's hatchery listing policy, NMFS reaffirmed the status of CCV steelhead as threatened and also listed the FRFH and Coleman NFH artificial propagation programs as part of the DPS on January 5, 2006 (71 FR 834). In doing so, NMFS applied the DPS policy to the species because the resident and anadromous life forms of steelhead remain "markedly separated" as a consequence of physical, ecological, and behavioral factors, and may therefore warrant delineation as separate DPSs 24 (71 FR 834; January 5, 2006). In May 2016, NMFS completed a 5-year status review of the CCV steelhead DPS. Based upon a review of available information, NMFS (2016) recommended that the CCV steelhead DPS remain classified as a threatened species. However, NMFS (2016) also indicated that the biological status of the DPS has declined since the previous status review in 2011. Their continued low numbers in most hatcheries, domination by hatchery fish, and relatively sparse monitoring makes the continued existence of naturally reproduced steelhead a concern. Due to this declining trend, NMFS (2016) suggests that the DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

On February 16, 2000 (65 FR 7764), NMFS published a final rule designating Critical Habitat for CCV steelhead. This Critical Habitat included all river reaches accessible to CCV steelhead in the Sacramento and San Joaquin rivers and their tributaries in California. NMFS proposed new Critical Habitat for CCV steelhead on December 10, 2004 (69 FR 71880) and published a final rule on September 2, 2005 (70 FR 52488). This Critical Habitat includes the Merced River from the confluence with the lower San Joaquin River upstream to Crocker-Huffman Diversion Dam, as well as the San Joaquin River downstream of the Merced River, and the Delta. Habitat from Crocker Huffman Diversion Dam to the Merced Falls Diversion Dam is not accessible.

### *2.2.2 Critical Habitat and Physical or Biological Features for CCV Steelhead*

Critical habitat for CCV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba rivers and the Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries; and the waterways of the Delta.

Currently, the CCV steelhead DPS and critical habitat extends up the San Joaquin River to the confluence with the Merced River. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent would be defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series) (Bain and Stevenson 1999) (70 FR 52488; September 2, 2005). The following subsections describe the status of the Physical or Biological Features (PBFs) of CCV steelhead critical habitat, which are listed in the critical habitat designation (70 FR 52488; September 2, 2005).

*Spawning Habitat*

The PBFs of CCV steelhead critical habitat include freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, egg incubation, and larval development. Most of the available spawning habitat for steelhead in the Central Valley is located in areas directly downstream of dams due to inaccessibility to historical spawning areas upstream and the fact that dams are typically built at high gradient locations. These reaches are often impacted by the upstream impoundments, particularly over the summer months, when high temperatures can have adverse effects upon salmonids spawning and rearing below the dams (NMFS 2014). Even in degraded reaches, spawning habitat has a high value for the conservation of the species as its function directly affects the spawning success and reproductive potential of listed salmonids.

*Freshwater Rearing Habitat*

The PBFs of CCV steelhead critical habitat include freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large woody material (LWM), log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids (NMFS 2014). Some complex, productive habitats with floodplains remain in the system such as the lower Cosumnes River, Sacramento River reaches with setback levees primarily located upstream of the City of Colusa and flood bypasses like the Yolo and Sutter bypasses (Summer et al 2004; Jeffries 2008). However, the 25 channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators (NMFS 2014).

Freshwater rearing habitat also has a high value for the conservation of the species even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

*Freshwater Migration Corridors*

The PBFs of CCV steelhead critical habitat include freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging LWM aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream and downstream passage of adults and the emigration of smolts. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (i.e., hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration (NMFS 2014). For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. Stranding of adults has been known to occur in flood bypasses and associated weir structures (Vincik and Johnson 2013), and a number of challenges exist on many tributary streams. For juveniles, unscreened or complex in-river cover have degraded this PBF (NMFS 2014). However, since the primary freshwater migration corridors are used by numerous listed fish populations, and are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic value for the conservation of the species.

*Estuarine Areas*

The PBFs for CCV steelhead critical habitat include estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater; natural cover such as submerged and overhanging LWM, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation (50 CFR 226.211(c)).

The remaining estuarine habitat for this species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species (NMFS 2014). Regardless of the conditions, the remaining estuarine areas are considered to have a high value for the conservation of the species because they provide features that function to provide predator avoidance, as rearing habitat, and as a transitional zone to the ocean environment.

### *2.2.3 Life History*

*Egg to Parr*

The entire egg incubation life stage encompasses the time from when adult CCV steelhead spawn through the time when fry emerge from the gravel (CALFED and YCWA 2005). The length of time it takes for eggs to hatch depends mostly on water temperature. CCV steelhead eggs can reportedly survive at water temperature ranges of 35.6°F to 59°F (Myrick and Cech 2001), and have the highest survival rates at water temperature ranges of 44.6°F to 50.0°F (Myrick and Cech 2001). steelhead eggs hatch in 3 to 4 weeks at 50°F (10°C) to 59°F (15°C) (Moyle 2002). Studies conducted at or near 54.0°F report high survival and normal development of CCV steelhead incubating embryos (RMT 2010b). Relatively low mortality of incubating CCV steelhead embryos is reported to occur at 57.2°F, and a sharp decrease in survival has been reported for CCV steelhead embryos incubated above 57.2°F (RMT 2010b). After hatching, alevins remain in the gravel for an additional 2 to 5 weeks while absorbing their yolk sacs and emerge in spring or early summer (Barnhart 1986). A compilation of data from multiple surveys has shown that steelhead prefer a range of substrate sizes between approximately 18 and 35 mm (Kondolf and Wolman 1993). CCV steelhead embryo development requires a constant supply of well oxygenated water. This implies a loose gravel substrate allowing high permeability, with little silt or sand deposition during the development time period. Merz et al. (2004) showed that spawning substrate quality influenced a number of physical parameters affecting egg survival including temperature, DO, and substrate permeability. Coble (1961) noted that a positive correlation exists between dissolved oxygen levels and flow within redd gravel, and Rombough (1988) observed a critical threshold for egg survival between 7.5 and 9.7 mg/L. Fry emerge from the gravel usually about 4 to 6 weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, fry inhale air at the stream surface to fill their air bladders, absorb the remains of their yolks in the course of a few days, and start to feed actively, often in schools (Barnhart 1986, NMFS 1996).

The newly emerged juveniles move to shallow, protected areas such as stream margins and low gradient riffles, and forage for zooplankton in open areas, using cobble and gravel as cover (Hartman 1965, Everest et al. 1986, Fontaine 1988, Bradford and Higgins 2001). As steelhead parr increase in size and their swimming abilities improve, they increasingly exhibit a preference for higher velocity and deeper midchannel areas (Hartman 1965, Everest and Chapman 1972, Fontaine 1988). Growth rates have been shown to be variable and are dependent on local habitat conditions and seasonal climate patterns (Hayes et al. 2008).

Productive juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or boulders. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991). Optimal water temperatures for growth range from 59°F (15°C) to 68°F (20°C) (McCullough et al. 2001, Spina et al. 2006). Cherry et al. (1975) found preferred temperatures for rainbow trout (*O. mykiss*) ranged from 51.8°F (11°C) to 69.8°F (21°C) depending on acclimation temperatures (Myrick and Joseph J. Cech 2001).

*Smolt Migration*

Most juvenile steelhead spend 1 to 3 years in fresh water before emigrating to the ocean as smolts (Shapovalov and Taft 1954). During their downstream migration, juvenile CCV steelhead undergo a process referred to as smoltification, which is an adaptive physiological change to allow for movement from fresh to saltwater. Juvenile steelhead will often migrate downstream as parr in the summer or fall of their first year of life, but this is not a true smolt migration (Loch et al. 1988). CCV steelhead successfully smolt at water temperatures in the 43.7°F to 52.3°F range (Myrick and Cech 2001). The optimum water temperature range for successful smoltification in young CCV steelhead has been reported as 44.0°F to 52.3°F (Rich 1987 as cited in NMFS 2009b). Wagner (1974) reported that smolting ceased rather abruptly when water temperatures increased to 57°F to 64°F. NMFS (2009a) reported that water temperatures under 57°F are considered best for smolting. Smolt migrations occur in the late winter through spring, when juveniles have undergone a physiological transformation to survive in the ocean, and become slender in shape, bright silvery in coloration, with no visible parr marks. The primary period of CCV steelhead smolt outmigration from rivers and creeks to the ocean generally occurs from February to April (NMFS 2009b), though emigration appears to be more closely associated with size than age, with 6 in. to 8 in. being most common size range for downstream migrants. In the Sacramento River, juvenile CCV steelhead reportedly migrate to the ocean in spring and early summer at 1 to 3 years of age with peak migration through the Delta in March and April (Reynolds et al. 1993 as cited in NMFS 2014). Hallock et al. (1961) found that juvenile CCV steelhead in the Sacramento River Basin migrate downstream during most months of the year, but the peak emigration period occurred in the spring, with a much smaller peak in the fall (NMFS 2014).

*Ocean Behavior*

Most CCV steelhead spend 1 to 3 years in the ocean. Smolts arriving to the ocean that are smaller tend to remain in salt water longer than larger smolts (Shapovalov and Taft 1954, Chapman 1958, Behnke 1992). Larger smolts have been found to experience higher ocean survival rates (Ward and Slaney 1988). steelhead grow more rapidly in the ocean than in freshwater rearing habitats (Shapovalov and Taft 1954, Barnhart 1991). Unlike Pacific salmon, steelhead do not appear to form schools in the ocean (Behnke 1992). steelhead in the southern part of their range appear to migrate close to the continental shelf, while more northern populations may migrate throughout the northern Pacific Ocean (Barnhart 1986). It is possible that CCV steelhead may not migrate to the Gulf of Alaska region of the North Pacific as commonly as more northern populations such as those in Washington and British Colombia. Burgner (1993) reported that no coded-wired-tagged steelhead from California hatcheries were recovered from the open ocean surveys or fisheries that were sampled for steelhead between 1980 and 1988. Only a small number of disk-tagged fish from California were captured. This behavior might explain the small average size of CCV steelhead relative to populations in the Pacific Northwest, as food abundance in the nearshore coastal zone may not be as high as in the Gulf of Alaska.

Pearcy et al. (1990) found that the diets of juvenile steelhead caught in coastal waters of Oregon and Washington were highly diverse and included many species of insects, copepods, and amphipods, but by biomass the dominant prey items were small fishes (including rockfish and greenling) and euphausids.

There are no commercial fisheries for steelhead in California, Oregon, or Washington, with the exception of some tribal fisheries in Washington waters.

*Spawning*

CCV steelhead generally enter freshwater from August to November (with a peak in September) (Hallock et al. 1961), and spawn from December to April (with a peak in January through March) in rivers and streams where cold, well-oxygenated water is available (Hallock et al. 1961, McEwan and Jackson 1996, Williams 2006). The timing of upstream migration is correlated with high flow events, such as freshets, and the associated change in water temperatures (Workman et al. 2002). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams.

The female CCV steelhead selects a site with good intergravel flow, digs a redd with her tail, usually in the coarse gravel of the tail of a pool or in a riffle, and deposits eggs while an attendant male fertilizes them (NMFS 2014). Spawning occurs mainly in gravel substrates (i.e., particle size range of about 0.2−4.0 in.). Sand-gravel and gravel-cobble substrates are also used, but these must be highly permeable and contain less than 5 percent sand and silt for the water to be able to provide sufficient oxygen to the incubating eggs. Adults tend to spawn in shallow areas (i.e., 6−24 in. deep) with moderate water velocities (i.e., ~1 to 3.6 ft/s) (Bovee 1978 as cited in McEwan and Jackson 1996, Hannon and Deason 2007 as cited in Reclamation 2008). The optimal temperature range for spawning has been reported to range from 39° to 52°F (Bovee 1978, Reiser and Bjornn 1979, Bell 1986 all as cited in McEwan and Jackson 1996). Egg mortality begins to occur at 56°F (McEwan and Jackson 1996).

