UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

July 08, 2019 **Refer to NMFS No:** WCRO-2018-00244

Thomas Holstein
Environmental Branch Chief
Caltrans D4 Office of Local Assistance
P.O. Box 23660, MS-10B
Oakland, California 94623-0660

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Seismic Retrofit, Replacement, and Preventative Maintenance Activities at Three Bridges within the Town of Fairfax in Marin County, California (STPL-5277 [025]) (STPL-5277[026]) (STPL-5277[027])

Dear Mr. Holstein:

Thank you for your letters of March 6, 2018, December 6, 2018, and March 27, 2019, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for seismic retrofit, replacement, and preventative maintenance activities at three bridges located within the Town of Fairfax, Marin County, California.[1] Seismic retrofit is proposed for the Creek Road Bridge; preventative maintenance is proposed at the Canyon Road Bridge; and replacement is proposed for the Meadow Way Bridge. Your letter of March 27, 2019, requested NMFS combined our review and consultations for these three bridges collectively into one consultation.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for these actions. The proposed projects will occur within an area identified as EFH for California Central Coast (CCC) coho salmon (*O. kisutch*) managed under the Pacific Coast Salmon Fishery Management Plan. The proposed projects include design and staging considerations to avoid adverse effects to EFH. In this case, NMFS concluded the action would not adversely affect EFH. Thus, consultation under the MSA is not required for this action.

In the enclosed biological opinion, NMFS concludes the proposed bridge projects are not likely to jeopardize the continued existence of threatened CCC steelhead, nor are the projects likely to

[1] Pursuant to 23 USC 327, and through a series of Memorandum of Understandings beginning June 7, 2007, the Federal Highway Administration (FHWA) assigned and Caltrans assumed responsibility for compliance with Section 7 of the federal Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) for federally-funded transportation projects in California. Therefore, Caltrans is considered the federal action agency for consultations with NMFS for federally funded projects involving FHWA. Caltrans proposes to administer federal funds for the implementation of the proposed action, and is therefore considered the federal action agency for this consultation.

result in the destruction or adverse modification of its critical habitat. However, NMFS anticipates take of CCC steelhead will occur during construction activities as juvenile steelhead are likely to be present during dewatering of the work sites for project implementation. An incidental take statement with non-discretionary terms and conditions is included with the enclosed biological opinion. NMFS has also found that the proposed bridge projects are not likely to adversely affect designated critical habitat for CCC coho salmon.

Please contact Darren Howe at (707) 575-3152, or darren.howe@noaa.gov if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: Hugo Ahumada, Caltrans, Oakland, CA
Garrett Toy, Town Manager -Town of Fairfax, CA
Mark Lockaby, Public Works Manager – Town of Fairfax, CA
Roberta Morganstern, U.S. Army Corps of Engineers, San Francisco, CA
Xavier Fernandez, RWQCB, San Francisco, CA
Karen Weiss, CDFW – Bay Delta Office, Sacramento, CA
Copy to ARN File #151422WCR2019SR00030

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion for Creek Road, Meadow Way, and Canyon Road Bridge Projects in Fairfax, California

NMFS Consultation Number: WCRO-2018-00244

Action Agency: Department of Transportation (Caltrans)

Table 1. Affected Species and NMFS' Determinations:

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

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

Issued By:

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: July 08, 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

NOAA's 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 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 NMFS' North-Central Coast Office in Santa Rosa, California (ARN #151422WCR2019R00030).

1.2 Consultation History

By letter dated March 6, 2018, the California Department of Transportation (Caltrans) requested initiation of formal consultation with NMFS regarding Caltrans' proposed funding assistance to the Town of Fairfax for the Creek Road Bridge Seismic Retrofit Project. In the March 6, 2018, letter, Caltrans determined the project was likely to adversely affect threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) and not likely to adversely affect designated critical habitat for this species. Caltrans' letter also conveyed that CCC coho salmon (*O. kisutch*) are not present in the watershed, but portions of the watershed are designated as critical habitat for CCC coho; therefore Caltrans' conveyed their determination that the project may affect but is not likely to adversely affect designated critical habitat for CCC coho salmon.

At the request of NMFS, Caltrans provided additional general project information regarding the seismic retrofit of the Creek Road Bridge to NMFS by email messages dated April 24, 2018, June 20, 2018, and June 22, 2018. NMFS requested further details regarding construction of the cofferdams in an email dated July 5, 2018. Caltrans provided a response on July 9, 2018, via email. On July 26, 2018 and August 2, 2018, via email, NMFS requested clarification of project construction elements including the extent of riparian vegetation removal, operation of heavy equipment within the creek channel and the fish relocation plan. On July 30, 2018, Caltrans indicated fish relocation is proposed and a detailed fish collection and relocation would be submitted to NMFS prior to construction. Via email on August 1, 2018, and August 10, 2018, Caltrans' consultant clarified construction details previously requested by NMFS on July 26, 2018, and August 2, 2018. Due to the number of project revisions and clarifications made by Caltrans following submittal of the project's March 2018 Biological Assessment, NMFS provided Caltrans with a written project description prepared for use in the NMFS biological opinion on August 10, 2018. Caltrans provided comments to NMFS on the project description on September 6, 2018, via email. On October 31, 2018, via email, NMFS recommended utilization of a smaller mesh size than initially proposed to use for the dewatering intake pump based on the potential presence of salmonid fry in the creek during construction. Caltrans indicated that they would utilize the recommended mesh size on their dewatering intake pumps on November 2, 2018, via email. On February 5, 2019, NMFS confirmed with Caltrans via email, the extent of the creek anticipated to be dewatered. NMFS also confirmed with Caltrans via email on February 13, 2019, that shrubs, in addition to trees, would be mitigated for in the event of removal.

By letter dated December 6, 2018, Caltrans requested initiation of a separate consultation with NMFS for preventative maintenance at three other bridges within the Town of Fairfax. The Fairfax Multi-Bridge Preventative Maintenance Project proposed work at Spruce Road, Marin Road, and Canyon Road bridges. On February 28, 2019, a teleconference was held with Caltrans, consultants for the Town of Fairfax, and NMFS to discuss combining these preventative maintenance projects with the Creek Road Bridge seismic retrofit consultation. During this teleconference, Caltrans indicated an additional bridge project is planned for San Anselmo Creek in Fairfax; replacement of the Meadow Way Bridge. Caltrans indicated that they plan to initiate consultation with NMFS on the Meadow Way Bridge project soon. Since all of Caltrans proposed bridge projects are located on San Anselmo Creek in Fairfax, NMFS and Caltrans agreed to combine Creek Road Bridge seismic retrofit, Fairfax Multi-Bridge Preventative Maintenance Project, and the Meadow Way Bridge replacement into one section 7 consultation.

Caltrans and NMFS met on March 5, 2019, to discuss the status of various Caltrans projects and consultations. At that meeting, NMFS provided Caltrans with the most current information on the status of CCC steelhead, status of CCC coho salmon, and barriers to migration in the Corte Madera watershed. As a follow-up to that meeting, additional information was provided by NMFS to Caltrans via email on March 12, 2019. This new information was utilized by Caltrans to revise their findings regarding the potential effects of the proposed bridge projects in Fairfax and clarify their request for consultation with NMFS.

By letter dated March 27, 2019, Caltrans requested initiation of formal consultation for the Meadow Way Bridge Replacement Project and preventative maintenance actions at Canyon Road Bridge. Caltrans also requested these two projects be combined into the biological opinion under preparation by NMFS for the Creek Road Bridge Seismic Retrofit Project. It was requested this combined projects biological opinion be issued to Caltrans by May 15, 2019. Caltrans also clarified their findings regarding proposed preventative maintenance actions at two other Fairfax bridges associated with the Fairfax Multi-Bridge Preventative Maintenance Project; Marin Road Bridge and Spruce Road Bridge. Based on the presence of impassable barriers on Fairfax Creek downstream of these project sites, Caltrans determined actions at these two bridges would have no effect on listed anadromous salmonids nor their critical habitat.

On April 2, 2019, Caltrans and the Town of Fairfax held a site meeting along with the Town's consultant, WRA, NMFS, and Caltrans' consultant, Kelly Biological, to discuss the proposed actions at Creek Road Bridge, Canyon Road Bridge, and Meadow Way Bridge. Based on the delayed submittal of the final Biological Assessment and Biological Assessment Addendum for the Meadow Way Bridge, Caltrans and NMFS agreed upon a new target date of May 31, 2019, for issuance of the combined projects biological opinion.

On May 22, 2019, NMFS requested additional information regarding the area of existing structures, size of existing riprap, and scour depth via email to Caltrans. Caltrans provided an email response with this information on May 29, 2019, and requested a new completion date for the biological opinion of June 14, 2019. To confirm all elements of proposed actions at the three bridge sites, NMFS provided the draft project description prepared for the biological opinion to Caltrans via email on June 6, 2019. Caltrans returned the project description to NMFS on June 14, 2019, with minor comments and corrections.

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). Caltrans proposes to provide funding assistance to the Town of Fairfax to upgrade three bridges over San Anselmo Creek in the Corte Madera Creek watershed, Marin County, California. The three bridges over San Anselmo Creek are the Creek Road Bridge, the Meadow Way Bridge, and the Canyon Road Bridge. Construction is anticipated to begin mid-2021 and be completed by late 2024. The following describes actions that will occur at each bridge site.

1.3.1 Creek Road Bridge Retrofit

The purpose of the Creek Road Bridge Project is to seismically retrofit the structure to prevent catastrophic failure that could result from a maximum credible earthquake. The existing bridge, constructed in 1929, is an approximately 150-feet-long by 30-feet-wide four-span, reinforced-concrete structure supported on three sets of two-column concrete bents and two shallow abutments (one abutment at each end of the bridge near the top of the banks). Each of the three bents sit in the creek channel and their footprints are approximately 4 square feet each. The abutments are located within the creek banks and are approximately 120 square feet each. Approximately 240 square feet of rock riprap protects the northern slope downstream of the bridge.

Work will occur directly within the San Anselmo Creek channel, on the banks of the creek, and in the uplands outside the creek channel. Work within the creek channel consists of constructing infill walls between each pair of columns at three bridge bent locations. Work on the creek banks and uplands outside the creek channel consist of reinforcing and repaving of the bridge deck, and widening, thickening, and resurfacing the road approaches to the bridge. In-channel work will requiring dewatering of the construction site and these activities will be limited to the period between June 1 and October 15 (see Section 1.3.4, Avoidance and Minimization Measures). The following describes these actions and the equipment and access methods that will be used.

1.3.1.1 Creek Road Bridge Activities

The three infill walls would be constructed within temporary trenches that would be dug at the current location of each bent. Excavated materials would be stockpiled on Wessen Lane for later use as backfill around the support columns. The three trenches will be constructed as follows:

> Trench #1: Excavate a trench 23 feet-long by 8 feet-wide by 5 feet-deep below the existing creek channel surface without shoring. Within the open trench, the project will

construct a 16-foot long concrete infill wall that is 1 foot and 6 inches-thick, connecting the existing concrete columns. Then backfill the void with stockpiled native materials from the initial excavation.

Trench #2: Excavate a trench 35 feet-long by 15 feet-wide by 5 feet-deep below the existing creek channel surface. These are maximum dimensions without shoring. Within the open trench, the project will construct a 16-foot wide concrete infill wall that is one foot, six inches-thick, between the two concrete columns. Riprap will be embedded below the surface approximately 3 feet and 6 inches-deep (accommodating scour depth) with a 2-foot and 6-inch layer of backfill in the trench and completed to the surface with native creekbed materials (stockpiled during initial excavation) at this location.

Trench #3: Excavate a trench 40 feet-long by 15 feet-wide by 5 feet-deep below existing creek channel surface. These are maximum dimensions without shoring. Within the open trench, the project will construct a 16-foot-wide concrete infill wall that is 1 foot and 6 inches-thick, connecting the two concrete columns. Rip-rap will be embedded below the surface as a two-foot and six-inch layer of backfill in the trench and completed to the surface with native materials (from initial excavation) at this location.

Reinforcing and repaving of the bridge deck, and widening, thickening and resurfacing the road approaches to the bridge will require realignment of an existing stormwater outfall. Reinforcing, repaving of the bridge deck and widening, thickening, and resurfacing the road approaches will be performed by replacing the existing surface with a 9-inch thick concrete slab and resurfacing with asphalt. Upland vegetation, above top of bank, would be removed to accommodate the road reinforcement and replanted at the completion of the project. Two existing waterlines, one 6-inch and one 4-inch, located at the eastern and western abutments, above top of bank, may interfere with road approach reconfiguration and will be relocated outside of the work area. Realignment of the stormwater outfall will be performed by abandoning a segment of the pipe in place beneath the road deck and adjoining a new, 12-inch diameter corrugated metal pipe that will be rerouted around the road. The new stormwater outfall will discharge at the current outfall location at the top of the south bank of San Anselmo Creek downstream of the bridge. Downslope from the outfall, stormwater discharge has eroded the bank below. To correct this, and prevent further erosion, approximately 120 square feet of rip-rap will be installed in the bank extending below the outfall to the toe of the slope, covering an approximately 20-foot-long by 6-foot-wide area. At the toe, the scour protection will be buttressed into the substrate by extending below the creekbed. Natural substrate (stockpiled during excavation activities) would be placed on top of the riprap and the grade will be flush with the creekbed.

1.3.1.2 Creek Road Equipment and Access

Construction activities at Creek Road Bridge will require a small excavator (skid-steer tractor class) supported by hand-held soil tampers, concrete chipping guns, and concrete drills operated from the creek channel. Equipment will be lowered into the creek via a crane staged from the bridge deck. Construction personnel would enter the creek channel via a footpath and erect temporary steel and timber falsework to construct the infill walls, as described above.

Equipment and personnel access will require removal of riparian vegetation. Woodland and riparian vegetation present within the active work area would be removed or trimmed to accommodate construction activities. Woodland and riparian vegetation currently on site is comprised of approximately 5 to 20 trees and/or shrubs. The vegetation consists of California bay (*Umbellularia Californica*) and big-leaf maple (*Acer macrophyllum*). Riparian understory consists of California blackberry (*Rubus ursinus*), Himalayan blackberry (*R. armeniacus*), and English ivy (*Hedera helix*). Saplings of white alder (*Alnus rhombifolia*), big-leaf maple, buckeye (*Aesculus californica*), and arroyo willow (*Salix lasiolepis*) are also present. Native vegetation removed would be replanted at the close of construction (see Section 1.3.4 Avoidance and Minimization Measures).

Construction activities in the creek channel may require dewatering of the work area. Approximately 200 feet of channel would be dewatered and creek flow would be diverted around the work area. Cofferdams would be constructed using gravel-filled bags wrapped in polyethylene plastic sheeting and a bypass pipe would be used to divert any surface flow around the work site. Once the cofferdams are closed, any remaining water would be pumped out through a screened mesh of 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens per the standards prescribed by NMFS (1997a). Water collected during dewatering activities will be captured in a settling basin fitted with a filtration system (consisting of filter bags or similar) prior to discharge downstream of the work site.

During dewatering, fish would be collected by qualified biologists and relocated to a site downstream or upstream of the work area (see Section 1.3.4, Avoidance and Minimization Measures). Residual water rising to the surface in the exposed trenches, resulting from excavation would be pumped out, filtered, and discharged downstream of the work area into the creek. Dewatering will occur once during the period between June 1 and October 15 (inclusive).

1.3.2 Meadow Way Bridge Replacement

The purpose of the Meadow Way bridge project is to replace the existing bridge with a new span preventing catastrophic failure during a seismic event. The existing wood and concrete bridge was originally built in the 1950s and is approximately 70 feet-long by 14 feet-wide. The existing bridge is a five-span wood frame with 12, 12-inch-diameter wooden pilings (creosote treated) supporting the structure at four locations (3 pilings clustered at each of the 4 locations), with six of the pilings located within the creekbed.

The proposed new bridge span consists of a 70-foot-long by 21.5-foot-wide single-span concrete-arch bridge supported on two cast-in-place abutments (one abutment in each bank). Each abutment will connect with wingwalls and will be supported on 56 cast in drill hole (CIDH) piles. The footprints of the existing and new bridge would overlap.

Work will occur directly within the San Anselmo Creek channel and in the riparian area and uplands outside the creek channel. Work within the creek channel consists of constructing infill walls between each pair of columns at three bridge bent locations, and dismantling the existing bridge. Work within the banks and uplands outside the creek channel consists of reinforcing and repaving of the bridge deck, and widening, thickening, and resurfacing the road approaches to the bridge. The following describes these actions and the equipment and access methods that will be used.

1.3.2.1 Meadow Way Bridge Replacement Activities

In order to maintain public access across San Anselmo Creek at this location during construction, the new bridge would be built on the south side of the existing bridge while the existing bridge remains in service. Once the new bridge is constructed, the existing bridge will be removed and the new bridge will be moved sideways to its permanent location. Construction will occur over two years. A portion of the creek will be dewatered at the start of each construction season and a bypass pipe installed to divert creek flow. Work in the stream channel and dewatering will be limited to the period between June 1 and October 15 (see Section 1.3.4, Avoidance and Minimization Measures). The following further describes activities that will occur during the two stages of construction.

Stage One: Stage One construction activities will occur during the first year of construction. During Stage One, the upstream or southern halves of each of the two new concrete abutments will be cast in place, two retaining walls would be built, an access ramp to the creekbed would be constructed, CIDH piles to support the abutments would be installed, and the new concrete arch bridge will be cast-in-place and attached to arches spanning the abutments in its temporary location.

Two new abutments will support the bridge on each bank of San Anselmo Creek. The upstream halves (southern portion) of the new abutments would be cast-in-place during Stage One. Their locations will be in approximate alignment with the existing abutments to support the new bridge in its temporary location. The downstream or northern halves of the abutments would be constructed during Stage Two. The eastern and western embankments behind and in front of the existing abutments will be retained temporarily with soil nails parallel and perpendicular to the roadway alignment. The approach embankments in front, behind, and next to the current abutments would need to be excavated to accommodate the new abutments. The new abutments will be supported by concrete foundations (pile cap) and subterranean CIDH piles within each bank. After completing the excavations, drilling rigs would be used to install 56, 24-inch-diameter CIDH concrete piles. For this, the areas around each abutment and retaining walls would be excavated to a maximum of 8 feet below ground surface extending approximately 110 feet for the western abutment and retaining wall and approximately 130 feet for the eastern abutment. The abutment and retaining wall foundations on each bank will be protected from scour using filter fabric, rock riprap, and native creekbed materials. An approximately 2.5-foot layer of riprap would be keyed into the toe of the bank approximately 2 feet deep, extending up the bank to approximately 144 feet in elevation. The total area of riprap to be buried is approximately 1,600 square feet. The bank protection will be finished with an approximately 3-foot layer of native creekbed materials that were stockpiled during excavation of the creekbed. Excavations within the banks may daylight groundwater. In the event that groundwater is encountered, sheetpiles will be installed (using vibratory methods) to isolate and manage the waters so that the piles can be installed. Water would then be pumped out into settling tanks (Baker tanks or similar) and sheetpiles would be removed when pile installations are complete.

The western bank of San Anselmo Creek at the bridge site is eroding; therefore two retaining walls will be constructed in an upper and lower adjacent location to the western abutment. The lower wall will be a conventional concrete retaining wall supported with CIDH piles, and the upper wall will be a concrete tieback wall with tiebacks placed in drilled holes extending approximately 45 feet into the bank behind the new wall.

The eastern bank is deeply undercut and currently superficially supported with unreinforced concrete and wood shoring in front of the future location of the eastern abutment. To remedy the undercut and stabilize the bank, approximately half of the existing shoring will be removed. The new eastern abutment wall will be cast-in-place behind the removed shoring, protected by a course of sloping heavy rock riprap, topped with 3 feet of sloping native creekbed materials.

Following completion of the elements described above, the new arched concrete bridge will be constructed. The bridge will rest on two arched ribs and four transverse beams that will be cast-in-place, spanning the new abutments at the east and west banks. The deck will be a poured concrete slab. To facilitate construction of these components, temporary wood and/or steel falsework will be staged within the creek channel. All but approximately 2 feet of the entire deck width will be cast-in-place during Stage One. The remaining approximately 2 feet will be poured in Stage Two, due to space limitations. Once the cast-in-place concrete materials are cured, falsework and other materials remaining in the creekbed would be removed prior to removal of the cofferdams and rewetting of the channel. By the end of Stage One, the new bridge span would be in its temporary location, the temporary approach roadways will be constructed south of the existing bridge, and the vehicular and non-motorized traffic would be using the new bridge span in its temporary location. Cars and pedestrians would be kept within the small detour area with temporary railing (Type K) and temporary fencing. Construction activities above the top-of-bank and outside the creek channel may occur outside the period of June 1 to October 15 (see Section 1.3.4, Avoidance and Minimization Measures) to prepare the road deck for Stage Two activities during the next construction season.

Stage Two: Stage Two construction would occur during the second year and consists of dismantling and removing the old bridge span, constructing the downstream (northern) halves of the abutments, constructing wingwalls, sliding the new bridge into place, stabilizing banks and restoring and revegetating the bed and banks. Prior to the removal of the old bridge, utility pipes (sewer, water and gas) affixed to the bridge would be placed downstream at a temporary location before being permanently affixed beneath the new bridge deck following completion of construction activities. To accommodate construction, the access ramp to the creekbed would be reopened at the start of this second season of construction.

The existing bridge would be removed piece by piece using one or two cranes, starting with its superstructure portions. To avoid dropping pieces of the bridge into the creek, special catchment containers and bridge removal methods will be deployed beneath the bridge. After the removal of the superstructure, the wooden pile extensions would be cut at least three feet below the creekbed elevations (below scour depth) and the holes backfilled with existing creek materials. The remaining half of the existing wood and unreinforced concrete shoring in front of the eastern abutment will also be removed and the abutment wall protected using buried rock riprap.

Following removal of the original span, the northern halves of each of the two abutments and the two downstream wingwalls will be constructed. Excavations, CIDH pile and rock riprap installations, and backfilling over the riprap would be completed, similar to Stage One construction, and the same access route for Stage One will be reopened and used. The slopes above the retaining walls and wingwalls would be contour-graded. The areas behind the walls would be backfilled and approach slabs and the approach roadways would be constructed. Once the existing bridge has been removed, and the abutments and bridge approaches have been constructed, the new bridge span would be shifted into place using cranes and/or hydraulic lifts, and the new bridge deck would be connected to the bridge approaches on each side of the bridge. Approach railings at all four bridge corners, landscaping and vegetation restoration with native plants (trees, bushes and other ground cover) on all affected slopes, fencing, and other surface improvements around the bridge may continue outside the June 1 to October 15 work window until project completion.

Disturbed areas in the creek channel will be returned to their pre-construction condition through grading and replacing native cobble, gravel, and soils that were removed or disturbed during construction. The creek channel would be finished using bio-engineering, low earth berms and woody nooks. Final grading in the creek channel shall conform to the existing creek channel contours both downstream and upstream. Large wood is proposed to be installed on the bank along the access route, immediately upstream of the new retaining wall on the north side. A site-specific revegetation plan will be developed for this location (see Section 1.3.4, Avoidance and Minimization Measures).

1.3.2.2 Meadow Way Equipment and Access

Construction activities at the Meadow Way Bridge site will require construction of an approximately 230-foot long earthen access ramp to the creek for transporting heavy equipment including pile drilling rigs, dump trucks, cranes, loaders, excavators, large containers, and transport of materials. The lower portion of the ramp will be supported using temporary fill on the creekbed. The creekbed would be used by the construction operations. Excavation spoils, required for backfilling later on, would be stored in containers placed on the creekbed temporarily during the in-water construction season (June 1 through October 15) due to lack of space above at the roadway level. A secondary staging area will be utilized outside the creek channel due to spatial limitations surrounding the Meadow Way Bridge.

Construction activities will require removal of one California bay tree and invasive Himalayan blackberry vines and broom shrubs on the southwest corner of the new bridge. Pruning of other trees and removal of other vegetation in the construction zones would also be necessary. In total, Caltrans estimates a maximum of 0.07 acre of riparian vegetation may be removed for construction and a maximum of 0.13 acre of ruderal vegetation may be removed for access. A revegetation plan for the site will be prepared prior to the start of construction (see Section 1.3.4, Avoidance and Minimization Measures).

If water is present in San Anselmo Creek at the construction site, approximately 300 feet of channel will be dewatered and creek flow diverted around the work area using a bypass pipe. The bypass system will convey low-flow volumes around the construction site and return flow to the creek downstream of the bridge. Cofferdams, composed of visqueen wrapped, gravel bags or similar across the creekbed upstream of the bridge to collect summer flow and guide them to the bypass pipe. Once the cofferdams are closed, any remaining water would be pumped out through a screened mesh of 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens per the standards prescribed by NMFS (1997a). Water collected during dewatering activities will be captured in a settling basin fitted with a filtration system (consisting of filter bags or similar) prior to discharge downstream of the work site. As the area is dewatered, any fish present will be collected and returned to the creek downstream or upstream of the work site by qualified biologists (see Section 1.3.4, Avoidance and Minimization Measures). Dewatering will occur twice, once each construction season, and be limited to the period between June 1 and October 15 (inclusive). Residual water rising to the surface in the exposed trenches, resulting from excavation would be pumped out, filtered, and discharged downstream of the work area into the creek.

1.3.3 Canyon Road Bridge Repair

The purpose of the Canyon Road Bridge Repair Project is to conduct preventative maintenance repairs to extend the life of the bridge. The existing bridge is a concrete box culvert that was reconstructed in 1998 and is approximately 33 feet long by 12 feet wide. Beneath the bridge, the creek channel is concrete lined with a 53-foot long Denil-style fish ladder running through the center of the channel. A cluster of old redwood trees behind the bridge's wingwall is causing the wingwall to bulge, degrading its structural integrity. Proposed preventative maintenance consists of project elements that will within the San Anselmo Creek channel, over the creekbed, and outside the creek channel in the upland developed areas. Work within the creek channel consists of repair and replacement of two wingwalls (northwest wingwall and northeast wingwall) and structural damage repairs to the north abutment. Work over the creekbed and above-top-of-bank outside the creek channel in the upland developed areas consist of sealing cracks in the bridge deck replacing guard rails. In-channel work will requiring dewatering of the construction site and these activities will be limited to the period between June 1 and October 15 (see Section 1.3.4, Avoidance and Minimization Measures). The following describes these actions, and the equipment and access methods that will be used.