Few direct counts of fecundity are available for CCV steelhead populations, but because the number of eggs laid per female is highly correlated with adult size, adult size can be used to estimate fecundity with reasonable precision. Adult steelhead size depends on the duration of and growth rate during their ocean residency (Meehan and Bjornn 1991). CCV steelhead generally return to freshwater after 1 or 2 years at sea (Hallock et al. 1961), and adults typically range in size from 2 to 12 pounds (Reynolds et al. 1993). Steelhead about 55 cm (fork length) long may have fewer than 2,000 eggs, whereas steelhead 85 cm (FL) long can have 5,000 to 10,000 eggs, depending on the stock (Meehan and Bjornn 1991). The average for Coleman NFH since 1999 is about 3,900 eggs per female (USFWS 2011).

Unlike Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning multiple times before death (Busby et al. 1996). However, it is rare for steelhead to spawn more than twice before dying; and repeat spawners tend to be biased towards females (Busby et al. 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby et al. 1996). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners were relatively numerous (17.2 percent) in Waddell Creek. Null (2013) found between 36 percent and 48 percent of kelts released from Coleman NFH in 2005 and 2006 survived to spawn the following spring, which is in sharp contrast to what Hallock (1989) reported for Coleman NFH in the 1971 season, where only 1.1 percent of adults were fish that had been tagged the previous year. Most populations have never been studied to determine the percentage of repeat spawners. Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider et al. 1986).

*Kelts*

Post-spawning steelhead (kelts) may migrate downstream to the ocean immediately after spawning, or they may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954). Recent studies have shown that kelts may remain in freshwater for an entire year after spawning (Teo et al. 2011), but that most return to the ocean (Null 2013).

### *2.2.4 Description of Viable Salmonid Population Parameters*

As an approach to determining the conservation status of salmonids, NMFS has developed a framework for identifying attributes of a VSP. The intent of this framework is to provide parties with the ability to assess the effects of management and conservation actions and ensure their actions promote the listed species' survival and recovery. This framework is known as the VSP concept (McElhany et al. 2000). The VSP concept measures population performance in terms of four key parameters: abundance, population growth rate, spatial structure, and diversity.

*2.2.4.1 Abundance*

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s, the CCV steelhead run size had declined to about 40,000 adults (McEwan 2001). Hallock et al. (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River upstream of the Feather River. Steelhead counts at the RBDD declined from an average of

11,187 from 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations. Comprehensive steelhead population monitoring has not taken place in the Central Valley since then, despite 100 percent marking of hatchery steelhead smolts since 1998. Efforts are underway to improve this deficiency, and a long-term adult implementation monitoring plan has been formulated (Eilers et al. 2010, Fortier et al. 2014).

There is very little monitoring focused on CCV steelhead; as a result, population trends and status are largely unknown. However, analyses of CCV steelhead abundance across the DPS indicate that naturally reproducing stocks are suffering severe and long-term declines, rangewide, within the San Joaquin River watershed. In the San Joaquin River tributaries, the CCV steelhead populations are very small, with most fish apparently demonstrating the resident phenotype (Zimmerman et al. 2009). Chipps Island trawl data also suggests that natural CCV steelhead production is very low (NMFS 2016). The apparent CCV steelhead population declines have been attributed to longstanding human induced factors that exacerbate the adverse effects of natural environmental variability (NMFS 1996). Important factors in this decline include habitat destruction and degradation of freshwater spawning and rearing habitat, river flow regulation, over-fishing, and the introduction of non-native piscivorous fish species (62 FR 43937). In particular, impassable dams block access to 80 percent of historically available CCV steelhead habitat and block access to all historical CCV steelhead spawning habitat for about 38 percent of historical populations (Lindley et al. 2006).

Current abundance data are limited to returns to hatcheries and redd surveys conducted on a few rivers. The hatchery data are the most reliable, as redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period.

Coleman NFH operates a weir on Battle Creek, where all upstream fish movement is blocked August through February, during the hatchery spawning season. Counts of steelhead captured at and passed above this weir represent one of the better data sources for the CCV DPS. However, changes in hatchery policies and transfer of fish complicate the interpretation of these data. In 2005, per NMFS request, Coleman NFH stopped transferring all adipose-fin clipped steelhead above the weir, resulting in a large decrease in the overall numbers of steelhead above the weir in recent years. In addition, in 2003, Coleman NFH transferred about 1,000 clipped adult steelhead to Keswick Reservoir, and these fish are not included in the data. The result is that the only unbiased time series for Battle Creek is the number of unclipped (wild) steelhead since 2001, which have declined slightly since that time, mostly because of the high returns observed in 2002 and 2003.

Prior to 2002, hatchery- and natural-origin steelhead in Battle Creek were not differentiable, and all steelhead were managed as a single, homogeneous stock, although USFWS believes the majority of returning fish in years prior to 2002 were hatchery-origin. Abundance estimates of natural-origin steelhead in Battle Creek began in 2001. These estimates of steelhead abundance include all CCV steelhead, including resident and anadromous fish.

Steelhead returns to Coleman NFH increased from 2011 to 2014. After hitting a low of only 790 fish in 2010, 2013 and 2014 have averaged 2,895 fish. Since 2003, adults returning to the hatchery have been classified as wild (unclipped) or hatchery-produced (adipose fin clipped). Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200 to 300 fish each year. Numbers of wild adults returning each year have ranged from 252 to 610 from 2010 to 2014.

Redd counts are conducted in the American River and in Clear Creek (Shasta County). An average of 143 redds have been counted on the American River from 2002 to 2015 (Hannon et al. 2003, Hannon and Deason 2008, Chase 2010). Surveys were not conducted in some years on the American River due to high flows and low visibility. An average of 178 redds have been counted in Clear Creek from 2001 to 2015. The Clear Creek steelhead population appears to have increased in abundance since Saeltzer Dam was removed in 2000, as the number of redds observed in surveys conducted by the USFWS has steadily increased since 2001. The average redd index from 2001 to 2011 is 178, representing a range of approximately 100 to 1,023 spawning adult steelhead on average each year, based on an approximate observed adult-to-redd ratio in Clear Creek (USFWS 2015). The vast majority of these steelhead are wild fish, as no hatchery steelhead are stocked in Clear Creek.

The East Bay Municipal Utilities District (EBMUD) has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season, and the overall trend is a slight increase. However, it is generally believed that most of the steelhead spawning in the Mokelumne River are resident fish (Satterthwaite et al. 2010), which are not part of the CCV steelhead DPS. Recent genetic studies have shown that Mokelumne River Hatchery steelhead are now closely related to Feather River Hatchery fish, because these fish are considered to be native Central Valley stock (Pearse and Garza 2015). Thus in the most recent 5-year status review, NMFS recommended that steelhead originating from the Mokelumne River Hatchery be included as part of the CCV steelhead DPS population (NMFS 2016).

The returns of CCV steelhead to the FRFH experienced a sharp decrease from 2003 to 2010, with only 679, 312, and 86 fish returning in 2008, 2009, and 2010, respectively. In recent years, however, returns have experienced an increase with 830, 1,797, and 1,505 fish returning in 2012, 2013, and 2014, respectively. Almost all these fish are hatchery fish, and stocking levels have remained fairly constant, suggesting that smolt and/or ocean survival was poor for age classes that showed poor returns in the late 2000s.

Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the relative abundance of the CCV steelhead DPS, as well as the proportion of wild steelhead relative to hatchery steelhead (CDFG 2018). The overall catch of steelhead at these facilities has been highly variable since 1993. Variability in catch is likely due to differences in water year types as Delta exports fluctuate. The percentage of unclipped steelhead in salvage has also fluctuated, but has generally declined since 100 percent clipping started in 1998. The number of stocked hatchery steelhead has remained relatively constant overall since 1998, even though the number stocked in any individual hatchery has fluctuated.

The years 2009 and 2010 showed poor returns of steelhead to the FRFH and Coleman NFH, probably due to three consecutive drought years in 2007 to 2009, which would have impacted parr and smolt growth and survival in the rivers, and possibly due to poor coastal upwelling conditions in 2005 and 2006, which strongly impacted fall-run Chinook salmon post-smolt survival (Lindley et al. 2009). Wild (unclipped) adult counts appear not to have decreased as greatly in those same years, based on returns to the hatcheries and redd counts conducted on Clear Creek, and the American and Mokelumne rivers. This may reflect greater fitness of naturally produced steelhead relative to hatchery fish, and certainly merits further study.

Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2015 that no clear trend is present, other than the fact that the numbers are still far below those seen in the 1960s and 1970s, and only a tiny fraction of the historical estimate. Returns of natural origin fish are very poorly monitored, but the little data available suggest that the numbers are very small, though perhaps not as variable from year to year as the hatchery returns.

*2.2.4.2 Productivity*

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the Central Valley annually, based on rough calculations from sporadic catches in trawl gear (Good et al. 2005). The Mossdale trawls on the San Joaquin River conducted annually by CDFW and USFWS capture steelhead smolts, although usually in very small numbers. These steelhead recoveries, which represent migrants from the Stanislaus, Tuolumne, and Merced rivers, suggest that the productivity of CCV steelhead in these tributaries is very low.

*Spatial Structure*

About 80 percent of the historical spawning and rearing habitat once used by anadromous steelhead in the Central Valley is now upstream of impassible dams (Lindley et al. 2006). The extent of habitat loss for steelhead most likely was much higher than that for salmon because steelhead were undoubtedly more extensively distributed. Due to their superior jumping ability, the timing of their upstream migration, which coincided with the winter rainy season, and their less restrictive preferences for spawning gravels, steelhead could have utilized at least hundreds of miles of smaller tributaries not accessible to the earlier-spawning salmon (Yoshiyama et al. 1996).

Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Steelhead were found as far south as the Kings River (and possibly Kern River systems in wet years) (McEwan 2001). Native American groups, such as the Chunut people, have had accounts of steelhead in the Tulare Basin (Latta 1977). Steelhead are well-distributed throughout the Central Valley below the major rim dams (Good et al. 2005, NMFS 2016). Zimmerman et al. (2009) used otolith microchemistry to show that steelhead of anadromous parentage occur in all three major San Joaquin River tributaries, but at low levels, and that these tributaries have a higher percentage of resident steelhead compared to the Sacramento River and its tributaries.

Most of the steelhead populations in the Central Valley have a high hatchery component, including Battle Creek (adults intercepted at the Coleman NFH weir), the American River, Feather River, and Mokelumne River. This is confounded, of course, by the fact that most of the dedicated monitoring programs in the Central Valley occur on rivers that are annually stocked. Clear Creek and Mill Creek are the exceptions.

The low adult returns to the San Joaquin tributaries and the low numbers of juvenile emigrants typically captured suggest that existing populations of CCV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed. The loss of these populations would severely impact CCV steelhead spatial structure and further challenge the viability of the CCV steelhead DPS.

Efforts to provide passage of salmonids over impassable dams have the potential to increase the spatial diversity of Central Valley steelhead populations if the passage programs are implemented for steelhead. In addition, the San Joaquin River Restoration Program (SJRRP) calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of spring-run and fall-run Chinook salmon. If the SJRRP is successful, habitat improved for spring-run Chinook salmon could also benefit CCV steelhead (NMFS 2016).

*2.2.4.3 Diversity*

*Genetic Diversity*

The CCV steelhead abundance and growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley et al. 2006). Recent reductions in population size are also supported by genetic analysis (Nielsen et al. 2003).

Garza and Pearse (2008) analyzed the genetic relationships among CCV steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were often more closely related to below barrier fish from other watersheds than to steelhead above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers.

The genetic diversity of CCV steelhead is also compromised by hatchery-origin fish, which likely comprise the majority of the annual spawning runs, placing the natural population at a high risk of extinction (Lindley et al. 2007). There are four hatcheries (Coleman NFH, FRFH, Nimbus Fish Hatchery, and Mokelumne River Fish Hatchery) in the Central Valley which combined release approximately 1.6 million yearling steelhead smolts each year. These programs are intended to mitigate for the loss of steelhead habitat caused by dam construction, but hatchery-origin fish now appear to constitute a major proportion of the total abundance in the DPS. Two of these hatchery stocks (Nimbus and Mokelumne River Hatcheries) originated from outside the DPS (primarily from the Eel and Mad rivers) and are not presently considered part of the DPS. However, during the recent NMFS 5-year status review for CCV steelhead, NMFS recommended including the Mokelumne River Hatchery steelhead population in the CCV steelhead DPS due to the close genetic relationship with FRFH steelhead that are considered part of the native Central Valley stock (NMFS 2016).

*Life-history Diversity*

Steelhead in the Central Valley historically consisted of both summer-run and winter-run Chinook salmon migratory forms, based on their state of sexual maturity at the time of river entry and the duration of their time in freshwater before spawning. Only winter-run (ocean-maturing) steelhead currently are found in CCV rivers and streams (McEwan and Jackson 1996, Moyle 2002). Summer-run steelhead have been extirpated due to a lack of suitable holding and staging habitat, such as cold water pools in the headwaters of CV streams, presently located above impassible dams (Lindley et al. 2006).

Juvenile steelhead (parr) rear in freshwater for 1 to 3 years before migrating to the ocean as smolts (Moyle 2002). The time that parr spend in freshwater is inversely related to their growth rate, with faster-growing members of a cohort smolting at an earlier age but a smaller size (Seelbach 1993, Peven et al. 1994). Hallock et al. (1961) aged 100 adult steelhead caught in the Sacramento River upstream of the Feather River confluence in 1954 and found that 70 had smolted at age-2, 29 at age-1, and one at age-3. Seventeen of the adults were repeat spawners, with three fish on their third spawning migration, and one on its fifth. Age at first maturity varies among populations. In the Central Valley, most steelhead return to their natal streams as adults at a total age of 2 to 4 years (Hallock et al. 1961, McEwan and Jackson 1996).

### *2.2.5 Climate Change*

One major factor affecting the range-wide status of the threatened and endangered anadromous fish in the Central Valley, and aquatic habitat at large is climate change. Lindley et al. (2007) summarized several studies (Hayhoe et al. 2004; Dettinger et al. 2004; Dettinger 2005; VanRheenen et al. 2004; Knowles and Cayan 2002) on how anthropogenic climate change is expected to alter the Central Valley, and based on these studies, described the possible effects to anadromous salmonids. Climate models for the Central Valley are broadly consistent in that temperatures in the future would warm significantly, total precipitation may decline, the variation in precipitation may substantially increase (i.e., more frequent flood flows and critically dry years), and snowfall would decline significantly (Lindley et al. 2007). Climate change is having, and would continue to have, an impact on salmonids throughout the Pacific Northwest and California (Battin et al. 2007).

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). An altered seasonality results in runoff events occurring earlier in the year due to a shift in precipitation falling as rain rather than snow (Roos 1991; Dettinger et al. 2004). Specifically, the Sacramento River basin annual runoff amount for April- to July has been decreasing since about 1950 (Roos 1987, 1991). Increased air temperatures influence the timing and magnitude patterns of the hydrograph.

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (VanRheenen et al. 2004). Factors modeled by VanRheenen et al. (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100 percent in shallow snowpack areas). Additionally, an air temperature increase of 3.8°F (2.1°C) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen et al. 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the Central Valley, where snowpack is shallower than in the San Joaquin River watersheds to the south. Modeling indicates that stream habitat for cold water species declined with climate warming and remaining habitat suitable may only exist at higher elevations (Null et al. 2013). Climate warming is projected to cause average annual stream temperatures to exceed 24°C (75.2°F) slightly earlier in the spring, but notably later into August and September. The percentage of years that stream temperatures exceeded 24°C (for at least 1 week) is projected to increase, so that if air temperatures rise by 6°C, most Sierra Nevada rivers would exceed 24°C for some weeks every year.

Warming is already affecting CV Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 9°F (5°C), it is questionable whether any CV Chinook salmon populations can persist (Williams 2006). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951 to 1980, the most plausible projection for warming over Northern California is 4.5°F (2.5°C) by 2050 and 9°F (5°C) by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the Central Valley are at the southern limit of their range, and warming would shorten the period in which the low elevation habitats used by naturally producing Chinook salmon are thermally acceptable. This should particularly affect fish that emigrate as fingerlings, mainly in May and June, and especially those in the San Joaquin River and its tributaries. Central Valley salmonids are highly vulnerable to drought conditions. The increased in-river water temperature resulting from drought conditions is likely to reduce the availability of suitable holding, spawning, and rearing conditions in Clear Creek and in the Sacramento, Feather, and Yuba rivers. During dry years, the availability of thermally suitable habitats in spring-run Chinook salmon river systems without major storage reservoirs (e.g., Mill, Deer, and Butte creeks) is also likely to be reduced. Multiple dry years in a row could potentially devastate Central Valley salmonids. Prolonged drought due to lower precipitation, shifts in snowmelt runoff, and greater climate extremes could easily render most existing spring-run Chinook salmon habitat unusable, either through temperature increases or lack of adequate flows. The drought that occurred from 2007 to 2009 was likely a factor in the recent widespread decline of all Chinook salmon runs (including spring-run Chinook salmon) in the Central Valley (Williams et al. 2011).

The increase in the occurrence of critically dry years also would be expected to reduce abundance, as, in the Central Valley, low flows during juvenile rearing and outmigration are associated with poor survival (Kjelson and Brandes 1989; Baker and Morhardt 2001; Newman and Rice 2002). In addition to habitat effects, climate change may also impact Central Valley salmonids through ecosystem effects. For example, warmer water temperatures would likely increase the metabolism of predators, reducing the survival of juvenile salmonids (Vigg and Burley 1991). In summary, climate change is expected to exacerbate existing stressors and pose new threats to Central Valley salmonids, including CCV steelhead, by reducing the quantity and quality of inland habitat (Lindley et al. 2007).

Since 2005, there has been a period of widespread decline in all CV Chinook salmon stocks. An analysis by Lindley et al. (2009) that examined fall-run Chinook salmon found that unusual oceanic conditions led to poor growth and survival for juvenile salmon entering the ocean from the Central Valley during the spring of 2005 and 2006 and most likely contributed to low returns in 2008 and 2009. This reduced survival was attributed to weak upwelling, warm sea surface temperatures, low prey densities, and poor feeding conditions in the ocean. When poor ocean conditions are combined with drought conditions in the freshwater environment, the productivity of salmonid populations can be significantly reduced. Although it is unclear how these unusual ocean conditions affected CCV steelhead, it is highly likely they were adversely impacted by a combination of poor ocean conditions and drought (NMFS 2011).

Although CCV steelhead would experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile CCV steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 57°F to 66°F (14°C to 19°C). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough et al. 2001). In fact, McCullough et al. (2001) recommended an optimal incubation temperature at or below 52°F to 55°F (11°C to 13°C). Successful smoltification in steelhead may be impaired by temperatures above 54°F (12°C), as reported in Richter and Kolmes (2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but potentially at the expense of decreased survival due to higher metabolic demands and greater presence and activity of predators. Stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations.

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

## 2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Action Area for proposed actions that involve instream construction work must include the Proposed Project footprint and the area downstream, where instream construction activities can temporarily decrease water quality. The effects of increased turbidity would attenuate downstream as suspended sediment settles out of the water column. Instream projects with a larger footprint than the Proposed Project have created turbidity plumes of 25-75 nephelometric turbidity units (NTUs) extending up to 1,000 ft (304.8 m) downstream as a result of instream construction activities (NMFS 2006). Therefore, a conservative definition of the Action Area for restoration projects with instream activities includes the project boundary and the segment of river extending from the edge of the project boundary to 1,000 ft (304.8 m) downstream. The Action Area for this Proposed Project includes adjacent biological monitoring control sites, that are located both upstream and downstream of the Proposed Project footprint, to collect baseline information before implementation to enable hypothesis testing following restoration, using a BACI study design (CFS 2018). However, the downstream control site is shared with the Merced River Ranch and Henderson Park Restoration projects and monitoring "take" coverage for CCV steelhead at the downstream control site has been and is currently covered by 4(d). Therefore, the Action Area for the Proposed Project includes the stretch of the Merced River from the upstream control site to the downstream boundary and extending downstream for 1,000 ft. This is the area in which the Proposed Project could result in direct or indirect effects on federally listed species.

Figure 1 shows the Proposed Project and Action Area boundaries.

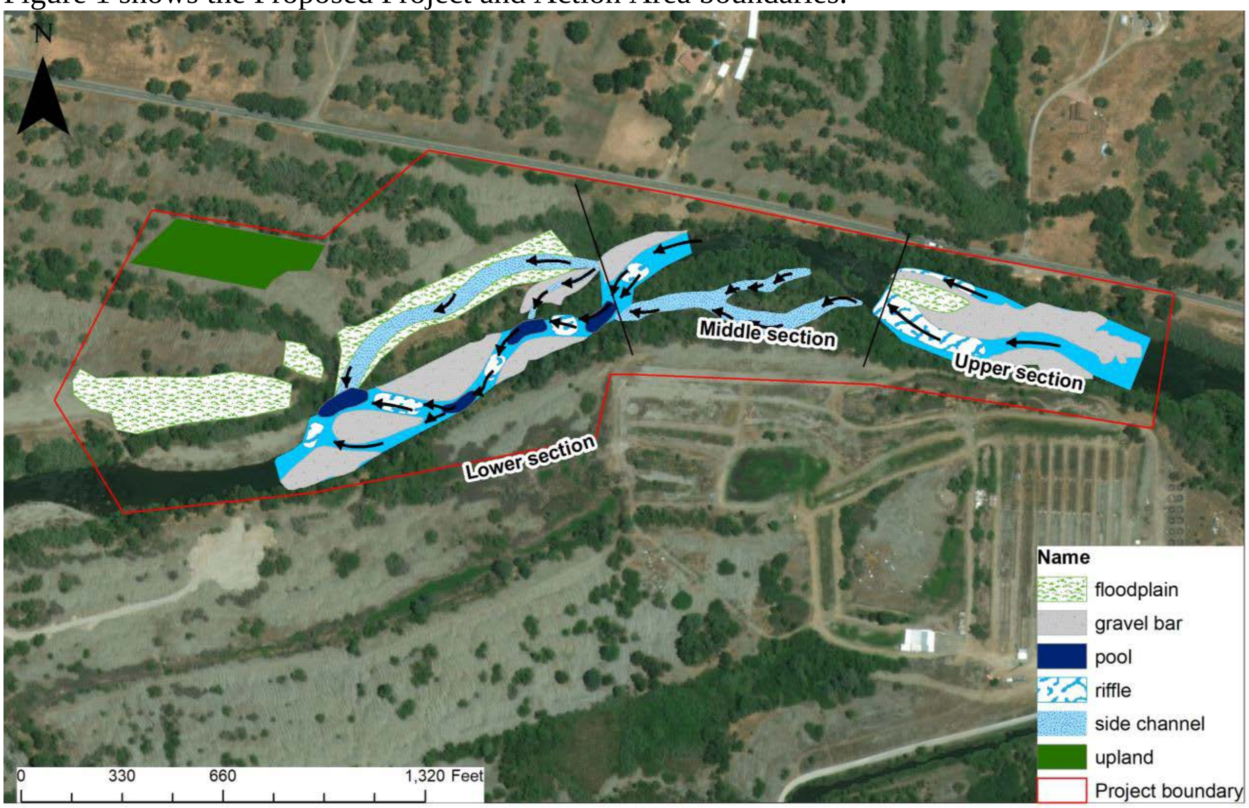


Figure 1. Proposed Project conceptual design with grading for side channels and floodplains and gravel addition areas indicated.