1.3.3.1 Canyon Road Activities

Northwest Wingwall Repair: Remove existing stacked concrete sacks (approximately 15 feet-long by 1-foot and 6-inches-thick, and approximately 6 feet-high and 10 feet-high at either end) and concrete footing (approximately 27 square feet) from the northern bank, upstream of the bridge. Construct a new, vertical, concrete-reinforced wingwall, approximately 15 feet long by 8 feet tall, that will be supported on a new footing and connected to the northern edge of the existing upstream bridge abutment. An approximately 24-foot length of the northern creek edge, upstream of the bridge, will be excavated to accommodate removal of the existing footing and construction of the new footing. The surface of the new wingwall and its footing will be flush with the existing abutment wall. The space behind the wingwall will be backfilled with soil. Two feet by two feet of rock riprap with geotextile lining will be placed in front of the foundation of the wall and footing. Six inches of natural material of similar composition to the creekbed (cobble or similar) will be placed over the riprap. The final grade will be flush with the creekbed.

North Abutment Repairs: Two inches of concrete surface of the north abutment wall will be removed to expose the rebar grid. Concrete will be removed manually by chipping and grinding. Once the rebar grid is exposed, it will be manually cleaned using a wire brush or similar hand tool. Once cleaning is complete, a two-inch layer of grout will be applied and finished smoothly. Soil nails will be used to secure the abutment to the redwood tree cluster situated on the slope behind the abutment.

Northeast Wingwall Repair: Remove and replace existing wingwall on the northeast side (downstream) of the bridge above the existing abutment. Extend the new wall to envelope an existing storm drain pipe daylighting adjacent to the bridge. The new wingwall will be doweled into the existing abutment wall and angled into the creek bank. A new triangular footing will join the wingwall with the existing invert slab; the top will be flush with the creekbed. Two feet by 2 feet of rock riprap will be buried into a 4 square-foot section of the creek bank, outside of the channel, above ordinary high water, at the downstream edge of the wall. Riprap will be flush with the exposed slope. A new cable railing will be installed at the top of the wall. Removal of the existing abutment will impact two trees; an approximately 3-inch diameter at breast height (DBH) multi-trunk California bay and an approximately 2-inch DBH big leaf maple sapling.

Bridge Deck Repair: Cracks in the bridge deck will be sealed using methacrylate.

Guard Rail Replacement: The existing wooden approach railings at all four corners of the bridge will be replaced with metal beam guard railings.

1.3.3.2 Canyon Road Equipment and Access

Construction activities at Canyon Road Bridge will require the use of construction equipment including air compressors, generators, a shot blaster, shotcrete pumps and hoses, concrete saws, concrete chipping guns and drills, and soil drilling equipment. Construction vehicles moving in and out of the construction area would be a small, skidsteer loader (Bobcat class or similar) with backhoe or bucket attachments, polyester concrete mix truck, paver, roller, small excavator, a coldplaning machine, snooper lift truck, utility pickup trucks, flatbed trucks, dump trucks, dump trailers, a truck-mounted crane, concrete delivery trucks and a testing van. These vehicles and equipment would not be all at the site at the same time but move in and out, and would be staged on adjacent roads as needed. No new easement or temporary or permanent right-of-way would be necessary. Equipment, large or small, would be lowered onto the creekbed with a truck-mounted crane. Work would be taking place both from the bridge deck as well as in the creek channel. Construction operations would be completed manually and using powered equipment. Rock riprap would be lowered one by one into the creek channel using the crane.

Two native trees will be removed to facilitate work within the creek banks. One approximately 3 inch DBH multi-trunk California bay and one approximately 2 inch DBH big leaf maple will be removed. In addition, trimming and cutting of vegetation around the worksite, as well as clearing and grubbing, will occur.

The creekbed will be used by the construction operations. If water is present, approximately 100 feet of channel, upstream and downstream of the northern bank, will be dewatered and creek flow will be diverted around the work area using a bypass pipe to convey low-flow volumes around the construction site, releasing downstream of the bridge. Cofferdams, composed of visqueen wrapped, gravel bags or similar across the creekbed upstream of the bridge to collect summer flow and guide them to the bypass pipe. Once the cofferdams are closed, any remaining water would be pumped out through a screened mesh of 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens per the standards prescribed by NMFS (1997a). Water collected during dewatering activities will be captured in a settling basin fitted with a filtration system (consisting of filter bags or similar) prior to discharge downstream of the work site. As the area is dewatered, any fish present will be collected and returned to the creek downstream or upstream of the work site by qualified biologists (see Section 1.3.4, Avoidance and Minimization Measures). Dewatering will occur once during the period between June 1 and October 15 (inclusive). Residual water rising to the surface in the exposed trenches, resulting from excavation would be pumped out, filtered, and discharged downstream of the work area into the creek.

1.3.4 Avoidance and Minimization Measures

The following avoidance and minimization measures will be implemented at all three bridge project sites:

1. Work within the creek channel will be limited to the period between June 1 and October 15 (inclusive).
2. Erosion control best management practices (BMPs) such as silt fencing, construction exclusion fencing, straw waddles and erosion control fabric installation will be implemented.
3. Contaminants (including construction debris, materials, and PAHs) will be prevented from entering the stream.
4. No equipment will be washed within the creek channel or where wash water could flow into the creek channel.
5. Prior to proposed project construction, the contractor will establish a concrete washout area for concrete trucks in a location where wash water will not enter the creek or adjacent areas.
6. Spill containment and treatment materials will be contained on site.
7. All refueling and maintenance of equipment, other than stationary equipment, will occur outside the creek's top-of-bank.
8. Spill control absorbent material will be in place underneath stationary equipment at all times to capture potential leaks. Any hazardous chemical spills will be cleaned immediately.
9. All stockpiling of construction materials, equipment, and supplies, including storage of chemicals, will occur outside the creek channel.
10. All workers will ensure that food scraps, paper wrappers, food containers, cans, bottles, and other trash generated are deposited in covered or closed trash containers. Trash containers will not be left open and unattended overnight.
11. All construction materials and waste will be completely removed and properly disposed.
12. Replace all native, riparian trees (4-inch DBH or larger) and shrubs (3 feet tall or larger) that were removed from the creekbed or banks at a ratio of 2:1. A site-specific replanting and

mitigation plan will be submitted to NMFS no less than 30 days prior to the initiation of construction.

13. Pump intakes for dewatering creek areas will be screened with 2.38 mm woven wire, 2.38 mm perforated plate, or 1.75 mm profile wire.
14. Allow discharged water to settle prior to pumping into the creek. Use filtration basin or surround hose-release with filter bags and discharge outside wetted channel. and
15. Collect and relocate fish as cofferdams are installed and the site is dewatered in preparation for construction. A site-specific fish collection and relocation plan will be submitted to NMFS no less than 30 days prior to the initiation of construction.

1.4 Interrelated or Interdependent 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 the proposed actions.

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 Incidental Take Statement 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.

Caltrans determined the proposed action may affect and is likely to adversely affect CCC steelhead. Sections 2.1 through 2.11 of this opinion discuss the potential adverse effects to CCC steelhead and their critical habitat. Caltrans also determined the proposed action is not likely to adversely affect CCC coho salmon critical habitat. Our concurrence with Caltrans' determination regarding effects to CCC coho salmon critical habitat is documented in the "Not Likely to Adversely Affect" Determination section (Section 2.12) of this opinion.

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.

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. 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).

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

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

For critical habitat, NMFS determines the range-wide status of critical habitat by examining the condition of its physical or biological features which were identified when critical habitat was designated. The designation of critical habitat for CCC steelhead uses the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

2.1.1 Use of Best Available Scientific and Commercial Information

To conduct the assessment presented in this opinion, NMFS examined an extensive amount of information from a variety of sources. Detailed background information on the biology and status of listed species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, and governmental and non-governmental reports. Additional information regarding the effects of the project’s actions on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned resources, and from information acquired via email messages, telephone conversations, and a site visit. For information that has been taken directly from published, citable documents, those citations have been referenced in the text and listed at the end of this document. Additional information regarding the potential effects of the proposed activities at the three San Anselmo Creek bridges on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned resources, and the following:

1. Biological Assessment, Creek Road Bridge Seismic Retrofit, Fairfax, California. Prepared by WRA, Inc., March 2018.
2. Biological Assessment, Fairfax BPMP (Multi-Bridge), Fairfax, California. Prepared by WRA, Inc., October 2018.
3. Biological Assessment, Meadow Way Bridge Project, Fairfax, California. Prepared by WRA, Inc., March 2019.
4. Addendum to the Biological Assessment, Meadow Way Bridge Project, Fairfax, California. Prepared by WRA, Inc., April 2019.

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.

2.2.1 Species Description, Life History, and Status

This biological opinion analyzes the effects of the federal action on the following Federal-listed species (Distinct Population Segment [DPS]) and designated critical habitat:

CCC Steelhead (Distinct Population Segment [DPS])
Threatened (January 5, 2006; 71 FR 834)
Critical habitat (September 2, 2005; 70 FR 52488).

The CCC steelhead DPS includes steelhead in coastal California streams from the Russian River to Aptos Creek and the drainages of Suisun Bay, San Pablo Bay, and San Francisco Bay. CCC steelhead occur in San Anselmo Creek and are expected to be present in the action area during construction. The action area includes critical habitat for CCC steelhead (70 FR 52488; September 2, 2005).

2.2.1.1 Steelhead General Life History

Steelhead are anadromous fish, spending some time in both fresh- and saltwater. The older juvenile and adult life stages occur in the ocean, until the adults ascend freshwater streams to spawn. Eggs (laid in gravel nests called redds), alevins (gravel dwelling hatchlings), fry juveniles newly emerged from stream gravels), and young juveniles all rear in freshwater until they become large enough to migrate to the ocean to finish rearing and maturing to adults. General reviews for steelhead in California document much variation in life history (Shapovalov and Taft 1954, Barnhart 1986, Busby *et al.* 1996, McEwan 2001). Although variation occurs in coastal California, steelhead usually live in freshwater for one to two years in central California, then spend two or three years in the ocean before returning to their natal stream to spawn. Steelhead may spawn one to four times over their life. Adult steelhead which originate from the Corte Madera Creek watershed typically immigrate from the ocean to freshwater between December and April, peaking in January and February, and juveniles migrate as smolts to the ocean from January through June, with peak emigration occurring in April and May (Fukushima and Lesh 1998). Given the proposed construction period between June 1 and October 15, only juvenile steelhead are likely to be present in the action area of this project during construction.

Steelhead fry rear in edgewater habitats and move gradually into pools and riffles, as they grow larger. Cover is an important habitat component for juvenile steelhead, both as a velocity refuge and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Rearing steelhead juveniles prefer water temperatures of 7.2-14.4 degrees Celsius (°C) and have an upper lethal limit of 23.9°C (Barnhart 1986, Bjornn and Reiser 1991). They can survive in water up to 27°C with saturated dissolved oxygen conditions and a plentiful food supply. Fluctuating diurnal water temperatures also aid in survivability of salmonids (Busby *et al.* 1996). Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows, to the ocean to continue rearing to maturity.

Adults returning to spawn may migrate several miles, hundreds of miles in some watersheds, to reach their natal streams. Although spawning typically occurs between January and May, the specific timing of spawning may vary a month or more among streams within a region, and within streams interannually. Spawning (and smolt emigration) may continue through June (Busby *et al.* 1996). Female steelhead dig a nest in the stream and then deposit their eggs. After fertilization by the male, the female covers the nest with a layer of gravel. Steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration one or more years. The embryos incubate within the nest. Hatching time varies from about three weeks to two months depending on water temperature. The young fish emerge from the nest about two to six weeks after hatching.

2.2.1.2 Status of CCC Steelhead DPS

In this opinion, NMFS assesses four population viability parameters to help us understand the status of CCC steelhead DPS and the population's ability to survive and recover. These population viability parameters are: abundance, population growth rate, spatial structure, and diversity (McElhany *et al.* 2000). While there is insufficient information to evaluate these population viability parameters in a thorough quantitative sense, NMFS has used existing information to determine the general condition of the CCC steelhead DPS and factors responsible for the current status of the CCC steelhead DPS.

We use these population viability parameters as surrogates for numbers, reproduction, and distribution, the criteria found within the regulatory definition of jeopardy (50 CFR 402.20). For example, the first three parameters are used as surrogates for numbers, reproduction, and distribution. We relate the fourth parameter, diversity, to all three regulatory criteria. Numbers, reproduction, and distribution are all affected when genetic or life history variability is lost or constrained, resulting in reduced population resilience to environmental variation at local or landscape-level scales.

Historically, approximately 70 populations[2] of steelhead existed in the CCC steelhead DPS (Spence *et al.* 2008, Spence *et al.* 2012). Many of these populations (approximately 37) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts (Bjorkstedt *et al.* 2005). The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (McElhany *et al.* 2000, Bjorkstedt *et al.* 2005).

While historical and current data of abundance are limited, CCC steelhead DPS numbers are substantially reduced from historical levels. A total of 94,000 adult steelhead were estimated to spawn in the rivers of this DPS in the mid-1960s, including 50,000 fish in the Russian River - the largest population within the DPS (Busby *et al.* 1996). Near the end of the 20th century, McEwan (2001) estimated that the wild steelhead population in the Russian River watershed was between 1,700 and 7,000 fish. Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels, with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vicente, Soquel, and Aptos creeks) of individual run sizes of 500 fish or less (62 FR 43937). However, as noted in Williams *et al.* (2016) data for CCC steelhead populations remain scarce outside of Scott Creek, which is the only long-term dataset and shows a significant decline. Short-term records indicate the low but stable assessment of populations is reasonably accurate; however, it should be noted that there is no population data for any populations outside of the Santa Cruz Mountain stratum, other than hatchery data from the Russian River. In addition, some loss of genetic diversity has been documented and attributed to previous among-basin transfers of stock and local hatchery production in interior populations in the Russian River (Bjorkstedt *et al.* 2005). In San Francisco Bay streams, reduced population sizes and fragmentation of habitat has likely also led to loss of genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see: Busby *et al.* 1996, NMFS 1997b, Good *et al.* 2005, Spence *et al.* 2008, Williams *et al.* 2011, and Williams *et al.* 2016.

[2] Population as defined by Bjorkstedt *et al.* 2005 and McElhaney *et al.* 2000 as, in brief summary, a group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group. Such fish groups may include more than one stream. These authors use this definition as a starting point from which they define four types of populations (not all of which are mentioned here).

Although available time series data sets are too short for statistically robust analysis, the information available indicates CCC steelhead populations have likely experienced serious declines in abundance, and apparent long-term population trends suggest a negative growth rate. This would indicate the DPS may not be viable in the long term, and DPS populations that historically provided enough steelhead immigrants to support dependent populations may no longer be able to do so, placing dependent populations at increased risk of extirpation. However, because CCC steelhead have maintained a wide distribution throughout the DPS, roughly approximating the known historical distribution, CCC steelhead likely possess a resilience that could slow their decline relative to other salmonid DPSs or ESUs in worse condition. The 2005 status review concluded that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (Good *et al.* 2005), a conclusion that was consistent with a previous assessment (Busby *et al.* 1996) and supported by the NMFS Technical Recovery Team work (Spence *et al.* 2008). On January 5, 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834).

Although numbers did not decline further during 2007/08, the 2008/09 adult CCC steelhead return data indicated a significant decline in returning adults across their range. Escapement data from 2009/2010 indicated a slight increase; however, the returns were still well below numbers observed within recent decades (Jeffrey Jahn, NMFS, personal communication, 2010).

In the Russian River, analysis of genetic structure by Bjorkstedt *et al.* (2005) concluded previous among-basin transfers of stock, and local hatchery production in interior populations in the Russian River likely has altered the genetic structure of the Russian River populations. Depending on how "genetic diversity" is quantified, this may or may not constitute a loss of overall diversity. In San Francisco Bay streams, reduced population sizes and fragmentation of habitat has likely led to loss of genetic diversity in these populations. More detailed information on trends in CCC steelhead DPS abundance can be found in the following references: Busby *et al.* 1996, NMFS 1997b, Good *et al.* 2005, and Spence *et al.* 2008.

The status review by Williams *et al.* published in 2011 concluded that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" as new information released since Good *et al.* 2005 did not appear to suggest a change in extinction risk. The most recent status review (Williams *et al.* 2016) reached the same conclusion. On May 26, 2016, NMFS affirmed no change to the determination that the CCC steelhead DPS is a threatened species (81 FR 33468), as previously listed (76 FR 76386).

2.2.1.3 Status of CCC Steelhead and CCC Steelhead Critical Habitat

In designating critical habitat, NMFS considers, among other things, the following requirements of the species: 1) space for individual and population growth, and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for spawning, reproduction, and rearing offspring; and, generally 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on Physical or Biological Features (PBF)[3] and/or essential habitat types within the designated area that are essential to the conservation of the species and that may require special management considerations or protection (81 FR 7214).

PBFs for CCC steelhead critical habitat and their associated essential features within freshwater include:

1. freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2. freshwater rearing sites with:
    a. water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    b. water quality and forage supporting juvenile development; and
    c. natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

The condition of CCC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[4]: logging, agriculture, mining, urbanization, stream channelization and bank stabilization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Habitat impacts of concern include altered stream bank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality/quantity, lost riparian vegetation, and increased sediment delivery into streams from upland erosion (Weitkamp *et al.* 1995; Busby *et al.* 1996; 64 FR 24049; 70 FR 37160; 70 FR 52488). Widespread diverting of rivers and streams, as well as the pumping of groundwater hydraulically connected to stream flow, has dramatically altered the natural hydrologic cycle in many of the streams within the CCC ESU and DPS, which can delay or preclude migration, dewater aquatic habitat, and degrade water quality. Stream channelization, commonly caused by streambank hardening and stabilization, represents a very high threat to instream and floodplain habitat throughout much of CCC steelhead designated critical habitat (NMFS 2016). Streambank stabilization confines stream channels and precludes natural channel movement, resulting in increased streambed incision, reduced habitat volume and complexity.

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[3] NMFS previously used the term “Primary Constituent Elements”, but has now shifted to using “Physical or Biological Features. 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 primary constituent elements, physical or biological features, or both.”
[4] Other factors, such as over fishing and artificial propagation have also contributed to the current population status of these species. All these human induced factors have exacerbated the adverse effects of natural environmental variability from such factors as drought and poor ocean productivity.

A final recovery plan for CCC steelhead was prepared by NMFS in October 2016 (NMFS 2016). The plan describes key threats, actions needed to achieve recovery, and measurable criteria by which NMFS will determine when recovery has been reached. Recovery plan actions are primarily designed to restore ecological processes that support healthy steelhead populations, and address the various activities that harm these processes and threaten the species' survival. The recovery plan calls for a range of actions including the restoration of floodplains and channel structure, restoring riparian conditions, improving streamflows, restoring fish passage, protecting and restoring estuarine habitat, among other actions.

2.2.1.4 Additional Threats to the CCC Steelhead DPS and Their Critical Habitat

Global climate change presents an additional potential threat to salmonids and their critical habitats. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir *et al.* 2013). Snowmelt from the Sierra Nevada has declined (Kadir *et al.* 2013). However, total annual precipitation amounts have shown no discernable change (Kadir *et al.* 2013). CCC steelhead may have already experienced some detrimental impacts from climate change. NMFS believes the impacts on listed salmonids to date are likely fairly minor because natural, and local, climate factors likely still drive most of the climatic conditions listed salmonids experience, and many of these factors have much less influence on salmonid abundance and distribution than human disturbance across the landscape.

The threat to salmonids from global climate change will increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley *et al.* 2007, Moser *et al.* 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe *et al.* 2004, Moser *et al.* 2012, Kadir *et al.* 2013). Total precipitation in California may decline; critically dry years may increase (Lindley *et al.* 2007, Schneider 2007, Moser *et al.* 2012). Wildfires are expected to increase in frequency and magnitude (Westerling *et al.* 2011, Moser *et al.* 2012).

In the San Francisco Bay region, warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan *et al.* 2012). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the 21st Century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan *et al.* 2012).

Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia *et al.* 2002, Ruggiero *et al.* 2010). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008; Feely 2004; Osgood 2008; Turley 2008; Abdul-Aziz *et al.* 2011; Doney *et al.* 2012). The projections described above are for the mid to late 21st Century. In shorter time frames, natural climate conditions, albeit likely already influenced by the human addition of carbon dioxide to the atmosphere, are more likely to predominate (Cox and Stephenson 2007; Santer *et al.* 2011).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for this project consists of the three bridge construction sites on San Anselmo Creek in Marin County, California. The three sites are located at the San Anselmo Creek crossings by Creek Road, Meadow Way, and Canyon Road. Each site includes the creek channel, banks, and uplands areas extending up to a distance of 600 feet from the mainstem San Anselmo Creek. Each of these sites is located far enough away from each other that their effects will not overlap, resulting in an action area with three distinct sites.

The action area at each bridge site includes areas subject to construction, equipment access, staging/storage, stream diversion, water quality effects, fish capture, and an additional 200-feet of mainstem creek above and below work areas where fish relocation will occur. For Creek Road, the action area includes approximately 700 linear feet of stream channel. For Meadow Way, the action area includes approximately 925 linear feet of stream channel. For Canyon Road, the action area includes approximately 600 linear feet of stream.

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).

The following sub-sections provide information on watershed-wide conditions affecting the action area, and conditions specific to the action area.

2.4.1 General Watershed Description

The action area is located on San Anselmo Creek within the Corte Madera Creek watershed in Marin County, California. San Anselmo Creek generally flows in an easterly direction as it joins with Sleepy Hollow Creek to form Corte Madera Creek, ultimately discharging to San Pablo Bay. San Anselmo Creek originates in the Cascade Canyon Open Space preserve, travelling through the towns of Fairfax, San Anselmo, and Ross.

San Anselmo Creek is located in a Mediterranean climatic region, with over 90 percent of annual precipitation occurring between November and April. Cool, moist coastal fog generally alternates with clear, warm weather during the months of May through September, and significant rainfall during that time is rare. Land use in the watershed varies. Headwater areas are located in protected open space preserves, with residential and commercial development of moderate density predominating at lower elevations. Flows within the watershed are highly variable and can go quickly from low base flow conditions to high flows and then quickly recede again.

2.4.2 Status of CCC Steelhead and Critical Habitat in the Action Area

Surveys have consistently documented steelhead in San Anselmo Creek since 1960 (Rich 2000, Leidy *et al.* 2005a). Habitat conditions in the action area likely support adult steelhead spawning and egg incubation. Although streamflows are low in the action area during the dry season, perennial flow in most years supports summer and fall juvenile steelhead rearing.

Instream habitat conditions for steelhead within the action area of San Anselmo Creek are low to moderate quality. Habitat quality is diminished by a low amount of large woody debris, bank stabilization associated with bridge crossings, and low/dry flow conditions during the summer and fall. The creek in the action area is primarily low gradient riffle habitat with substrate composed of gravels and cobble. For Creek Road and Canyon Road, channel slope in the action area is gradual and no deep pools are present. Overwinter habitat conditions may be limited by the presence of few secondary channels and backwater areas, but other features such as small boulders and undercut banks provide refugia from high velocity flow events. The action area at Meadow Way includes a deep pool with an undercut bank upstream of the bridge, providing refuge habitat. No impediments to fish passage are present at the Creek Road Bridge or Meadow Way Bridge sites.

At the Canyon Road Bridge, San Anselmo Creek passes through a concrete box culvert. A Denil-style fish ladder extends through this culvert to provide upstream fish passage. The concrete and steel plate fish ladder is approximately 53.6 feet in length as it passes through the culvert and extends downstream. This ladder was assessed during 2006 surveys completed by Ross Taylor and Associates (RTA 2006). This survey and assessment concluded that conditions at the Canyon Road fish ladder may not be adequate for passage of all salmonid species or life-stages presumed present. This conclusion was, in part, based on the slope of the fish ladder (17.53%) as it is near the upper limit for adult passage and assumed to be insufficient for resident and juvenile passage (RTA 2006). Ross Taylor and Associates (2006) recommended making visits to the site during winter storms to observe hydraulics during migration-level flows and to ensure the ladder was free of debris. The fish ladder was also described as having a slightly perched outlet (RTA 2006).

Creek Road dominant vegetation consists of woodland and riparian communities, which include a mosaic of native and non-native trees and shrubs. Woodland vegetation consists of California bay and big-leaf maple. Saplings of white alder and arroyo willow are also present. Riparian understory consists of California blackberry, Himalayan blackberry, and English ivy.

There are two dominant vegetation communities within the action area at Meadow Way: ruderal disturbed/developed, riparian redwood forest. The ruderal disturbed/ developed portion of the action area includes paved areas, structures, roadsides, landscaping, and gravel or bare dirt areas. The landscaping consists of cultivars and non-native herbaceous species commonly found in the region, such as American vetch (*Vicia americana*), various clovers (*Trifolium* spp.), oats (*Avena barbata*), bromes (*Bromus* spp.), and hedge-hog dogtail (*Cynosurus echinatus*). The dominant vegetation along the middle to upper part of the creek bank is Himalayan blackberry and English ivy.

Riparian redwood forest within this action area has overstory species including native tree species including redwood (*Sequoia sempirvirens*), California bay, buckeye, oaks (*Quercus kelloggii*, *Q. garryana*, and *Q. agrifolia var. agrifolia*), and a multi-stem arroyo willow. The understory is comprised mainly of California blackberry, Himalayan blackberry, English ivy, and non-native grasses.

Vegetative communities at the Canyon Road location consist of ruderal disturbed/ developed and riparian redwood forest. The ruderal disturbed/ developed portion includes pavement (Canyon Road and driveways), gravel and bare dirt roadsides, structures (homes and outbuildings), backyards, landscaping or bare areas, and the concrete sack retaining wall on the northwest side of the bridge. In the areas that are not landscaped, the vegetation is predominately non-native species commonly found in the region, such as privet (*Ligustrum japonicum*), English ivy, goosegrass (*Galium aparine*), cut leaf geranium (*Geranium dissectum*), and non-native grasses.

Riparian redwood forest at Canyon Road includes redwood, big-leaf maple, and California bay. The understory is sparse with few shrubs. The herbaceous/vine layer is comprised mainly of English ivy and Himalayan blackberry with some California polypody (*Polypodium californicum*) and non-native grasses.