The river corridor in the Action Area is partly confined with a meandering channel. The channel is confined by Merced Falls road along the upstream half of the north bank as well as dredger tailings along both the north and south banks. These channel confinements substantially reduce the amount of floodplain and other off channel features available to be inundated during high flow events. There is a remnant vegetated bar terrace in the middle of the Action Area on the south bank. However, channel incision resulting from flow regulation and reduction in sediment supply has isolated this bar terrace from the channel during commonly occurring flow events. The bar terrace starts to inundate at approximately 2,000 cfs (ESA Associates 2017). The river channel within the Action Area can generally be characterized with three primary sections, separated by a series of bedrock steps at a bend in the river. The average river bed slope is 0.0028, which is slightly steeper than the average bed slope of the downstream river corridor through the town of Snelling. This is due to the bedrock outcrop producing a slope break that controls bed elevations. In the upper section of the Action Area above the bedrock outcrops, the channel is uniform and straight with very little variation in the channel topography. The north bank is confined by Merced Falls Road; south of the road it is vegetated with a narrow band of trees and shrubs. The south bank also has a narrow band of vegetation and is bounded to the south by a tailings pile. The Calaveras Trout Farm (private trout farm) and the Merced River Fish Hatchery (Chinook salmon hatchery operated by the CDFW) are located south of the tailings. The salmon hatchery receives piped water from Crocker Huffman Diversion Dam impoundment and water is diverted from the Crocker Huffman Diversion Dam impoundment to the trout farm via a combination of canals and pipes (Vogel 2007). Bed materials in this area are mostly large cobbles and bedrock, although there is lateral sorting in the channel with finer sediments present near the channel banks. At the very upstream limit there are some gravels in the channel, presumably from CDFW gravel augmentation.

The bedrock exposed middle section of the Action Area is characterized by several river islands and steps in the riverbed profile followed by a narrower channel meander that is adjacent to Merced Falls Road. The channel in this area is very complex with multiple islands and bedrock steps. The overall channel topography slopes to the north in this location, where flow appears to be directed to the north bank. The north bank shows signs of erosion adjacent to Merced Falls Road. The south bank is relatively low relief due to the presence of a large vegetated bar-terrace. Within the terrace there are several side channels adjacent to the main river channel. In the lower most section the channel returns to a uniform state, with little to no variation in the cross sectional or longitudinal profile. Both banks are confined by a narrow band of vegetation and dredger tailings. The lowest section of the Action Area is roughly 1,000 ft long transitions from a river island and bedrock step into a long uniform channel. The upper channel of the river island does not appear to convey much flow, but there are several small (e.g. 5-10’) channels that flow to the south. Adjacent to the northern edge of the river island is a river bed step. Downstream of the river island both the river bed and cross section topography are very simple, resulting in homogenous hydraulic conditions. The banks have a 20- 50’ wide riparian corridor before transitioning into tailing piles. At the southern boundary of the middle and lower sections is a culvert that appears to provide drainage from the trout hatchery.

## 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). CCV steelhead have experienced declines in abundance in the past several decades.

The Merced River is a tributary to the San Joaquin River in the southern portion of the CCV. The river, which drains an approximately 1,273 square mile ($mi^2$ ) (3,297 square kilometer [$km^2$ ]) watershed, has three forks; main, north and, south, which each originate in the Sierra Nevada mountain range. The north and south forks flow into the main Merced River before it enters Lake McClure. Elevations in the watershed range from 13,000 ft (4,000 m) at the crest of the Sierra Nevada to 50 ft (15 m) at the confluence with the San Joaquin River.

Factors that currently may limit steelhead populations in the lower Merced River include impedance of passage during critical life stages, high water temperatures, and reduced quality and availability of habitat (NOAA Fisheries 1996a). Due in part to the long-term scarcity or absence of *0. mykiss* in the entire San Joaquin Basin (DFG 1993), no distinct steelhead run is thought to inhabit the Merced River, although large adult *0. mykiss* enter Merced River Hatchery from time to time (DFG 1993; Moyle et al. 1996; NOAA Fisheries 1996b). Little or no historic record of escapement is available.

### *2.4.1 Factors Affecting the Species and Habitat in the Action Area*

The Merced River has been affected by a range of human activities, including dam construction for water storage and diversion, land use conversion, introduction of exotic plant and animal species, gold and aggregate mining, and bank protection (Stillwater Sciences 2002). These kinds of modifications are known to change habitat such as water temperature, flow, and availability of spawning and rearing habitat that are critical to CV steelhead (NOAA Fisheries 1996a).

*Barriers Water Diversions and Unscreened Diversions*

There are four major permanent barriers on the Merced River. New Exchequer Dam (RM 65) was built in 1967 to enlarge a pre-existing dam that was built in the 1926, while McSwain Dam (RM 56) was completed in 1966. These dams were built for irrigation, flood control, and power production. Merced Falls (RM 55) and Crocker-Huffman (RM 52) dams are the two other dams, which are low diversion dams and located below McSwain Dam. Collectively, these dams are known as the Merced River Development Project, owned and operated by Merced Irrigation District, and licensed by the Federal Energy Commission (FERC; Stillwater Sciences 2002). New Exchequer Dam has the capacity to store 1,024.6 thousand acre-feet (T AF) of water. McSwain Dam adds 9.73 TAF of storage, whereas Merced Falls and Crocker-Huffman dam have a capacity of 0.9 TAF and 0.2 TAF, respectively. The existence of dams is one of the major factors contributing to the decline CV steelhead by limiting access to historical habitat (NOAA Fisheries 1996a). Historical accounts suggest that salmon occurred up to an elevation of approximately 2,000 feet near El Portal on the Merced River (Yoshiyama 1999). By 1925, Crocker-Huffman, Merced Falls, and Exchequer dams limited access to upstream salmon and steelhead habitats. Currently, only the reach downstream of Crocker-Huffman Dam is accessible to these species. Crocker-Huffman and Merced Falls dams are equipped with fish ladders to allow upstream passage of adult salmon and steelhead. However, these ladders were shut down when the Merced River Hatchery was constructed and are no longer in use (Stillwater Sciences 2002).

Since most of the Merced River corridor is privately owned below Crocker-Huffman dam, there are several diversion dams owned and operated by Merced ID or riparian water rights diverters, as well as several unaccountable diversions along the river. Many of the diversions are unscreened or inadequately screened. From Crocker-Huffman dam to Shaffer Bridge, there are seven riparian rights small diversions. Downstream of Shaffer Bridge, 238 diversions have been identified, which are typically pumps to supply water for agricultural use (Odenweller 2004; Witts and Raquel 2004). Studies have shown that water diversions reduce survival of emigrating juvenile salmonids through direct losses at unscreened or inadequately screened diversions, and indirect losses resulting from reduced stream flows. Fish losses at diversions can result from physical injury, impingement, entrainment, or predation. Delayed passage, increased stress, and increased vulnerability to predation may contribute to indirect mortality at diversions (NOAA Fisheries 1996a, Odenweller 2004). In one of DFG's pre-screening evaluations of salmonid entrainment on a small riparian diversion on the Merced River near Snelling, DFG found that the existing screen was inadequate to effectively keep fish from being entrained in the diversion canal. DFG captured rainbow trout, Chinook salmon, hardhead (Mylopharodon conocephalus), Sacramento pikeminnow (Ptychocheilus grandis), etc. in the canal during their evaluation (DFG 2002).

*Flow*

Flow conditions in the Merced River are affected by storage, diversion, and flood control due to the presence of the dams mentioned above. The river is approximately 150 miles in length and drains 1,276 square miles of watershed originating in Yosemite National Park. The Merced River is heavily allocated for agricultural water use from the dams that are owned and controlled by Merced ID. Merced ID diverts an average of 522 TAF of water annually from the mainstem Merced River at Merced Falls Dam and Crocker-Huffman Dam. This represents 52 percent of the average unimpaired discharge from the watershed. Merced ID also is required to release 94 T AF annually from Crocker-Huffman Dam for the Merced River riparian water users (Stillwater Sciences and EDAW 2001).

In addition to flow storage and diversion for agricultural supply, the U.S. Army Corps of Engineers limits flow in the Merced River for flood control. A total of 350 T AF of storage space in New Exchequer Dam reservoir is reserved for flood control between October 31 and March 15, and an additional 50 TAF is reserved for forecasted spring snowmelt between March and May 15. The flood control release rules limit the maximum flow release from the Merced River Development Project to 6,000 cubic feet per second (cfs) as measured at the U.S. Geological Survey (USGS) gauge Merced River at Stevinson, which is located near the confluence with the San Joaquin River (Stillwater Sciences 2002).

Flow regulation and flood control have reduced the frequency and magnitude of 1.5-, 2-, 5-, and 10-year floods in the Merced River by 80 to 84 percent, resulting in changes to geomorphology of the river and habitat downstream of Crocker-Huffman dam. Flows equivalent to the pre-dam channel-forming flow have not occurred since completion of New Exchequer Dam. In addition, flow regulation has shifted the timing of peak flows from spring to winter. This shift from spring peaks to winter peaks likely affects riparian vegetation establishment along the river corridor because native riparian species germinate in spring, and plants germinating in areas inundated in spring are vulnerable to drowning and scour during the following fall and winter. Currently, the distribution of Merced River riparian vegetation downstream of Crocker-Huffman Dam generally is fragmented and narrow compared to historical accounts (Stillwater Sciences 2002). Such conditions have reduced the amount of shaded riverine aquatic habitat available to lower water temperatures in the summer and provide refugia for rearing juvenile CV steelhead. In addition, changes in the magnitude and timing of reservoir releases can influence the timing of steelhead migration. Relatively early attraction of steelhead into tributaries can be triggered by occasional reservoir releases of cold water or the occurrence of high flows early in the fall. Conversely, low flows and higher water temperatures can inhibit or delay migration to spawning areas. Unnatural and/or rapid flow fluctuations downstream of reservoirs can cause dewatering of redds and stranding of juveniles. Because rearing steelhead may be present year-round, suitable flows are necessary throughout the year. In many streams, flows and water temperatures are most critical during the summer. The stream reaches that are presently accessible to steelhead often lack the summer habitat conditions needed to sustain juvenile steelhead through their freshwater rearing period. These unsuitable conditions, which are exacerbated by reservoir operations and water diversions that reduce summer flows, and can be particularly severe in drought years (NOAA Fisheries 1996a, Dennis McEwan, DFG, pers. comm. 2001, 2002).

*Water Temperature*

Water temperature is a primary factor limiting natural steelhead production in many Central Valley streams. Although cold water releases occur below some dams, the amount and quality of habitat available for steelhead rearing below these dams is a fraction of what was once available. Most of the time cold water releases are not available below many migration barriers, or are only possible when reservoirs are at capacity. Appropriate water temperature regimes below many dams cannot be maintained at levels comparable to temperatures achieved naturally in the 11pper watersheds that once provided habitat (NOAA Fisheries 1996a).

*Water Quality*

The Merced River has been identified by the Central Valley Regional Water Quality Control Board as impaired due to the usage of agricultural pesticides diazinon, chlorpyrifos, and group A pesticides (i.e., aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor eposide, hexachlorocyclohexane, lindane, endosulfan, and toxaphene. The U.S. Environmental Protection Agency (EPA) considers diazinon and chlorpyrifos to be of a higher priority than Group A pesticides in controlling the usage of these pesticides and improving the water quality in the Merced River (EPA 2000a and 2000b).

Diazinon is applied during the winter rainy season to control woodboring insects in dormant almond orchards (Dubrovsky et al. 1998). Because it is applied during the rainy season, diazinon can be transported to the river by rain and run-off when CV steelhead may be present. Diazinon is moderately mobile and persistent and is highly toxic to birds, mammals, terrestrial insects, freshwater fish, and aquatic insects (EPA 2000a). Studies have have shown that exposure of salmonids to diazinon can result in diminished responsiveness to predators and reduced homing responses (EPA 2000a). The EPA currently is evaluating the need to discontinue and phase out diazinon usage in the United States (EPA 2000a).