2.4.3 Factors Affecting the Species' Environment in the Action Area

Aquatic habitat in the action area has been adversely affected by human activities occurring since development in the watershed began in the late 1800's. Residential development has resulted in bank armoring and channelization, non-point source pollutant contamination, removal of riparian vegetation. These activities have had negative effects on steelhead habitat quality in the action area. Increased impervious surfaces associated with roadways and private residences in the watershed have likely decreased rainfall infiltration rates in upland habitats, increased peak flood flows, and decreased summer flows in San Anselmo Creek.

Habitat impairments associated with the existing bridges are also present and affect PBFs in the action area. Bridge abutments in the streambank confine the channel and prevent channel migration. In-channel piers confine flows and alter sediment and debris transport, and scour protection and bank stabilization constrain flows and impair bed and bank habitat. Constraints such as these have impaired habitat complexity and steelhead use. However, while habitat limitations do exist in the action area, current conditions in the action area provide sufficient water quantity, water temperature, water velocity, cover/shelter, riparian vegetation, space, food, and safe passage to support steelhead migration, spawning, and rearing.

Upland areas adjacent to San Anselmo Creek at the Creek Road, Meadow Way, and Canyon Road bridge crossings consist of single-family residential properties. Bank erosion is evident in some areas and private landowners have placed riprap, concrete walls, and other materials along the stream bank to curb erosion. Placement of these materials has confined the stream, and diminished natural geomorphic processes and associated biological functions. Based on current channel conditions, designated critical habitat within the action area is degraded from properly functioning condition due to impacts from residential development in the watershed.

In the action area, the threat to CCC steelhead from climate change is likely to include a continued increase in average summer air temperatures, more extreme heat waves, and an increase in frequency of drought (Lindley *et al.* 2007). In future years and decades, many of the changes are likely to further degrade habitat throughout the watershed, including the action area of this project, by reducing streamflow during the summer and raising summer water temperatures.

2.4.4 Previous Section 7 Consultations Affecting the Action Area

No previous individual section 7 consultations with NMFS have occurred within the Meadow Way and Canyon Road portions of the action area. At Creek Road Bridge, NMFS completed section 7 consultation with the Federal Emergency Management Agency (FEMA) for repairs to riprap bank stabilization underneath the structure in 2007 (NMFS PCTS #SWR-2007-1527). Flood waters and bank failure during winter storms during 2005-2006 undermined the eastern bridge abutment at the Creek Road Bridge along approximately 130 feet of streambank. Flood waters also exposed 25 feet of a 12-inch sewer pipe that parallels the underside of the bridge. Consultation concluded with a May 4, 2007, concurrence letter from NMFS to FEMA that determined the project was not likely to adversely affect listed fish species or designated critical habitat under the jurisdiction of NMFS.

NMFS has also completed programmatic consultations for salmonid habitat restoration actions that include the action area of this project. To date, no habitat restoration actions covered under existing programmatic Section 7 consultations have occurred in the action area. These programmatic consultations include the NOAA Restoration Center’s restoration program and the Corps’ Regional General Permit Number 12, programmatic consultation. Both of these consultations authorize a limited amount of take for juvenile salmonids during instream work conducted in the summer months.

Section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions could potentially occur in the San Anselmo Creek watershed, including the action area of this project. Salmonid monitoring approved under these programs includes carcass surveys, smolt outmigration trapping, and juvenile density surveys. In general, these activities are closely monitored and require measures to minimize take during the research activities. Through June 2019, no research activities authorized by these NMFS programs have occurred in San Anselmo Creek.

2.4.5 Climate Change Impacts in the Action Area

The long-term effects of climate change have been presented under the Rangewide Status of the Species and Critical Habitat section of this biological opinion (Section 2.2.1.4). These include changes in streamflow regimes, water temperatures, and rainfall patterns. CCC steelhead in the action area may have already experienced some detrimental impacts from climate change. However, these detrimental impacts across the action area are likely to be minor because natural and local climate factors continue to drive most of the climatic conditions steelhead experience. These natural factors are likely less influential on fish abundance and distribution than anthropogenic impacts across the action area. Future climate change impacts in the action area are likely to increase as air and water temperatures warm, and precipitation rates change. However, during the timeframe considered in this opinion, these changes are expected to materialize as insignificant alterations to current habitat conditions in the action area.

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.

In this biological opinion, our approach to determine the effects of the action was based on institutional knowledge and a review of the ecological literature and other relevant materials. We used this information to gauge the likely effects of the proposed project via an exposure and response framework that focuses on the stressors (physical, chemical, or biotic), directly or indirectly caused by the proposed action, to which CCC steelhead are likely to be exposed. Next, we evaluate the likely response of the above listed fish to these stressors in terms of changes to survival, growth, and reproduction, and changes to the ability of PBFs to support the value of critical habitat in the action area. Where data to quantitatively determine the effects of the proposed action on listed fish and their critical habitat were limited or not available, our assessment of effects focused mostly on qualitative identification of likely stressors and responses.

The effects of proposed actions by the three bridge projects are reasonably likely to include: adverse effects to steelhead from fish collection; adverse effects to steelhead from dewatering; insignificant effects to critical habitat from dewatering; insignificant effects to steelhead and critical habitat from temporary increases in suspended sediment concentrations; a discountable potential for steelhead and critical habitat to be exposed to toxic chemicals; insignificant effects to steelhead and critical habitat from temporary reductions in riparian vegetation; and insignificant effects to steelhead and critical habitat resulting from the maintenance and placement of structures (bridges) in and over the channel.[5] Although some of these effects are insignificant and discountable, they are considered and addressed in the remainder of this analysis, particularly the Integration and Synthesis portion of the opinion.

2.5.1 <u>Fish Collection and Relocation</u>

Fish collection and relocation will be performed in coordination with dewatering prior to construction at the Creek Road, Meadow Way, and Canyon Road sites. The fish collection and relocation are proposed to avoid fish stranding and exposure to construction activities. Before and during dewatering of the creek channel, CCC steelhead and other fish will be captured by a

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[5] Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

qualified fisheries biologist using one or more of the following methods: electrofishing, dip net, seine, throw net, block net, minnow trap. Collected fish will be immediately returned to the stream at suitable locations in San Anselmo Creek downstream or upstream of the dewatered areas as determined by qualified biologists.

Steelhead relocation activities will occur outside the adult migration and spawning season, during the summer low-flow period after emigrating smolts and kelts (post-spawned adults) have left the creek. Therefore, NMFS expects the CCC steelhead that will be captured and relocated will be limited to young-of-the-year and pre-smolting juveniles. Data to precisely quantify the number of steelhead in the action area are not available, but estimates can be made from recent fish sampling at other sites within San Anselmo Creek. Ross Taylor and Associates (2012) conducted fish capture and relocation within San Anselmo Creek, approximately 0.8 miles downstream of the Creek Road site, during which they collected approximately 19 juvenile steelhead per 100 feet of channel in late June 2012.[6] Because interannual variation in juvenile fish abundance occurs in response to variations in cohort strength, precipitation, temperature, predator or prey abundance; restoration actions; and other factors, NMFS will assume that juvenile density may be greater or lesser (+/-5 juvenile steelhead per 100 feet of channel) than reported by Ross Taylor and Associates (2012). Since the area to be dewatered at Creek Road is approximately 200 feet long, NMFS estimates up to 48 juvenile steelhead may be captured and relocated.[7] Similarly, because the area to be dewatered at Meadow Way is approximately 300 feet long, NMFS estimates up to 72 juvenile steelhead may be captured and relocated during each of the two years of construction at Meadow Way. Because dewatering will occur twice at Meadow Way (once in each construction season), we expect up to 144 juvenile steelhead will be relocated over the two construction seasons at this site.[8] The area to be dewatered at Canyon Road is approximately 100 feet long, therefore NMFS estimates that 24 juvenile steelhead will be relocated.[9]

Fish relocation activities pose a risk of injury or mortality to rearing juvenile salmonids. Any fish collecting gear, whether passive (Hubert 1996) or active (Hayes *et al.* 1996) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish capture varies widely, depending on the method used, the ambient conditions, and the expertise and experience of the field crew. Because fish relocation activities will be conducted by qualified fisheries biologists, direct effects to and mortality of juvenile steelhead during capture will be minimized.

Although sites selected for relocating fish should have similar water temperature as the capture sites and are expected to have adequate habitat available, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may have to

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[6] 99 young-of-the-year O. mykiss (50-70mm Fork Length [FL]) and six age two or greater O. mykiss (160-180mm FL) over a distance of approximately 570 feet.

[7] (24 steelhead / 100 feet of channel)x(200 feet of channel to be dewatered) = 48 juvenile steelhead in the length of channel to be dewatered at Creek Road.

[8] (24 steelhead / 100 feet of channel)x(300 feet of channel to be dewatered) = 72 juvenile steelhead in the length of channel to be dewatered at Meadow Way during one event. Because dewatering at this site will occur twice in two years, we expect the total number of steelhead to be relocated will be 144.

[9] (24 steelhead / 100 feet of channel)x(100 feet of channel to be dewatered) = 24 juvenile in the length of channel to be dewatered at Canyon Road.

contend with other fish causing increased competition for available resources such as food and habitat area. Frequent responses to crowding by steelhead include emigration and reduced growth rates (Keeley 2003). Some of the fish released at the relocation sites may choose not to remain in these areas and move either upstream or downstream to areas that have more vacant habitat and a lower density of steelhead. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse. NMFS does not expect impacts from increased competition would be large enough to adversely affect the survival chances of individual steelhead, or cascade through the watershed population based on the small area that would likely be affected and the relatively small number of individuals likely to be relocated (particularly when compared with the remainder of individuals throughout the drainage not affected by the project). As described above, sufficient habitat appears to be available San Anselmo Creek to sustain fish relocated without crowding of other juvenile steelhead.

Data on fish relocation efforts since 2004 shows most mortality rates are below three percent for steelhead (Collins 2004, CDFG 2005, 2006, 2007, 2008, 2009, 2010a, 2010b). Fish that avoid capture during relocation efforts may be exposed to risks described in the following section on dewatering. NMFS expects no more than three percent of steelhead would be will be harmed or killed during fish capture and relocation activities. If harm and mortality rates reach maximum levels, up to two steelhead are expected to be harmed or killed during relocation efforts at the Creek Road site.[10] Similarly, fish relocation activities are expected to harm up to three steelhead during each of the two years of construction at Meadow Way, resulting in up to six steelhead being harmed or killed during relocation actions at this site.[11] Up to one steelhead is expected to be harmed or killed during relocation efforts at the Canyon Road site.[12]

2.5.2 Dewatering

As described above, the three projects will require dewatering a combined total of approximately 600 feet of San Anselmo Creek. Dewatering is expected to last between June 1 and October 15 for each dewatering event. Cofferdams constructed of gravel bags will be used to isolate work areas and these work areas will be dewatered with pumps. Streamflow in San Anselmo Creek will be bypassed around the dewatered work sites with diversion pipes.

NMFS anticipates temporary changes to instream flow within the work areas. Isolation and dewatering of these work areas is expected to cause temporary loss, alteration, and reduction of aquatic habitat, and may result in mortality of any salmonids that avoid capture during fish relocation activities. Any remaining juvenile steelhead within these work areas may be harmed

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[10] (Up to 48 steelhead estimated to be present within the area to be dewatered)x(3% mortality rate) = 1.44 steelhead mortalities during fish handling and relocation activities at Creek Road. Rounding this yields an estimate of 2 steelhead mortalities.

[11] (Up to 72 steelhead estimated to be present within the area to be dewatered each year)x(3% mortality rate) = 2.16 steelhead mortalities during fish handling and relocation activities per year. Rounding this yields an estimate of 3 steelhead mortalities per year at Meadow Way. Two years of dewatering at Meadow Way totals up to 6 steelhead mortalities for the Meadow Way site.

[12] (Up to 24 steelhead estimated to be present within the area to be dewatered)x(3% mortality rate) = 0.72 steelhead mortalities during fish handling and relocation activities at Canyon Road. Rounding this yields an estimate of 1 steelhead mortality.

by concentrating or stranding them in residual wetted areas, or entrapping them within the interstices of channel substrate where they may not be seen by fish relocation personnel. Steelhead juveniles that avoid capture in the work area will likely die due to desiccation, thermal stress, or crushing. However, fish relocation efforts (described above) are expected to be effective at removing fish in the work areas. Because of this, NMFS expects that the number of juvenile steelhead that may be missed and have the potential to be left within the dewatered area will be very low; less than one percent of the fish within the action area prior to dewatering. Based on this, NMFS estimates that up to one steelhead juvenile may be harmed during each of the channel dewatering events.[13] Because there will be one dewatering event at Creek Road, two dewatering events at Meadow Way (one during each of the two construction seasons), and one dewatering event at Canyon Road, we expect that up to four juvenile CCC steelhead may be killed during dewatering operations over the course of project implementation.

Dewatering operations may also affect aquatic food sources that CCC steelhead feed on. Benthic (bottom dwelling) aquatic macroinvertebrates, an important food source for salmonids, may be killed or their abundance reduced when creek habitat is dewatered (Cushman 1985). However, effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because construction activities will be relatively short-lived. Rapid recolonization, typically within one to two months, of disturbed areas by macroinvertebrates is expected following rewatering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile salmonids is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flow, if present, will be bypassed around the work sites. The temporary loss of approximately 200 feet of instream habitat at Creek Road, 300 feet at Meadow Way and 100 feet at Canyon Road during dewatering events is not expected to impair designated critical habitat because aquatic and riparian habitat at the site would be returned to pre-project conditions after the water diversion system is removed. The temporary cofferdams and water diversion structure in the action area are not expected to impact steelhead outside the dewatered area. Dewatering will occur for a limited duration and the dewatered area will be relatively small compared to the available habitat within the San Anselmo Creek watershed in and near the action area. Fish will be able to find food and cover outside of the action area as needed to maintain their fitness during project construction. Based on the foregoing, steelhead are not anticipated to be exposed to a reduction in food sources from the minor and temporary reduction in aquatic macroinvertebrates as a result of dewatering activities.

2.5.3 Increased Suspended Sediment Concentrations

Construction at each of the three bridges would result in disturbance of the creekbed and banks for equipment access, construction activities, and for the placement/removal of the cofferdams. Instream and near-stream construction activities have been shown to result in temporary

[13] (Up to 48 steelhead estimated to be present during dewatering at Creek Road)x(1% steelhead left within dewatered area) = 0.48 steelhead mortalities at Creek Road. Rounding this yields an estimate of 1 steelhead mortality. (Up to 72 steelhead estimated to be present during dewatering at Meadow Way each year)x(1% steelhead left within dewatered area) = 0.72 steelhead mortalities at Meadow Way each year. Rounding this yields an estimate of 1 steelhead mortality per year at Meadow Way. (Up to 24 steelhead estimated to be present during dewatering at Canyon Road)x(1% steelhead mortality) = 0.24 steelhead mortalities at Canyon Road. Rounding this yields an estimate of 1 steelhead mortality at Canyon Road.

increases in suspended sediment concentrations (Furniss *et al.* 1991, Reeves *et al.* 1991, Spence *et al.* 1996). Increases in sediment may affect fish in a variety of ways. High concentrations of suspended sediment can disrupt normal feeding behavior and efficiency (Cordone and Kelley 1961, Bjornn *et al.* 1977, Berg and Northcote 1985), reduce growth rates (Crouse *et al.* 1981), and increase plasma cortisol levels (Servizi and Martens 1992). High and prolonged turbidity concentrations can reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and can also cause fish mortality (Sigler *et al.* 1984, Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Small pulses of turbid water can also cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival. Increased sediment deposition can fill pools thereby reducing the amount of potential cover and habitat available, and smother coarse substrate particles which can impair macroinvertebrate composition and abundance (Sigler *et al.* 1984, Alexander and Hansen 1986).

For this project, work areas will be isolated from the flowing waters of San Anselmo Creek by the cofferdams during construction and little to no degradation of water quality is anticipated once the cofferdams are in place. Post-construction, disturbed soils may become mobilized when fall and winter storms increase stream flow levels. NMFS anticipates these activities would affect water quality in the action area in the form of small, short-term increases in turbidity during re-watering and subsequent higher flow events during the first winter storms post-construction. Although both severe episodic and chronic elevated sediment and turbidity levels may affect steelhead and critical habitat as described above, sedimentation and turbidity levels associated with this project are not expected to rise to the levels discussed in the previous paragraph because the project will include methods to minimize disturbance of the stream channel and prevent conveyance of sediment and turbidity into the waters of San Anselmo Creek. Due to the employment of BMPs at each of the bridge sites, including use of the cofferdams, work within the dry season (June 1 – October 15), and use of other erosion control methods, NMFS anticipates any resulting elevated turbidity levels would only occur for a short time, and would be well below levels and durations expected to cause harm to salmonids or to salmonid prey species. Employment of the BMPs described above are designed to prevent the migration of silts and sediments from the work site. Based on the streamflow conditions (low summer surface flows) and construction timing (work within the summer months), during rewetting of the channel NMFS expects any sediment or turbidity generated by the project would not extend more than 50 feet downstream of the work area at each site. Thus, it is unlikely that any meaningful amount of suspended sediment effects will result from this project, and any project-related suspended sediment effects that do result will be temporary and will likely have an insignificant impact on CCC steelhead and their critical habitat.

2.5.4 Toxic Chemicals

Construction operations in, over, and near surface water have the potential to release contaminants into surface waters. All three bridge projects have the potential to introduce oils and hydrocarbons from construction equipment into surface waters. Oils and hydrocarbons can contain a wide variety of polynuclear aromatic hydrocarbons (PAHs), and metals. PAHs can alter salmonid egg hatching rates and reduce egg survival as well as harm the benthic organisms that are a salmonid food source (Eisler 2000). Some of the effects that metals can have on salmonids are: immobilization and impaired locomotion, reduced growth, reduced reproduction, genetic damage, tumors and lesions, developmental abnormalities, behavior changes (avoidance), and impairment of olfactory and brain functions (Eisler 2000). These effects have the potential to harm exposed fish and temporarily degrade habitat. However, the Project includes BMPs to address spills and prevent the introduction of contaminants into San Anselmo Creek. The work areas will be isolated; project limits will be clearly delineated; no equipment is proposed to be fueled or otherwise serviced within the stream bed; spill containment materials will be present on site; and proper handling and disposal of all construction waste will occur. Due to these measures, conveyance of toxic chemicals into San Anselmo Creek during project implementation is not expected, and the potential for the project to degrade water quality and harm CCC steelhead and their critical habitat is considered to be discountable. Additionally, existing creosote pilings at Meadow Way Bridge will be removed with replacement of the structure and eliminate this source of contaminants.

2.5.5 Effects on Critical Habitat

As discussed above, the project's construction activities are expected to result in short-term disturbance to the channel and the adjacent streambank areas. Localized impacts to water quality in the form of increased levels of turbidity and suspended sediment will be contained during construction by the cofferdams and post-construction mobilization of sediment during high flow events are expected to be minimal. Given the small amounts of sediment and turbidity generated by the project, NMFS expects PBFs of critical habitat associated with water quality for CCC steelhead in the action area are unlikely to be adversely affected. Any sediment and turbidity associated with project activities will rapidly dissipate downstream in San Anselmo Creek during subsequent high flows over the next rainy season.

PBFs of steelhead foraging habitat in the action area will be temporarily impacted by dewatering of approximately 600 linear feet of San Anselmo Creek. Food supplies within the dewatered reach will be temporarily reduced. Benthic (*i.e.*, bottom dwelling) aquatic macroinvertebrates may be killed or their abundance reduced when stream habitat is dewatered (Cushman 1985). However, effects to aquatic macroinvertebrates resulting from streamflow diversion and dewatering is expected to be short-term because construction activities will be of short-duration (approximately four months) and the dewatered reaches are relatively small. Therefore, rapid recolonization (typically one to two months) of disturbed areas by macroinvertebrates is expected following rewatering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile steelhead would likely be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since streamflow would be bypassed around the construction work sites. Based on the foregoing, NMFS expects the temporary loss of habitat space and impacts to aquatic macroinvertebrates as a result of dewatering activities would result in insignificant effects to rearing PBFs for steelhead in the action area.

The temporary water diversion and cofferdams are not expected to adversely affect the critical habitat PBFs associated with migration because the diversion will not be in place during periods of adult and smolt steelhead migration or spawning in San Anselmo Creek. Water diversion around the worksite will be limited to the period between June 1 and October 15 when adults and smolts are not actively migrating between freshwater and the ocean. Cofferdams will be removed prior to the beginning of adult or smolt migration period of December through May.

2.5.5.1 Riparian and Aquatic Vegetation

The project will result in temporary reductions in riparian vegetation within portions of the action area due to the removal and trimming of vegetation along the bed and banks of San Anselmo Creek for equipment access and construction. Riparian vegetation helps maintain stream habitat conditions necessary for steelhead. Riparian zones serve important functions in stream ecosystems such as providing shade (Poole and Berman 2001), sediment storage and filtering (Cooper *et al.* 1987, Mitsch and Gosselink 2000), nutrient inputs (Murphy and Meehan 1991), water quality improvements (Mitsch and Gosselink 2000), channel and stream bank stability (Platts 1991), source of woody debris that creates fish habitat diversity (Bryant 1983, Lisle 1986, Shirvell 1990), and both cover and shelter for fish (Bustard and Narver 1975, Wesche *et al.* 1987, Murphy and Meehan 1991). Riparian vegetation disturbance and removal can degrade these ecosystem functions and impair stream habitat for steelhead. Where riparian vegetation is removed or trimmed, steelhead may be exposed to poor shade, substrate, water quality, habitat diversity, cover, and shelter. These habitat impairments have the potential to limit or preclude successful spawning and rearing, reduce adult migration success, and expose juveniles and smolts to increased predation.

In the action area of this project, existing riparian vegetation provides cover and habitat complexity for migrating steelhead adults and rearing juveniles in San Anselmo Creek. However, vegetation is limited under and immediately adjacent to the bridges by existing rock riprap, concrete wingwalls, bridge abutments, bridge pilings, and overhead shading by the bridges. Construction of the Denil-style fish ladder at the Canyon Road Bridge site has resulted in a concrete apron that extends across the full width of the channel under the bridge and extends an additional 24 feet downstream in the channel. Despite the existence of this hardscape at the bridges, the three sites contain relatively well-developed riparian vegetation along the banks immediately upstream and downstream of the bridges. Tall riparian trees, steep banks in some areas, and the narrow/incised channel provide moderate levels of shade to the wetted portion of the channel.

The projects have incorporated measures to minimize the amount of vegetation removal. At Creek Road Bridge, from 5 to 20 trees and/or shrubs are anticipated to be removed. At Meadow Way, it is estimated a total of 0.07 acres of riparian vegetation will be disturbed or removed. At Canyon Road, only two native trees will be removed. Thus, the amount of vegetation to be removed provides a small amount of cover and habitat complexity at each project site. Post-construction, the projects will develop replanting plans that replace all lost native riparian trees. Native trees 4-inch DBA or larger will be replaced at a ratio of 2:1. Native shrubs 3 feet or taller will also be replaced at a ratio of 2:1. Revegetation will be performed immediately upon completion of construction activities at each bridge site. Because riparian vegetation typically begins to provide habitat benefits relatively rapidly during reestablishment, usually within the first one to two years following planting, the expected effects to steelhead and their habitat will be temporary. However, during the approximately one- to two-year-long duration while the riparian vegetation is beginning to reestablish, steelhead in the action area will be exposed to reduced riparian cover, potentially exposing them to habitat limitations described in the paragraph above.

Considering the small amount of riparian vegetation to be removed at each site and the existing condition of the riparian zone at the three bridge work sites, riparian habitat impacts by this project are not expected to reach the scale where any PBFs of steelhead critical habitat will be altered, temporarily or permanently. With minimal temporal loss of vegetation and some vegetative cover remaining intact at the work sites, no measureable increase in water temperature or reduction in the amount of terrestrial food input into San Anselmo Creek is anticipated. In addition, invasive and non-native understory plants in the work site will be removed where they conflict with project construction. Thus, the ability of critical habitat to support listed species' conservation needs in the action area will be maintained. Additionally, NMFS does not anticipate harm, injury, or behavioral impacts to CCC steelhead associated with exposure to this temporary level of minor reductions in riparian vegetation.

2.5.5.2 Impaired Habitat Conditions from In-channel Structures

Development in and over channels has the potential to impair stream habitat. Habitat impairments associated with the existing bridges are present in the action area - abutments on the streambank confine the channel and prevent channel migration, in-channel piers confine flows and alter sediment and debris transport, and scour protection and bank stabilization constrain flows and impair bed and bank habitat. These constraints have the potential to result in poor habitat complexity, including poor cover and poor refugia. However, while habitat limitations do exist in the action area, current conditions are not so severe that steelhead use is likely significantly impaired – riparian cover, substrate, channel complexity, passage conditions, and water quality support steelhead use of the action area.

Replacement of the Meadow Way Bridge with a new bridge in the same location as the existing bridge, and repair of the Creek Road and Canyon Road bridges has the potential to perpetuate bridge-related constraints in the action area. The repaired bridges will persist and contain in-bank abutments and scour protection. Such features have the potential to reduce or prevent floodplain connectivity and channel functions that form and maintain physical habitat conditions. These features may also impair water quality, fish prey species, reduce natural cover, and create obstructions to migration. Such impairments have the potential to degrade PBFs of critical habitat for CCC steelhead. However, while this project does include structures at the bridges that could result in such impairments, proposed actions are not expected to significantly impair PBFs of critical habitat for CCC steelhead. Water quantity and quality will not be impaired; scour protection will be buried; and no structures will be installed that would be expected to cause an obstruction to fish passage. At the Meadow Way Bridge, the project is expected to incrementally improve CCC steelhead passage in the action area by removing existing in-channel piers. Thus, while projects with in-channel structures have the potential to impair PBFs necessary for the support of CCC steelhead migration and rearing, generally, the effects of in-channel structures resulting from this specific project are not expected to result in significant impacts to CCC steelhead or CCC steelhead 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 environmental baseline (Section 2.4).

NMFS does not anticipate any cumulative effects in the action area other than those ongoing actions already described in the Environmental Baseline above and resulting from climate change. Given current baseline conditions and trends, NMFS does not expect to see significant improvement in habitat conditions in the near future due to existing land and water development in the watershed.