Chlorpyrifos is used to protect grain and a variety of orchard and row crops during the March to September inigation season (e.g., to control worms in alfalfa and sugarbeets, and codling moths and twig borers in walnuts and almonds) (Stillwater Sciences 2002). Ecological risk assessment indicates that risks to birds, fish (i.e., salmonids), and mammals are high and risks to aquatic invertebrates are very high (EPA 2000b). Fish and aquatic invertebrate mortality can result from application rates as low as 0.01 pounds/acre. In addition, chlorpyrifos bioaccummulates in the tissues of aquatic organisms and, due to its acute toxicity and persistence in sediments, is hazardous to bottom feeding species (Extoxnet 2001).

*Hatchery Operations*

The Merced River Hatchery, located below Crocker-Huffman Dam, was built in 1970 by Merced ID with funds provided by the California Department of Water Resources (DWR), and is operated by DFG. This is the only salmon hatchery on the San Joaquin River south of the Delta (DFG 1993). Hatchery production is small relative to the Mokelumne River Hatchery and Feather River Hatchery. Its primary objective is to supplement natural production and help restore and maintain a healthy salmon run that supports sport and commercial fisheries. Revised hatchery production protocols utilize best management practices such as non-selective mating procedures and maintaining genetic diversity by spawning fish over the entire duration of the natural run to ensure expression of full run-time. The Merced River Hatchery produces and provides juvenile salmon for sustaining and supplementing salmon runs on the Merced, Tuolumne, and Stanislaus rivers, as well as providing juvenile salmon for study purposes throughout the San Joaquin basin. Its production success led to the closure of the ladders at the Crocker-Huffman and Merced Falls Dams resulting in more limited access by CV steelhead to their habitat in the upper reaches of the Merced River (Stillwater Sciences 2002).

*Spawning Gravels*

Spawning success (i.e., egg hatching and fry emergence) is highly dependent on flow, temperature, and dissolved oxygen levels during the development of embryos and growth of the fry (Kondolf and Wolman 1993, Barnard and McBain 1994). Barnhart (1986) noted the existence of gravels with high permeability and few fines (less than five percent sand and silt by weight) in highly productive steelhead spawning streams.

In the Merced River, sediment supply from the upper 81 percent of the watershed is intercepted by New Exchequer Dam. Because the dam intercepts the sediment supply from the upper watershed, erosion of the river bed and banks and input from Dry Creek are currently the only sources of coarse sediment to the river. Dry Creek joins the Merced River at RM 31.7 and is the only major tributary to the river downstream of Crocker-Huffman Dam. Sediment supplied from Dry Creek consists primarily of sand but includes some gravel. The creek enters at an in-channel mining pit, which captures most of the sediment delivered from the Dry Creek watershed. At the same time, bedload stored in the river channel and floodplain downstream of the dams has been removed by gold dredging and aggregate mining. Based on Stillwater Sciences baseline evaluation report, bedload sediment supply from the upper watershed was estimated to be roughly 11 to 21 thousand tons per year between 1926 and 1946. Downstream of the dams, an estimated 7 to 14 million tons of bedload, or 350 to 1,350 times the natural annual bedload supply from the upper watershed, has been removed from the channel by mining. Sediment transport continuity through the Merced River is interrupted by a series of gold dredging and aggregate mining pits. At these pits, channel slope, depth, and width have been modified to the extent that all bedload being transported from upstream reaches is deposited into the pits.

Reaches downstream of the pits are deprived of upstream bedload supply, causing scour of the bed and banks to restore the bedload supply (Stillwater Sciences 2002). This indicates that the Merced River is deprived of sediment/gravel below dams and downstream of instream aggregate mining pits. This lack of bedload supply includes gravels that may be utilized as spawning gravel by CCV steelhead.

### *2.4.2 Occurrence of Listed Species and Critical Habitat*

The number of juvenile CV fall-run Chinook salmon and CCV steelhead observed during pre-project snorkel surveys are shown in Table 2. Juvenile CV fall-run Chinook salmon were captured during 2016 pre-construction seine sampling in the main channel of the Merced River within the Action Area. No juvenile CCV steelhead were captured during 2016 pre-project seine sampling (Table 3). As predicted, juvenile salmonid density within the Proposed Project was relatively low because of its low suitability for juvenile rearing. Enhancing areas within the Action Area by adding gravel and cobble, including areas which already support spawning, is predicted to result in increased spawning utilization and higher quality incubation habitat for salmonids.

Table 2: Total number of juvenile Chinook and steelhead observed during pre-project snorkel surveys within the Action Area from 2011-2016

| Year | Months | Number of Surveys | Fall-run Chinook salmon | CCV steelhead |
|---|---|---|---|---|
| 2011 | Jun. | 2 | 23 | 3 |
| 2012 | Mar.-Jun. | 4 | 384 | 28 |
| 2013 | Feb., Apr. | 2 | 1676 | 151 |
| 2014 | Feb., Apr., May | 3 | 3145 | 0 |
| 2015 | Feb., Apr., May | 3 | 1 | 0 |
| 2016 | Feb., Apr., May | 3 | 0 | 1 |

Table 3: Total number of juvenile Chinook salmon and steelhead captured during pre-construction seine surveys for the Proposed Project in 2016

| Year | Months | Number of Surveys | Fall-run Chinook salmon | CCV steelhead |
|---|---|---|---|---|
| 2016 | March | 1 | 26 | 0 |

As part of a lower San Joaquin River study as described in Brown (2000), the author collected fish at four locations in the lower Merced River: 1) near Snelling Road Bridge (site RM 45 described by Brown); 2) near McConnell State Park (RM 27.0); 3) near Hagaman County Park (RM 12.2); and 4) at River Road (RM 1.2). Samples were collected by a combination of electrofishing or seining, or fish were observed by snorkeling. Brown collected CCV steelhead only at the Snelling Road Bridge site. From 2006 through 2008, EMRCD and Stillwater Sciences sampled fish in the main stem of the Merced River at 17 sites located from Crocker Huffman Diversion Dam to near the confluence of the Merced River with the San Joaquin River.

Depending on the year, sampling occurred between March and October, and methods included snorkeling surveys, seining, backpack electrofishing, and boat electrofishing. CCV steelhead were found only at the two upper DTR sites within 3.2 mi of Crocker-Huffman Diversion Dam, and none exhibited signs of smolting (M. Ardohain, pers. comm. 2005, as cited in Stillwater Sciences 2008). PG&E conducted a suite of fisheries study above and below Merced Falls Dam as part of relicensing. Sampling occurring above Merced Falls Dam was only within impounded water and lacustrine methodologies (i.e. boat electrofishing and gillnetting) were employed, while downstream sampling was a mixture of both stream and lacustrine sampling methods (i.e. snorkeling and backpack shocking with limited boat electrofishing). Researchers reported that all CCV steelhead captured appeared to be resident and of hatchery origin. Some of the collected fish showed fin scarring and wear from rearing in raceways. In addition, fish scales were collected and reviewed for 25 fish. Growth patterns indicated a stable rate with no indication of rapid increases generally associated with saltwater residency. During its evaluation of rearing habitat in the lower Merced River in 2012 and 2013, Merced ID surveyed by snorkeling 243 sites from Crocker Huffman Diversion Dam to Shaffer Road Bridge. Twenty-seven juvenile CCV steelhead were observed at 9 sites during 2012 and 14 juvenile CCV steelhead were observed at 10 sites during 2013. More than half of the CCV steelhead were observed within 5 mi of Crocker-Huffman Diversion Dam, with only 4 CCV steelhead observed within about 8 mi of the Shaffer Road Bridge. CDFW conducted snorkel surveys within the lower Merced River from April 20 through May 30, 2014, to document the distribution and abundance of CCV steelhead. Water temperature was also monitored. Surveys were part of a plan prepared by CDFW in preparation of a potential rescue of salmonids at risk of exposure to warm water conditions resulting from consecutive critically dry water years, including one of the driest years on record (2014) (Dean Marsten pers. comm.; June 2, 2014). Snorkeling occurred twice each week between Crocker Huffman Diversion Dam and the “G” Street Bridge. Fish count tallies were provided for sequential designated areas (i.e. alpha-numeric riffle units) per CDFW’s salmon spawning distribution maps. The purpose of conducting this monitoring was two-fold: 1) identify where CCV steelhead and salmon occur; and 2) identify the water temperature conditions that exist where the CCV steelhead and salmon are located. During the first 6 weeks of the surveys (through May 29, 2014), CDFW observed as many as 78 CCV steelhead within a survey week. Most observations were in the uppermost 1 RM (44%), with nearly 80% of the observations occurring in the upper 3 RM. Most observed CCV steelhead were larger than 12 in.; less than 4% of the observations were of young-of-the-year CCV steelhead.

Snorkel surveys conducted by CFS from February through June for monitoring associated with the Merced River Ranch and Henderson Park Restoration projects from 2010 to 2016 generally observed the first CCV steelhead fry (fork length ≤ 50 mm) in April. This fry observation timing is similar to the nearby Stanislaus River when the first CCV steelhead fry are typically observed between mid-March and early April (Kennedy and Cannon 2005). By June almost all observed CCV steelhead had fork lengths greater than 50 mm. CCV steelhead observed in the Merced River have ranged in fork length from less than 50 mm to greater than 400 mm. However, the majority of CCV steelhead observed have been less than or equal to 50 mm fork length. Rotary screw traps operated in the lower Merced River between 2007 and 2009 captured no CCV steelhead (Montgomery et al. 2009). A majority of outmigrating CCV steelhead smolts leave the nearby Stanislaus River during the late winter and early spring. Based on recoveries of CCV steelhead in the Caswell and Oakdale rotary screw traps, approximately 70% of CCV steelhead smolts have exited the Stanislaus River by the end of March (NMFS 2014). Recent genetic analysis of CCV steelhead in the lower Merced River suggests that the population is largely comprised of a resident CCV steelhead hatchery strain (Pearse and Garza 2015). In general, the quality and quantity of salmonid spawning habitat throughout the lower Merced River, including within the Action Area, has been degraded by anthropogenic impacts (NMFS 2014). The Merced River below Crocker Huffman Dam to the confluence with the San Joaquin River has low channel complexity and is lacking in floodplains and side channels that inundate regularly, resulting in limited juvenile salmonid rearing habitat (NMFS 2014). Many of the juvenile Chinook salmon and CCV steelhead rearing within the Merced River are observed holding in association with submerged vegetation and woody material. Juvenile CCV steelhead which are older than 1 year are observed holding in deeper riffles or runs with substrate consisting of a combination of gravel, cobble, and boulders/bedrock. Various types of fish cover are present within the Action Area, including submerged terrestrial vegetation and roots, instream woody material, bedrock, and overhead cover provided by lowgrowing riparian vegetation. Some locations support aquatic macrophytes that also provide cover for fish.

The physical or biological features (PBFs) of CCV steelhead Critical Habitat present in the Action Area are freshwater rearing habitat, spawning habitat, and freshwater migration corridors. As described above, the Merced River has been converted from a multi-channel system to a single, incised and constricted channel. Features such as floodplains and other off-channel salmonid rearing habitat within the Action Area only function at high flows (2,000 cfs or greater). Instream habitats and adjacent riparian/floodplain areas within the Merced River downstream of Crocker Huffman Diversion Dam have been modified or converted for uses such as agriculture, rural residential, gravel and gold mining. These major actions and other events have led to the deterioration of riparian and aquatic habitat conditions for salmonids. The Merced River is lacking in floodplain areas that inundate regularly and in channel complexity, which has resulted in very limited juvenile salmonid rearing habitat (NMFS 2014). The cover that is present includes: submerged terrestrial vegetation and roots, aquatic macrophytes, instream woody material, and overhead cover provided by low-growing riparian vegetation. Despite the anthropogenic impacts that have reduced the quality and quantity of juvenile salmonid rearing habitat in the Merced River, a limited number of CCV steelhead juveniles have been observed rearing during snorkel surveys within the Action Area.