2.7 Integration and Synthesis

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

CCC steelhead are threatened. Factors responsible for the decline of CCC steelhead and their critical habitat include logging, agriculture, mining, urbanization, stream channelization and bank stabilization, dams, wetland loss, and water withdrawals, and global climate change. As an independent population, the Corte Madera Creek CCC steelhead population is important to the recovery of the DPS. Although no population estimates are available, current information suggests steelhead numbers in the Corte Madera watershed are substantially reduced from historic levels.

Juvenile CCC steelhead are expected to be present in the action area during project implementation. As described in Section 2.5 Effects of the Action, NMFS identifies the following effects as having the potential to result from the project: adverse effects to steelhead from fish collection; adverse effects to steelhead from dewatering; insignificant effects to critical habitat from dewatering; insignificant effects to steelhead and critical habitat from temporary increases in suspended sediment concentrations; a discountable potential for steelhead and critical habitat to be exposed to toxic chemicals; insignificant effects to steelhead and critical habitat from temporary reductions in riparian vegetation; and insignificant effects to steelhead and critical habitat resulting from the maintenance and placement of structures (bridges) in and over the channel. NMFS expects the aforementioned insignificant and discountable effects (e.g., temporary reductions in riparian vegetation, temporary increases in suspended sediment concentrations, and exposure to construction debris and materials) will not occur simultaneously with other effects in any significant way, or will not occur when steelhead are likely to be present in the action area.

Adverse effects to CCC steelhead associated with fish collection and relocation, and dewatering, include the potential for injury and mortality of CCC steelhead juveniles. However, NMFS expects that low numbers of CCC steelhead juveniles will be present in the action area to be exposed to this effect. Fish collection and relocation will be performed in coordination with dewatering prior to construction at the Creek Road, Meadow Way, and Canyon Road sites. Based on the low mortality rates for similar relocation efforts, NMFS anticipates few juvenile steelhead would be injured or killed by fish relocation and construction activities during implementation of this project. Anticipated mortality from relocation is expected to be less than three percent of the fish relocated, and mortality from dewatering is expected to be less than one percent of the fish in the area prior to dewatering (combined mortality to not exceed four percent).

Fish relocation and dewatering will occur four times (once at Creek Road, twice at Meadow Way, and once at Canyon Road) at the three bridge sites over the duration of this project. At Creek Road, up to 48 juvenile steelhead are expected to be collected and relocated during construction dewatering. At Meadow Way, up to 72 juvenile steelhead are expected to be collected and relocated each year for two construction seasons (144 juvenile steelhead total). Up to 24 juvenile steelhead are expected to be collected and relocated at Canyon Road. With injury and mortality resulting from netting and electrofishing estimated to be about three percent, two steelhead mortalities at Creek Road, three steelhead mortalities at Meadow Way (six total for two years of construction), and one steelhead mortality at Canyon Road are expected. An additional one percent of the juvenile steelhead may be killed during dewatering if they were missed during collection and are left within the dewatered area. With four dewatering events, up to four additional juvenile steelhead may be killed by stranding within the dewatered reaches.

Due to the relatively large number of juveniles produced by each spawning pair, steelhead spawning in the San Anselmo Creek watershed in future years are likely to produce enough juveniles to replace the few that may be lost at the work sites due to relocation and dewatering. It is unlikely that the small potential loss of up to 13 juvenile steelhead during the duration of this project will impact future adult returns. Therefore, project-related fish relocation and dewatering are unlikely to appreciably reduce the likelihood of survival and recovery of CCC steelhead.

Habitat conditions for steelhead within the action area are of low to moderate quality; however, conditions in the action area are sufficient to support use by all freshwater lifestages of steelhead. Effects to CCC steelhead critical habitat from the proposed project are expected to include temporary impacts due to construction, permanent impacts due to the perpetuation of structures (bridges) in, over, and adjacent to the stream, and minor permanent benefits due to reduction of structures in, over, and adjacent to the stream. As discussed in Section 2.5 Effects of the Action, these temporary and permanent effects to CCC steelhead critical habitat are not expected to adversely affect PBFs of CCC steelhead critical habitat, and the minor permanent improvements (removal of creosote bridge support pilings) are expected to result in incremental benefits to critical habitat within the action area.

In California, climate change is expected to result in higher average summer air temperatures, lower total precipitation, reductions in the amount of snowfall and rainfall, and reduced stream flow levels in Northern and Central Coastal rivers and streams. Estuaries may also experience changes in productivity due to changes in freshwater flows, nutrient cycling, and sediment amounts. For this project, construction would be completed by 2024 and the above effects of climate change are unlikely to be detected with that time frame. The short-term effects of project construction will have completely elapsed prior to these climate change effects. Long-term effects on the stream channel associated with repairs and replacement of the bridges are not expected to significantly magnify the likely climate change impacts.

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 CCC 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

In the biological opinion, NMFS determined that incidental take of juvenile CCC steelhead would occur. NMFS anticipates that take of threatened CCC steelhead will be associated with fish relocation and dewatering during the Creek Road Bridge Seismic Retrofit Project, the

Meadow Way Bridge Replacement Project, and the Canyon Road Preventative Maintenance Project.

The number of threatened steelhead that may be incidentally taken during project activities is expected to be small, and limited to the juvenile (pre-smolt) life stage. Fish relocation and dewatering will be performed one time at Creek Road, twice in two years at Meadow Way (once per year), and one time at Canyon Road. NMFS expects that no more than three percent of the steelhead present within the action area prior to dewatering will be injured or killed during fish relocation. NMFS also expects that less than one percent of the fish within the dewatered area will be injured or killed during dewatering activities.

Up to 48 juvenile steelhead are expected to be captured and relocated at Creek Road. Up to 72 juvenile steelhead are expected to be captured and relocated at Meadow Way each year; with two consecutive years of construction, the two-year total is up to 144 juvenile steelhead. Up to 24 juvenile steelhead are expected to be collected and relocated at Canyon Road. With injury and mortality resulting from netting and electrofishing estimated to be about three percent, two steelhead mortalities at Creek Road, three steelhead mortalities at Meadow Way (six total for two years of construction), and one steelhead mortality at Canyon Road are expected.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of CCC steelhead:

1. Undertake measures to ensure that injury and mortality to steelhead resulting from fish relocation and dewatering activities are low.

2. Undertake measures to minimize harm to steelhead from construction of the projects and degradation of aquatic habitat.

3. Prepare and submit post-construction reports regarding the effects of fish relocation, construction, and post-construction site performance.

4. Ensure the Canyon Road Bridge fish ladder is properly functioning for steelhead passage and adequately maintained.

2.9.4 Terms and Conditions

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

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

    a. Caltrans and/or the Town of Fairfax will develop a written fish collection and relocation plan for each of the three bridge construction sites. Plans must be submitted to NMFS (address specified in 3a below) for review and approval no less than 30 days prior to the beginning of construction.

    b. Caltrans and/or the Town of Fairfax will retain qualified biologists with expertise in the areas of anadromous salmonid biology, including handling, collecting, and relocating salmonids; salmonid/habitat relationships; and biological monitoring of salmonids. All biologists working on the projects must be qualified to conduct fish collections in a manner which minimizes potential risks to steelhead. Electrofishing, if used, will be performed by a qualified biologist and conducted according to the NMFS Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act, June 2000. See: http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/4d-Rules/upload/electro2000.pdf.

    c. The biologists will monitor the construction site during placement and removal of cofferdams, and streamflow diversions to ensure that any adverse effects to salmonids are minimized. The biologists will be on site during all dewatering events to capture, handle, and safely relocate steelhead. Caltrans or the biologist will notify NMFS biologist Darren Howe at (707) 575-3152 or darren.howe@noaa.gov one week prior to capture activities in order to provide an opportunity for NMFS staff to observe the activities.

    d. Captured steelhead will be handled with extreme care and kept in water to the maximum extent possible during relocation activities. All captured fish will be kept in cool, shaded, aerated water protected from excessive noise, jostling, or overcrowding any time they are not in the stream, and fish will not be removed from this water except when released. To avoid predation, the biologists will have at least two containers and segregate young-of-year fish from larger age-classes and other potential aquatic predators. Captured steelhead will be relocated, as soon as possible, to a suitable instream location in which suitable habitat conditions are present to allow for adequate survival of transported fish and fish already present.

e. If any salmonids are found harmed, the biological monitor will contact NMFS biologist, Darren Howe, by phone immediately at (707) 575-3152 or the NMFS North Central Coast Office (Santa Rosa, California) at 707-575-6050. The purpose of the contact is to review the activities resulting in take, determine if additional protective measures are required, and to ensure appropriate collection and transfer of salmonid mortalities and tissue samples. All salmonid mortalities will be retained. Tissue samples are to be acquired from each salmonid mortality per the methods identified in the NMFS Southwest Fisheries Science Center Genetic Repository protocols (contact the above NMFS staff for directions) and sent to: NOAA Coastal California Genetic Repository; Southwest Fisheries Science Center; 110 McAllister Way; Santa Cruz, California 95060.

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

a. Caltrans and the Town of Fairfax will allow any NMFS employee(s) or any other person(s) designated by NMFS, to accompany field personnel to visit the project sites during activities described in this opinion.

b. All cofferdams, pumps, pipes and other diversion materials will be removed from the stream upon work completion and no later than October 15.

c. Fill material for cofferdams will be fully confined with the use of plastic sheeting, sandbags, or with other non-porous containment methods, such that sediment does not come in contact with stream flow or in direct contact with the natural streambed. All loose fill material for cofferdams or access ramps will be completely removed from the channel by October 15.

d. Any pumps used to divert live stream flow, outside the dewatered work area, will be screened and maintained throughout the construction period to comply with NMFS' Fish Screening Criteria for Anadromous Salmonids. See: https://www.westcoast.fisheries.noaa.gov/publications/hydropower/fish_passage_design_criteria.pdf.

e. Treated wood may not be used in any temporary platforms or scaffolds in the creek channel. Lumber used for temporary construction operations must be unfinished and untreated wood. All materials used for temporary platforms or scaffolds must be completely removed from the channel no later than October 15.

f. In areas where concrete is used, a dry work area must be maintained to prevent conveyance of runoff from curing concrete to the surface waters of the adjacent stream at all times. Water that inadvertently contacts uncured concrete must not be discharged into surface waters.

g. Construction equipment used within the creek channel will be checked each day prior to work within the creek channel (top of bank to top of bank) and, if necessary, action will be taken to prevent fluid leaks. If leaks occur during work in the channel (top of bank to top of bank), spills will be contained and affected soils will be removed and properly disposed of.

h. Caltrans and/or the Town of Fairfax will develop a written revegetation mitigation and monitoring plan for each of the three bridge construction sites. Revegetation mitigation and monitoring plans must be submitted to NMFS (address specified in 3a below) for review and approval no less than 30 days prior to the beginning of construction.

3. The following term and condition implements reasonable and prudent measure 3:

a. Caltrans and/or the Town of Fairfax will provide a written report to NMFS by January 15 of the year following the completion of construction for each of the three bridge projects. The reports must be submitted to NMFS North Central Coast Office, Attention: San Francisco Bay Branch Chief, National Marine Fisheries Service, 777 Sonoma Avenue, Room 325, Santa Rosa, California, 95404-6528. The reports must contain, at a minimum, the following information:

i. **Construction related activities –** The report will include the dates construction began and was completed; a discussion of any unanticipated effects or unanticipated levels of effects on salmonids, including a description of any and all measures taken to minimize those unanticipated effects and a statement as to whether or not the unanticipated effects had any effect on ESA-listed fish; the number of salmonids killed or injured during the project activities; and photographs taken before, during, and after the activity from photo reference points.

ii. **Fish Relocation --** The report will include a description of the location from which fish were removed and the release site including photographs; the date and time of the relocation effort; a description of the equipment and methods used to collect, hold, and transport salmonids; the number of fish relocated by species; the number of fish injured or killed by species and a brief narrative of the circumstances surrounding salmonid injuries or mortalities; and a description of any problems which may have arisen during the relocation activities and a statement as to whether or not the activities had any unforeseen effects.

4. The following terms and conditions implement reasonable and prudent measure 4:

a. Caltrans and/or the Town of Fairfax, in consultation with NMFS fish passage engineering, will assess the current condition of the fish ladder under the Canyon Road Bridge to determine if repairs and/or maintenance are required for proper operation of the facility. The assessment shall be completed no later than November 30, 2019.

b. If the assessment determines repair of the fish ladder is needed, Caltrans and/or the Town of Fairfax will prepare a plan for repair(s) and propose a schedule to complete the repair(s). The fish ladder repair plan shall be submitted to NMFS (address specified in 3a above) for review and approval no later than May 31, 2020.

c. Caltrans and/or Town of Fairfax will prepare a plan for the regular inspection and maintenance of the fish ladder under the Canyon Road Bridge. The fish ladder inspection and maintenance plan shall be submitted to NMFS (address specified in 3a above) for review and approval no later than May 31, 2020.

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). NMFS has no conservation recommendations at this time.

2.11 Reinitiation of Consultation

This concludes the formal consultation for the Creek Road Bridge Seismic Retrofit Project, the Meadow Way Bridge Replacement Project, and the Canyon Road Preventative Maintenance Project on San Anselmo Creek in Fairfax, Marin County, California.

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.