Spawning habitat for CCV steelhead is likely present within the Action Area. However, CCV steelhead have not been observed spawning within the Action Area. CV fall-run Chinook salmon spawning has been observed within the Action Area and there is overlap in their preferred spawning habitat characteristics (Zeug et al. 2014a). Gravel augmentation is expected to improve the quality and quantity of CCV steelhead spawning habitat within the Action Area. The Merced River within the Action Area could be used as a migration corridor for adult and juvenile CCV steelhead.

## 2.5 Effects of the Action

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

The following is an analysis of the potential direct and indirect effects to listed fish species that may occur as a result of implementing the proposed action in the Merced River. For our analysis on the effects of the proposed action to listed species, we have used the presence of species in the action area to determine the risk each the species and life stage may face if exposed to project impacts. The effects of the proposed action components that were analyzed include: (1) sediment and turbidity, (2) contaminants, (3) noise exposure, (4) habitat modification, and (5) monitoring activities.

Our assessment considers the nature, duration, and extent of the proposed actions relative to the spawning, rearing, and migration timing, behavior, and habitat requirements of all life stages of federally listed fish in the action area. Effects of the restoration project on aquatic resources include direct and indirect effects. When the project is complete, the Proposed Project would provide long-term beneficial impacts to the listed species and critical habitat. Potential impacts from specific monitoring actions related to each restoration activity are also described below.

### *2.5.1 Construction Activities*

NMFS expects that rearing juvenile CCV steelhead may be present in the action area during in-water construction activities (July 15 to October 15), potentially exposing juvenile steelhead to construction related adverse impacts such as increased sedimentation and turbidity, release of contaminants from construction equipment, increased noise and disturbance and modification of habitat.

Impacts to adult migration and spawning, egg incubation, and emergence would be avoided because construction activities would occur outside of the timing of those life stages. Therefore, no adverse effects to those life stages are expected during construction activities.

*Sediment and Turbidity*

Construction activities related to restoration actions would temporarily disturb soil and riverbed sediments as well as riparian vegetation, resulting in the potential for temporary increases in turbidity and suspended sediments in the Merced River within the Action Area. Restoration-related increases in sedimentation and siltation above the background level could potentially affect fish species and their habitat.

High concentrations of suspended sediment can have both direct and indirect effects on salmonids. The severity of these effects depends on the sediment concentration, duration of exposure, and sensitivity of the affected life stage. Based on the types and duration of proposed in-water construction methods, short-term increases in turbidity and suspended sediment may disrupt feeding activities or result in avoidance or displacement of fish from preferred habitat. Juvenile salmonids have been observed to avoid streams that are chronically turbid (Lloyd 1987) or move laterally or downstream to avoid turbidity plumes (Sigler et al. 1984). Bisson and Bilby (1982) reported that juvenile Coho Salmon (*Oncorhynchus kisutch*) avoid turbidities exceeding 70 NTUs. Sigler et al. (1984) found that prolonged exposure to turbidities between 25 and 50 NTUs resulted in reduced growth and increased emigration rates of juvenile Coho Salmon and steelhead compared to controls. These findings are generally attributed to reductions in the ability of salmon to see and capture prey in turbid water (Waters 1995). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). Berg and Northcote (1985) observed changes in social and foraging behavior and increased gill flaring (an indicator of stress) in juvenile Coho Salmon at moderate turbidity (30-60 NTU). In this study, behavior returned to normal quickly after turbidity was reduced to lower levels (0-20 NTU). In addition to direct behavioral and physical effects on fish, increased sedimentation can alter downstream substrate conditions, as suspended sediment settles and increases the proportion of fine particles in the system. Adult salmonids require coarse substrate (gravel and small cobbles) to construct redds, and deposition of fine substrate may reduce egg and alevin survival and lead to decreased production of the macroinvertebrate prey of juvenile salmonids (Wu 2000, Chapman 1988, Phillips et al. 1975, Colas et al. 2013). Deposited fine sediment can impair growth and survival of juvenile salmonids (Suttle et al. 2004, Harvey et al. 2009). However, minor accumulations of deposited sediment downstream of construction are generally removed during normal annual high flow events (Anderson et al. 1996).

Impacts to CCV steelhead would be minimized by conducting all in-water restoration activities during the dry season between July 15 and October 15. Weekly redd surveys would be performed within the Action Area and in-water restoration work would cease immediately for the remainder of the season if evidence of salmon spawning is observed. The number of juvenile salmonids potentially residing in the Action Area during in-water restoration is expected to be very low because of the time of year and low quality of existing habitat. Individual fish that encounter increased turbidity or sediment concentrations would be expected to move laterally, downstream, or upstream of the affected areas. For juveniles, this may increase their exposure to predators if they are forced to leave protective habitat. Turbidity plumes would be expected to affect only a portion of the channel width and extend up to 1,000 ft downstream of the Action Area. Turbidity would be monitored in accordance with the Section 401 Water Quality Certification for the Proposed Project, and if turbidity exceeds the thresholds identified in the certification, work would cease until levels return to background levels.

The Proposed Project may have direct effects on rearing CCV steelhead by reducing water quality during project construction. Impacts to rearing CCV steelhead would be minimized by the water quality conservation measures. In addition, juvenile steelhead are highly mobile and would likely avoid the Proposed Project impacts by swimming away and rearing in highly suitable habitats of the river. Because water quality impacts are temporary and short in duration, in addition to their highly mobile behavior, adverse direct and indirect effects of sediment and turbidity on CCV steelhead would be avoided or minimized to the extent that the effects would be insignificant and not likely to reach a level that causes injury or death.

*Contaminants*

During restoration activities, the potential exists for spills or leakage of toxic substances that could enter the Merced River. Refueling, operation, and storage of construction equipment and materials could result in accidental spills of pollutants (e.g., fuels, lubricants, sealants, and oil).

High concentrations of contaminants can cause direct (sub-lethal to lethal) and indirect effects on fish. Direct effects include mortality from exposure or increased susceptibility to disease that reduces the overall health and survival of the exposed fish. The severity of these effects depends on the contaminant, the concentration, duration of exposure, and sensitivity of the affected life stage. A potential indirect effect of contamination is reduced prey availability; invertebrate prey survival could be reduced following exposure, therefore making food less available for fish. Fish consuming infected prey may also absorb toxins directly. For salmonids, potential direct and indirect effects of reduced water quality during construction would be addressed by avoiding construction during times when salmonids are most likely to be present, utilization of vegetable-based lubricants and hydraulic fluids in equipment operated in the wet channel, and a Spill Prevention and Response Plan to avoid, and if necessary, clean up accidental releases of hazardous materials. Implementation of conservation measures would minimize adverse effects to juvenile CCV steelhead such that impacts would be discountable and would not likely to reach a level that causes injury or death.

*Noise Exposure*

Noise generated by heavy equipment and personnel during restoration activities could adversely affect fish and other aquatic organisms. The potential direct effects of underwater noise on fish and other organisms depend on a number of biological characteristics (e.g., fish size, hearing sensitivity, behavior) and the physical characteristics of the sound (e.g., frequency, intensity, duration) to which fish and invertebrates are exposed. Potential direct effects include behavioral effects, physiological stress, physical injury (including hearing loss), and mortality. The loudest noise generated at the Action Area is expected from the sediment sorting equipment. This equipment would not come in contact with aquatic habitat. Diesel engines are the second greatest noise expected at the Action Area. No diesel engines or their exhaust systems would come in contact with the flowing channel. No indirect effects are anticipated as a result of construction noise.

Exposure of adult and juvenile salmonids to noise and disturbance would be minimized by conducting all instream activities during a single construction season between July 15 and October 15 when minimal numbers of adult and juvenile Chinook salmon and CCV steelhead are likely to be present in the Action Area.

Noise and disturbance would be limited to the immediate Action Area and, at any given time, the area immediately surrounding the restoration activity. Once construction is underway, individual fish approaching the Action Area from upstream or downstream are likely to detect the sounds/vibrations and avoid the Action Area.

By avoiding contact with flowing water from the sediment transport equipment and diesel engines that could generate noise, along with restricting the time period during which restoration activities would occur, the potential noise impacts would be minimized such that the impacts would be insignificant to CCV steelhead and not likely to reach a level that causes injury or death.

### *2.5.2 Habitat Modification*

Restoration activities would result in the disturbance of an estimated 2.33 acres of perched floodplain habitat. Approximately 65,000 cubic yards (yd3) of material would be excavated during floodplain lowering and side channel creation. Gravel would be deposited in-stream and placed by rubber-tired front-end loaders (Caterpillar 950 Loader). Creation of side channels and minor drainage channels would modify bank habitat; however, islands of native plants and trees would be preserved within the restoration area. Wetland areas on site would not be impacted or reduced in size, but minor channels would be created downstream to allow drainage at high flows. Habitat restoration would cause short-term adverse impacts and long-term beneficial impacts to steelhead.

Gravel and cobble placement in the main channel to create bar features, enhance salmonid spawning habitat, and increase water surface elevation to facilitate inundation of the side channel would alter channel habitat. Channel habitat would be temporarily disturbed when side channel connections with the main channel are created and may result in a short-term decrease in natural cover for salmonids. Side channel and floodplain excavation would change the hydrodynamics of the channel to provide more complex habitat in the Action Area. The amount of shallow water edge habitat used by rearing juvenile salmonids would increase along with frequency of floodplain and side channel inundation.

Bar feature creation and spawning gravel augmentation in the main channel has the potential to impact juvenile salmonids through disturbance and displacement. Cobble and gravel addition to the main channel would occur during a time period (July 15 to October 15), when few juvenile and adult salmonids are present within the Action Area. Gravel augmentation would temporarily impact CV fall-run Chinook salmon spawning riffles. However, gravel augmentation would occur before the spawning season and would increase the quality and quantity of spawning habitat within the Action Area. Juvenile CCV steelhead that may be present in locations where gravel and cobble addition would occur are expected to be able to avoid and temporarily or permanently relocate away from the area. Juvenile CCV steelhead are highly mobile and will rapidly move away from an area when they are disturbed. When heavy equipment enters the river to place gravel, fish in the vicinity are expected to be spooked and move rapidly away from the area of disturbance and thus avoid being injured or killed through crushing by the vehicle or gravel placement. Fish that are spooked are likely to endure short-term stress from being forced to migrate away from their current holding/rearing area and needing to temporarily or permanently locate a new holding/rearing location. When gravel is being repeatedly added to an area, then fish are likely to temporarily or permanently relocate from the area. Juvenile fish may be subject to increased predation risk while they are locating a new holding/rearing area. Displaced juvenile fish are likely to find a new holding/rearing location that is suitable as juvenile fish density, particularly CCV steelhead, in the Merced River within the Action Area has been observed to be low (CFS 2018). During creation and/or enhancement of spawning habitat that would also serve as juvenile salmonid rearing habitat (see Sellheim *et al.* 2016), juvenile salmonids are likely to avoid the construction area during the day and return to the new habitat when construction activities have ceased for the day to use the habitat over the night until construction starts again the next day. Juvenile salmonids feeding has been observed immediately downstream of gravel placement activity and returning to placement sites immediately after equipment activity has ceased. Relatively few juvenile salmonids are expected to be impacted by instream restoration activities as juvenile salmonid density has been observed to be low in the Merced River within the Action Area, particularly during the summer. The temporary displacement of fish and the stress they have to endure is not expected to affect the survival chances of individual fish based on the size of the area that would likely be affected and the small number of juvenile CCV steelhead likely to be displaced.

Instream restoration activities are expected to cause benthic aquatic macroinvertebrates to be killed, displaced, or their abundance reduced when they are covered with coarse sediment added to the channel to enhance salmonid spawning habitat. However, effects to aquatic macroinvertebrates from displacement and sediment smothering would be temporary because restoration activities would be relatively short lived and rapid recolonization (about one to two months) of the new sediment is expected (Merz and Chan 2005). The benthic macroinvertebrate production within the Action Area is expected to increase when construction is complete as there would be an increase in area of perennial riffle habitat. The amount of food available for juvenile salmonids and other native fishes is therefore expected to increase.

To the maximum extent practicable, existing riparian habitat would be retained and disturbance of riparian habitat would be minimized. All large gallery trees present in the site would be retained. However, riparian vegetation that cannot be avoided would be replanted as stated in the project description.

Following restoration activities, all disturbed or exposed soils would be stabilized and planted with native woody and herbaceous vegetation to control erosion and offset any unavoidable losses of vegetation. Non-native plant species would be replaced with native riparian plants. Some short-term losses of mature riparian vegetation may occur during restoration which may result in a short term reduction in natural cover for salmonids. However, plantings and natural riparian vegetation recruitment would establish and mature following project completion thereby resulting in an increase in the amount and extent of riparian habitat within the Project area.

Overall, completion of the project is expected to have beneficial impacts by increasing the quality and quantity of spawning and rearing habitat for CV fall-run Chinook salmon and CCV steelhead. Existing low-lying areas associated with relict side channel and floodplain topography would be enhanced to activate more frequently and at depths and velocities more appropriate for rearing salmonids. Creation of side channel habitat and enhancement of existing riffles would improve and increase area of spawning and rearing habitat for salmonids. Imported coarse material would be used to enhance in-channel features for spawning, incubation, and rearing habitat. Although some short-term disturbance may occur when coarse sediment is placed into the river channel to improve spawning, incubation, and rearing habitat, these effects would be minimized through implementation of the salmonid protection measures described above.

Disturbance to benthic macroinvertebrates would be temporary as they would rapidly colonize the newly added substrate. Riparian vegetation, including native trees and plants, would be retained and managed to maintain the vital ecological roles it currently provides within the community. Due to the timing of construction activities and mitigation measures that would be implemented, potential impacts from habitat modifications would be insignificant to CCV steelhead and not likely to reach a level that causes injury or mortality of CCV steelhead. Lastly, there would be long-term beneficial impacts from the Proposed Project for all life stages of CCV steelhead.

### *2.5.3 Monitoring Activities*

The long-term monitoring efforts accompanying the Proposed Project's aim to measure changes in the Action Area's hydrology, geomorphology, and river ecosystem as it relates to CCV steelhead and CV fall-run Chinook salmon life cycles (CFS 2017).

*Hydrology and Geomorphology*

Collecting data on hydrology and geomorphological changes would require in-water wading by staff to conduct survey work with survey-grade GPS equipment. Wading activities would likely be restricted during low-flow periods in late summer (i.e., July through September) when the presence of juvenile and adult salmonids is minimized due to the timing of their life cycles. Alterations to the riverbed topography and substrate from wading are trivial, and wading is generally considered a low-level and short-term disturbance to juvenile and adult salmonids. If juvenile or adult salmonids are observed during survey work then all effort would be made to avoid disturbing them by not wading or surveying in their vicinity. Therefore, impacts to juvenile and adult CCV steelhead are considered to be discountable.

*Stream Temperature*

Changes in stream temperature would be evaluated during and after the Proposed Project is implemented. These evaluations would require the installation of water temperature recorders within the Action Area. Installation of these temperature recorders may require minimal wading. However, the installation of the water temperature recorders would be in locations and at times of the year when presence of juvenile or adult salmonids is minimized. The installation and presence of these recorders would not have measureable biological impacts to the Action Area and impacts to CCV steelhead individuals would be discountable.

*Juvenile Salmonid Prey Base*

Changes to juvenile salmonid prey-base would be assessed before and after implementation. These assessments would require sampling of macroinvertebrates present in the drift and benthos. Sampling efforts may require minor disturbance of benthic substrate through wading and to dislodge macroinvertebrates. The total area of benthic substrate disturbed during sampling (using a Hess sampler) is small (< 10 ft2 [0.93 $m^2$]) and time spent wading is short-term (minutes). Care would be taken to avoid areas being used by salmonids (e.g., active redds). Juvenile salmonids can easily avoid staff and equipment associated with these sampling activities. Juvenile and adult salmonids that are spooked away from their holding/rearing area during invertebrate sampling would return to the area when the disturbance from sampling has ceased. If juvenile or adult salmonids are observed during macroinvertebrate sampling, effort would be made to avoid disturbing them by not sampling or wading in their vicinity. Biological impacts from macroinvertebrate sampling are considered temporary and minor and therefore insignificant to juvenile and adult CCV steelhead.

*Salmonid Snorkel and Video Surveys*

Snorkel surveys would require survey staff to observe and enumerate rearing juvenile salmonids within the Action Area and record the GPS coordinates and depth and velocity in the locations in which juvenile salmonids are observed. Snorkel surveys would require a day to complete and would typically be performed monthly from February through May, the time period when rearing juvenile salmonids are present. If present in the system, adult CCV steelhead may be observed during juvenile salmonid snorkel surveys during February through April, as these months overlap with the migration, holding, and spawning of CCV steelhead in the Merced River. Effort would be made to avoid actively spawning adult CCV steelhead during snorkel surveys by not wading or surveying in their vicinity. The presence of individuals conducting the snorkel surveys would have short-term impacts on fish behavior and habitat use. Performing snorkel surveys is likely to result in “take” of CCV steelhead through observation and harassment, if they are present.

Two types of video surveys would be used, shallow water and deep pool. Both survey types would take a day to complete, with shallow water video occurring up to monthly from February to May and deep pool video up to twice a year. During shallow water video, disturbing adult CCV steelhead would be avoided by not placing the cameras or wading in the vicinity of where actively spawning or holding adult CCV steelhead are observed. Juvenile and adult CCV steelhead may be observed during deep pool video surveys and the presence of the camera and boat may have short-term impacts on fish behavior and habitat use.

Direct observation is the least disruptive method for determining a species’ presence/absence and estimating their relative abundance. Its effects are also generally the shortest-lived and least harmful of the research activities discussed in this section. A cautious observer can effectively obtain data while only slightly disrupting the fishes’ behavior. Juvenile salmonids frightened by the turbulence and sound created by observers, are likely to seek temporary refuge in deeper water, behind or under rocks, or riparian vegetation. In extreme cases, some individuals may leave a particular pool or habitat type and then return when observers leave the area. At times, the research involves observing adult fish—which are more sensitive to disturbance. During some of the research activities, redds may be visually inspected, but would easily avoid trampling redds. Harassment is the primary form of take associated with these observation activities, and few if any injuries (and no deaths) are expected to occur. Because these effects are so small, there is little a researcher can do to mitigate them except to avoid disturbing sediments, gravel, and, to the maximum extent possible, the individual fish themselves, and allow any disturbed fish the time they need to reach cover. Performing video surveys is likely to result in take of CCV steelhead through observation and harassment, if they are present.

*Juvenile Salmonid Seine and Fyke-Net Sampling*

Monitoring juvenile salmonid habitat use within the main channel, side-channel, and floodplain in the Action Area may require seine sampling. Seine sampling may occur monthly from February through May. Seine sampling would be used when water turbidity (i.e. visibility) precludes snorkel surveys. Seining would require wading by individuals operating the seine net and the net would possibly agitate stream bottom substrate where it is deployed. Negative effects of seining include, small fish can be gilled in the mesh of a seine, scales and dermal mucus can be abraded by contacting the net, fish can be suffocated if they are not quickly removed from the net after the net is removed from the water to process the fish, and the fish can be crushed by the handler when removing the net from the water.

The fyke-net sampling would be used to determine if juvenile salmonids are using and benefitting from the floodplain and side channel areas that were rehabilitated as part of the Proposed Project. The fyke-nets would be checked twice a day to process fish in the live boxes and to clean debris from the traps and live boxes. Use of these nets can cause abrasion to fish from shaking fish down into the end prior to removal. Furthermore, these nets can result in mortality when small fish are gilled in the mesh of the nets. Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared regularly.

Captured fish would be held in cool, oxygenated freshwater and anesthetized prior to any handling. Captured juvenile CV fall-run Chinook salmon and CCV steelhead would be weighed and measured and then placed in an aerated recovery bucket. Once fish in the recovery buckets are behaving normally then the fish would be returned to a proper release location within the area from which they were captured.

Any physical handling is known to be stressful to fish (Sharpe et al. 1998). The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river and wherever the fish are held in buckets/live boxes), dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18º Celsius or dissolved oxygen is below saturation. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps if the traps are not emptied regularly. Decreased survival of fish can result when stress levels are high because stress can be immediately debilitating and may also increase the potential for vulnerability to subsequent challenges (Sharpe et al. 1998). The Proposed Project contains measures that mitigate the factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish. When these measures are followed, fish typically recover fairly rapidly from handling.

Seine and fyke sampling is expected to result in the take of CCV steelhead through capture and handling, if present in the system. However, no CCV steelhead were captured during pre-project seine sampling surveys performed within the Action Area in March 2016. If fish mortality occurs during seining or fyke-net sampling, then the sampling would cease immediately and NMFS would be contacted. Sampling would only be performed again with the approval of NMFS.

### *2.5.4 Effects on Critical Habitat*

The proposed restoration project is expected to cause direct short and long-term effects on critical habitat for CCV steelhead. The project is expected to temporarily cause adverse impacts to several PBFs of critical habitat for CCV steelhead. Potential project effects include temporary water quality degradation from localized increases in turbidity and suspended sediment, temporary disturbance to spawning riffles during gravel augmentation, temporary channel disturbance during connection of side channels to the main channel, short-term reduction of natural cover resulting from channel and riparian disturbance, and potential discharges of contaminants in the Merced River during restoration activities. The effects of these short-term impacts would be mitigated by the measures discussed above.

Long-term direct effects on designated critical habitat would be beneficial, including: increased channel complexity, reduced sedimentation and turbidity, increased side channel, floodplain, incubation, and spawning habitat, and improved riparian vegetation quality.

Project modifications would result in a beneficial change to freshwater incubation, rearing, and spawning PBFs because of the existing low quality rearing and spawning habitat in the action area and the increased quality and quantity of the restored habitat. The action area would also continue to function as a freshwater migration corridor by providing adequate passage for adult and juvenile salmonids. Therefore, the Proposed Project would have long-term benefits to critical habitat.

## 2.6 Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the Action Area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the status of the species (Section 2.2).

*Agricultural Practices*

Agricultural practices in the action area may adversely affect riparian habitats through upland modifications of the watershed that lead to increased siltation, reductions in water flow, or agricultural run-off. Grazing activities from cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which can flow into the receiving waters of the associated watersheds. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect listed salmonids reproductive success and survival rates (Dubrovsky 1998, Daughton 2002).

*Increased Urbanization*

Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. Increased growth would place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those which are situated away from waterbodies, would not require Federal permits, and thus would not undergo review through the ESA section 7 consultation process with NMFS. Increased urbanization also is expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways.

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

*Rock Revetment and Levee Repair Projects*

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

## 2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the Proposed Project. 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 Project 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.

*Status of the CCV Steelhead DPS*

The Status of Species and Environmental Baseline sections show that past and present impacts to the San Joaquin River basin have caused significant salmonid habitat loss, fragmentation and degradation. This has significantly reduced the quality and quantity of freshwater rearing sites and the migratory corridors within the lower valley floor reaches of the San Joaquin River and the south Delta for these listed species. Additional loss of freshwater spawning sites, rearing sites, and migratory corridors have also occurred upstream of the south Delta in the upper main stem and tributaries of the San Joaquin River. The 2016 status review (NMFS 2016) concluded that overall, the status of CCV steelhead appears to have changed little since the 2011 status review when the Technical Recovery Team concluded that the DPS was in danger of extinction. Further, there is still a general lack of data on the status of wild steelhead populations. There are some encouraging signs, as several hatcheries in the Central Valley (such as Mokelumne River), have experienced increased returns of steelhead over the last few years. There has also been a slight increase in the percentage of wild steelhead in salvage at the south Delta fish facilities, and the percent of wild fish in those data remains much higher than at Chipps Island. Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin continue to show an overall very low abundance, and fluctuating return rates.

*Status of the Environmental Baseline and Cumulative Effects in the action area*

CCV steelhead use the action area as a spawning, rearing, egg incubation, and migratory corridor. Within the action area, the essential features of freshwater spawning, egg incubation, rearing and migration habitats for steelhead have degraded over time due to agriculture, rural residential, gravel and gold mining, water impoundments, increased water diversions, decreased instream flows, and levees. The construction of New Exchequer Dam and gold mining has resulted in an essentially static channel in the lower river reach accessible to anadromous salmonids. The change in ecosystem as a result of halting the lateral migration of the river channel, the loss of floodplains, the removal of riparian vegetation, loss of gravel and instream woody material have likely affected the functional ecological processes that are essential for growth and survival of CCV steelhead in the action area.

*Summary of Project Effects on CCV Steelhead*

<u>Construction-related Effects</u>

During construction, some injury or death to individual fish is possible to result from placement of the gravel, or predation related to displacement of individuals away from the shoreline or at the margins or turbidity plumes. These construction type actions would occur during the summer and early fall months, when the abundance of individual steelhead is low and avoids adult and incubation periods, which would result in correspondingly low likelihood of injury or death. Alignment of a new channel is likely to result in increased turbidity, although this effect would be temporary in nature.  These construction effects may result in injury or death to salmonids due to physiological damage from avoidance activity, reduced foraging capability, and increased predation related to displacement of individuals away from the shoreline or at the margins or turbidity plumes. Depending on the life stage of the listed species, impacts from increased turbidity would vary. Juvenile and adult salmonids would have adjacent suitable habitat to temporarily move to if needed. Incubating eggs would be at the highest risk. However, with the timing of instream work during summer when eggs would not be present and weekly redd surveys to monitor for redds, this effect can be considered discountable.

As a result of channel realignment, floodplain restoration, and placement of instream habitat structures, spawning and rearing habitats are expected to increase and improve for CCV steelhead. A long-term benefit of the continued project is that population abundances are expected to increase.

Monitoring-related Effects

During monitoring activities, some injury or death to individuals is likely to occur as a result of capture and handling of fish. However, proper care and precautions would be taken during the monitoring activities to minimize stress and mortality to individual fish.

*Summary of Project Effects on CCV Steelhead Critical Habitat*

Within the action area, the relevant PBFs of the designated critical habitat for listed salmonids are spawning, egg incubation, rearing, and migration.

The PBFs for the above habitats is expected to be affected by the temporary removal of vegetation, short-term channel modifications, temporary increases in turbidity, and wading and seining during monitoring activities. These activities are expected to temporarily decrease the quality of habitat. The minor disturbances to habitat as part of monitoring efforts are expected to have insignificant effects to the habitat. Long-term impacts to critical habitat would be beneficial as it would increase the quality and quantity of habitat for all life stages of CCV steelhead.

*Summary*

Although there are some direct short-term impacts from the Proposed Project, when added to the environmental baseline and cumulative effects, the adverse impacts from the Proposed Project in the action area are minimal. Overall, the project would result in long-term beneficial effects to the individual steelhead and their critical habitat as it would result in an increase in quality and quantity of spawning and rearing habitat in the action area.

## 2.8 Conclusion

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

## 2.9 Incidental Take Statement

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

### *2.9.1 Amount or Extent of Take*

NMFS anticipates incidental take of CCV steelhead through the implementation of the proposed monitoring efforts in the action area. NMFS determined that incidental take is reasonably certain to occur as follows: incidental take of juvenile and adult CCV steelhead in the proposed action area. NMFS anticipates that juveniles and adults would be observed, harassed, captured, handled, or killed as a result of the proposed monitoring activities that would be occurring between February through December, up to three years. Specifically, incidental take is expected to occur during beach seining, snorkel surveys, spawning surveys, video monitoring, and fyke-net sampling activities, up to three years.

Table 4. Take of CCV steelhead for monitoring activities associated with the Proposed Project

| Method | Take Action | Life Stage | Expected Annual Take | Indirect Mortality |
|---|---|---|---|---|
| Beach Seine | Capture/ Handle/ Release Fish | Juvenile | 150 | 1 |
| Snorkel Surveys | Observe/Harass | Juvenile | 250 | 0 |
| Snorkel Surveys | Observe/Harass | Adult | 10 | 0 |
| Video Monitoring | Observe/Harass | Juvenile | 50 | 0 |
| Video Monitoring | Observe/Harass | Adult | 1 | 0 |
| Fyke-net Sampling | Capture/ Handle/ Release Fish | Juvenile | 250 | 2 |

### *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.

## 2.10 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). At this time, no conservation recommendations have been identified.

### *2.10.1 Reasonable and Prudent Measures*

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

1. Measures shall be taken to ensure that all activities minimize, to the maximum extent practicable, any adverse effects on CCV steelhead.

2. Measures shall be taken by Reclamation to monitor incidental take of CCV steelhead and provide NMFS with a report following each monitoring season.

### *2.10.2 Terms and Conditions*

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

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

    a. ESA-listed fish must be handled with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; e.g., the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the applicant must process ESA-listed fish first to minimize handling stress.

    b. Handling must stop (i.e. no sedation, measurements, weighing procedures, etc.) of ESA-listed fish if the water temperature exceeds 70 degrees Fahrenheit at the capture site. Under these conditions, listed fish may only be identified and counted.

    c. If ESA-listed fish are anesthetized to avoid injuring or killing them during handling, the fish must be allowed to recover before being released. Fish that are only counted must remain in water and not be anesthetized.

d. When using anesthesia, extreme care shall be taken to use the minimum amount of substance necessary to immobilize ESA-listed salmonids for handling and sampling procedures. It is the responsibility of the researcher to determine when anesthesia is necessary to reduce injuries to ESA-listed salmonids during handling and sampling activities.

e. In the event that debris (rocks, logs, abundant vegetation, etc.) are trapped within the beach seine, researchers will remove debris before fish are centralized in the net to prevent harm. Researchers will select the smallest mesh-size seine-net or dip-net that is appropriate to achieve sampling objectives while reducing the probability that smaller fish will become gilled in the net.

f. If any ESA-listed adult fish is unintentionally captures while sampling for juveniles, the adult fish must be released without further handling and such take must be reported.

g. Care must be exercised during spawning ground surveys to avoid disturbing ESA-listed adult salmonids and redds when they are spawning. Visual observation must be used instead of intrusive sampling methods, especially when just determining fish presence.

h. Approval from NMFS must be obtained before changing sampling locations or research protocols.

i. NMFS must be notified as soon as possible but no later than two days after any authorized level of take is exceeded or if such an event is likely. A written report detailing why the authorized take level was exceeded or is likely to be exceeded must be submitted.

j. Any NMFS employee or representative will be allowed to accompany field personnel while they conduct monitoring and evaluation activities.

k. Any NMFS employee or representative must be allowed to inspect any records or facilities related to the authorized monitoring and evaluation activities.

   a. Reclamation shall submit a riparian planting plan for on-site plantings prior to restoration activities. Measures would be taken to ensure the performance criteria of 70 percent survival of plantings, for a period of three consecutive years.

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

   a. On or before January 31st of every year, Reclamation must submit to NMFS a post-season report in the prescribed form describing the research activities, the number of listed fish taken and the location, the type of take, the number of fish intentionally killed and unintentionally killed, the take dates, and a brief summary of the research results. The report must be submitted electronically on our permit website, and the forms can be found at *https://apps.nmfs.noaa.gov/*. Falsifying annual reports or records is a violation of this authorization.

b. Reports 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

## 2.11 Reinitiation of Consultation

This concludes formal consultation for the Merced River Instream and Off-channel Habitat Rehabilitation Project.

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 Reclamation and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

## 3.1 Essential Fish Habitat Affected by the Project

EFH designated under the Pacific Coast Salmon FMP may be affected by the Proposed Action. Additional species that utilize EFH designated under this FMP within the action area include fall-run/late fall-run Chinook salmon. Habitat Areas of Particular Concern (HAPCs) that may be either directly or indirectly adversely affected include (1) complex channel and floodplain habitat, (2) spawning habitat, and (3) thermal refugia.

## 3.2 Adverse Effects on Essential Fish Habitat

Effects to the HAPCs listed above are discussed in context of effects to critical habitat PBFs as designated under the ESA in section 2.2.2. A list of adverse effects to EFH HAPCs is included in the EFH consultation. Affected HAPCs are indicated by number corresponding to the list in section 3.1:

1. Sediment and Turbidity
    a. Degraded water quality (1, 2, 3)
    b. Reduce habitat complexity (1, 2, 3)

2. Contaminants
    a. Degraded water quality (1)

3. Modification of Physical Habitat and Riparian Habitat
    a. Temporary loss of riparian habitat which provide shade, cover, nutrients, and habitat complexity due to vegetation removal or trimming (1, 3)

### 3.3 Essential Fish Habitat Conservation Recommendations

1. NMFS recommends the following measures in order to mitigate for sediment and turbidity:

    a. Reclamation shall implement erosion control measures such as silt fencing or fiber rolls to trap sediments and erosion control blankets on exposed slopes.

        a. Reclamation shall appropriately screen and clean gravel prior to placement in the main channel and side channels to avoid introduction of additional fine material into the Merced River.

    b. Grade and stabilize spoils sites to minimize erosion and sediment input to surface waters.

    c. Stream bank impacts shall be isolated and minimized to reduce bank sloughing. The banks would be stabilized following project activities.

2. NMFS recommends the following measures in order to mitigate for contaminants:

    a. Reclamation shall implement construction-site housekeeping practices, including prohibitions on discharging or washing potentially harmful materials into areas that could lead to waterways. Vehicles and equipment would be washed/cleaned only at approved off-site areas. All equipment would be steam cleaned prior to working within the stream channel to remove contaminants that may enter the river or adjacent lands.

    b. All equipment working within the stream corridor would be inspected daily for fuel, lubrication, and coolant leaks; and for leak potentials (e.g., cracked hoses, loose filling caps, stripped drain plugs); and, all equipment must be free of fuel, lubrication, and coolant leaks. All equipment would be fueled and lubricated in designated staging area located outside the stream channel and banks. Only vehicles serviced with vegetable-based lubricants would work in the active channel to reduce the potential for water quality impacts to the Merced River.

    c. A Spill Prevention and Response Plan that identifies any hazardous materials to be used during restoration work; describes measures to prevent, control, and minimize the spillage of hazardous substances; describes transport, storage and disposal procedures for these substances; and outlines procedures to be followed in case of a spill of a hazardous material. The Spill Prevention and Response Plan would require that hazardous and potentially hazardous substances stored onsite be kept in securely closed containers located away from drainage courses, agricultural areas, storm drains, and areas where stormwater is allowed to infiltrate. It would also stipulate procedures, such as the use of spill containment pans, to minimize hazard during onsite fueling and servicing of construction equipment. Finally, the Spill Prevention and Response Plan would require that the County be notified immediately of any substantial spill or release.

3. NMFS recommends the following measures in order to mitigate for the modification of physical and riparian habitat:

   a. During restoration activities, as much understory brush and as many trees as possible would be retained. The emphasis would be on retaining shade-producing and bank-stabilizing vegetation.

   b. Any disturbed and decompacted areas outside the restoration area would be revegetated with locally native species.

   c. There would be no impacts on heritage size trees (i.e. greater than 16 inches diameter breast height).

   d. Sensitive vegetation in the near vicinity of restoration areas would be flagged or fenced.

   e. All contractors and equipment operators would be given instructions to avoid impacts and be made aware of the ecological value of the site.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, approximately 7.2 acres of designated EFH for Pacific Coast salmon.

## 3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, Reclamation 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 response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the Action Agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

## 3.5 Supplemental Consultation

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

# 4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

## 4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Bureau of Reclamation. Other interested users could include Merced Irrigation District. Individual copies of this opinion were provided to the Bureau of Reclamation. The format and naming adheres to conventional standards for style.

## 4.2 Integrity

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

## 4.3 Objectivity

Information Product Category: Natural Resource Plan

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

***Best Available Information:*** This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH 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.

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