2.12 "Not Likely to Adversely Affect"' Determinations

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

Historically, the Corte Madera Creek watershed, including San Anselmo Creek, supported coho salmon. Recorded observations of coho within the watershed date from 1926 to 1984; the last sighting of coho was in 1984 (Leidy *et al.* 2005b). Based on this information, NMFS considers endangered CCC coho extirpated from San Anselmo Creek and the greater Corte Madera Creek watershed. Thus, Caltrans has determined that the project is expected to have no direct effects on endangered CCC coho salmon. However, Corte Madera Creek, including San Anselmo Creek, is designated critical habitat for endangered CCC coho salmon (64 FR 24049) and Caltrans has determined that the project may affect but is not likely to adversely affect CCC coho salmon critical habitat.

For CCC coho salmon critical habitat, the following essential habitat types have been identified: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development; 4) adult migration corridors; and 5) spawning areas. Within these habitat types, the PBFs[14] of coho salmon critical habitat include adequate: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions (64 FR 24029). Within the action area, the PBFs for CCC coho salmon migration and adult spawning are in low to moderate condition. PBFs in the action area for CCC coho salmon juvenile summer rearing, winter rearing, migratory, and growth and development are poor to low due to high summertime water temperatures, low summertime flow conditions, and impaired substrate, cover, shelter, and water velocity conditions.

NMFS evaluated the proposed project for potential adverse effects to CCC coho salmon critical habitat. NMFS considered the life history of CCC coho salmon (Weitkamp *et al.* 1995), aerial photographs of the work sites, and current habitat conditions (WRA Environmental Consultants 2018). The effects of the proposed actions on CCC coho salmon critical habitat are reasonably likely to include effects from dewatering, temporary increases in suspended sediment concentrations, temporary reductions in riparian vegetation, and perpetuation of impaired habitat conditions by the bridge structures within the action area.

As discussed in Section 2.5.5 of this opinion for CCC steelhead critical habitat, effects to habitat from proposed actions are expected to be temporary, insignificant, or discountable. Dewatering would result in temporary and minor impacts to water quality and streamflow, and could cause the temporary reduction of prey (macroinvertebrates) within the affected reaches. However, impacts to streamflow are not expected to impair habitat conditions beyond those that typically occur during summertime low flow conditions, and macroinvertebrate populations are expected to recover within one to two months after construction. Increases in turbidity will be negligible because of BMPs incorporated by the project to avoid or minimize the discharge of sediments.

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[14] The designation of critical habitat for CCC coho salmon uses the term PCE or essential features. The new critical habitat regulations (81 FR 7414) replace this term with PBFs. This shift in terminology does not change the approach used in conducting our analysis, whether the original designation identified primary constituent elements, physical or biological features, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The potential for construction–related toxins and pollutants to be introduced to the stream is expected to be discountable due to the spill prevention, containment, and disposal measures that are included in the project. Disturbances to riparian vegetation would be minimal as vegetation trimming and removal would be limited to small areas, and the affected areas would be replanted at a ratio of 2:1. Riparian vegetation is expected to return rapidly to pre-project cover levels following the cessation of construction actions and the establishment of revegetated areas. The perpetuation of structures (bridges) in, over, and near the channel that will result from the project is also not expected to impair critical habitat. For the above reasons, the potential effects of the Project are considered insignificant or discountable and are not expected to result in either a net change to existing habitat values in the action area or result in adverse impacts to designated critical habitat for CCC coho salmon.

3 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.

3.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is Caltrans and the Town of Fairfax. Other interested users could include citizens of affected areas, or others interested in the conservation of CCC steelhead. Individual copies of this opinion were provided to Caltrans.

3.2 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.

3.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

4 REFERENCES

Abdul-Aziz, O.I., N.J. Mantua, and K.W. Myers. 2011. Potential climate change impacts on thermal habitats of Pacific salmon (*Oncorhynchus* spp.) in the North Pacific Ocean and adjacent seas. Canadian Journal of Fisheries and Aquatic Sciences 68(9):1660-1680.

Alexander, G.R., and E.A. Hansen. 1986. Sand bed load in a brook trout stream. North American Journal of Fisheries Management 6:9-23.

Barnhart, R.A. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest), steelhead. United States Fish and Wildlife Service Biological Report 82 (11.60). 21 pages.

Berg, L., and T.G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Bjorkstedt, E.P, B.C. Spence, J.C. Garza, D.G. Hankin, D. Fuller, W.E. Jones, J.J. Smith, and R. Macedo. 2005. An Analysis of Historical Population Structure for Evolutionarily Significant Units of Chinook Salmon, Coho Salmon, and Steelhead in the North-Central California Coast Recovery Domain. NOAA Technical Memorandum NOAA-TM-NMFS_SWFSC-382. 210 pages.

Bjornn, T.C., M.A. Brusven, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chacho, and C. Schaye. 1977. Transport of granitic sediment in streams and its effect on insects and fish. University of Idaho, Forest, Wildlife, and Range Experiment Station, Bulletin 17, Moscow, ID.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W.R. Meehan, editor. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19. American Fisheries Society. Bethesda, Maryland. 751 pages.

Brewer, P. G., and J. Barry. 2008. Rising Acidity in the Ocean: The Other CO2 Problem. Scientific American.

Bryant, M.D. 1983. The role and management of woody debris in west coast salmonid nursery streams. North American Journal of Fisheries Management 3:322-330.

Busby, P.J., T.C. Wainwright, G.J. Bryant., L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NOAA Fisheries-NWFSC-27. 261 pages.

Bustard, D.R., and D.W. Narver. (1975). Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gardneri*). Journal of the Fisheries Research Board of Canada 32(5):667-680.

Cayan, D., M. Tyree, and S. Iacobellis. 2012. Climate Change Scenarios for the San Francisco Region. Prepared for California Energy Commission. Publication number: CEC-500-2012-042. Scripps Institution of Oceanography, University of California, San Diego.

CDFG (California Department of Fish and Game). 2005. Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects conducted under Department of the Army Regional General Permit No. 12 (Corps File No. 27922N) within the United States Army Corps of Engineers, San Francisco District, January 1, 2004 through December 31, 2004. March 1, 2005.

CDFG (California Department of Fish and Game). 2006. Annual report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects conducted under Department of Army Regional General Permit No. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District, January 1, 2005 through December 31, 2005. CDFG Region 1, Fortuna Office. March 1, 2006.

CDFG (California Department of Fish and Game). 2007. Annual report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects conducted under Department of Army Regional General Permit No. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District, January 1, 2006 through December 31, 2006. Northern Region, Fortuna Office. March 1, 2007.

CDFG (California Department of Fish and Game). 2008. Annual report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects conducted under Department of Army Regional General Permit No. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District, January 1, 2007 through December 31, 2007. Northern Region, Fortuna Office. March 1, 2008.

CDFG (California Department of Fish and Game). 2009. Annual report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects conducted under Department of Army Regional General Permit No. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District, January 1, 2008 through December 31, 2008. Northern Region, Fortuna Office. March 1, 2009.

CDFG (California Department of Fish and Game). 2010a. Unpublished data documenting history of fish trapped at Warm Springs Hatchery (Dry Creek) between 1980/81 and 2009/10.

CDFG (California Department of Fish and Game). 2010b. Annual report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects conducted under Department of Army Regional General Permit No. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District, January 1, 2009 through December 31, 2009. Northern Region, Fortuna Office. March 1, 2010.

Collins, B.W. 2004. Report to the National Marine Fisheries Service for instream fish relocation activities associated with fisheries habitat restoration program projects conducted under Department of the Army (Permit No. 22323N) within the United States Army Corps of Engineers, San Francisco District, during 2002 and 2003. California Department of Fish and Game, Northern California and North Coast Region. March 24, 2004. Fortuna, California.

Cooper J. R., J. W. Gilliam, R. B. Daniels, and W. P. Robarge. 1987. Riparian areas as filters for agricultural sediment. Soil Science Society of America Journal. 51:416–420.

Cordone, A.J., and D.W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. California Fish and Game 47:189-228.

Cox, P., and D. Stephenson. 2007. A changing climate for prediction. Science 113:207-208.

Crouse, M.R., C.A. Callahan, K.W. Malueg, and S.E. Dominguez. 1981. Effects of fine sediments on growth of juvenile coho salmon in laboratory streams. Transactions of the American Fisheries Society 110:281-286.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management. 5:330-339.

Doney, S.C, M. Ruckelshaus, J.E. Duffy, J.P. Barry, F. Chan, C.A. English, H.M. Galindo, J.M. Grebmeier, A.B. Hollowed, N. Knowlton, J. Polovina, N.N. Rabalais, W.J. Sydeman, L.D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. Annual Review of Marine Science 4:11-37.

Eisler, R. (2000). Handbook of chemical risk assessment: health hazards to humans, plants, and animals. Volume 1, Metals. Boca Raton, FL, Lewis Press.

Feely, R.A., C.L. Sabine, K. Lee, W. Berelson, J. Kleypas, V.J. Fabry, and F.J. Millero. 2004. Impact of anthropogenic CO2 on the CaCO3 system in the oceans. Science 305:362-366.

Fukushima, L., and E.W. Lesh. 1998. Adult and juvenile anadromous salmonid migration timing in California streams. California Department of Fish and Game 84(3):133-145.

Furniss, M.J., T.D. Roelofs, and C.S. Lee. 1991. Road construction and maintenance. Pages 297-323 in W. R. Meehan, editor. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication 19.

Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. United States Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-66. 598 pages.

Gregory, R.S., T.G. Northcote. 1993. Surface, Planktonic, and Benthic Foraging by Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) in Turbid Laboratory Conditions. Canadian Journal of Fisheries and Aquatic Sciences, 50: 233-240.

Harvey, B.C. 1986. Effects of suction gold dredging on fish and invertebrates in two California streams. North American Journal of Fisheries Management 6:401-409.

Hayes, D.B., C.P. Ferreri, and W.W. Taylor. 1996. Active fish capture methods. Pages 193-220 in B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society. Bethesda, Maryland. 732 pages.

Hayhoe, K., D. Cayan, C.B. Field, P.C. Frumhoff, E.P. Maurer, N.L. Miller, S.C. Moser S.H. Schneider, K.N. Cahill, E.E. Cleland, L. Dale, R. Drapek, and R.M. Hanermann. 2004. Emissions pathways, climate change, and impacts on California. Proceedings of the National Academy of Sciences of the USA 101(34):12422-12427.

Hubert, W.A. 1996. Passive capture techniques. Pages 157-192 in B.R. Murphy and D.W. Willis, editors. Fisheries Techniques. Second Edition. American Fisheries Society. Bethesda, Maryland. 732 pages.

Kadir, T., L. Mazur, C. Milanes, and K. Randles. 2013. Indicators of Climate Change in California. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment Sacramento, California.

Keeley, E.R. 2003. An experimental analysis of self-thinning in juvenile steelhead trout. Oikos 102:543-550.

Leidy, R.A., G.S. Becker, and B.N. Harvey. 2005a. Historical distribution and current status of steelhead/rainbow trout (*Oncorhynchus mykiss*) in streams of the San Francisco estuary, California. Center for Ecosystem Management and Restoration, Oakland, California.

Leidy, R.A., G. Becker, and B.N. Harvey. 2005b. Historical Status of Coho Salmon in Streams of the Urbanized San Francisco Estuary, California. California Fish and Game 91(4): 219-254.

Lindley, S.T., and coauthors. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1):26.

Lisle, T.E. 1986. Effects of woody debris on anadromous salmonid habitat, Prince of Wales Island, Southeast Alaska. North American Journal of Fisheries Management 6:538-550.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionary Significant Units. United Stated Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-42. 156 pages.

McEwan, D.R. 2001. Central Valley Steelhead. State of California, The Resources Agency, Department of Fish and Game. Contributions to the Biology of Central Valley Steelhead. Fish Bulletin 179(1): 1-44.

Meehan, W.R., and T.C. Bjornn. 1991. Salmonid distribution and life histories. Pages 47-82 in Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. W.R. Meehan, editor. American Fisheries Society Special Publication 19. American Fisheries Society. Bethesda, Maryland. 751 pages.

Mitsch, W.J., and J.G. Gosselink. 2000. Wetlands, 3rd ed. John Wiley & Sons, New York.

Moser, S., J. Ekstrom, and G. Franco. 2012. Our Changing Climate 2012 Vulnerability and Adaptation to the Increasing Risks from Climate Change in California. A Summary Report on the Third Assessment from the California Climate change Center. July. CEC-500-20102-007S.

Murphy, M.L., and W.R. Meehan. 1991. Stream ecosystems. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society, Special Publication Number 19. W. R. Meehan. Bethesda, MD, American Fisheries Society: 17-46.

NMFS (National Marine Fisheries Service). 1997a. Screening criteria for anadromous salmonids. Southwest Region, National Marine Fisheries Service. 12 pages.

NMFS. 1997b. Status review update for West Coast steelhead from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 68 pages.

NMFS. 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act. June 2000. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 5 pages.

NMFS. 2016. Final Coastal Multispecies Recovery Plan: California Coastal Chinook Salmon, Northern California Steelhead, Central California Coast Steelhead. National Marine Fisheries Service. West Coast Region. California Coastal Office. Santa Rosa, California. October 2016.

Osgood, K.E. 2008. Climate Impacts on U.S. Living Marine Resources: National Marine Fisheries Service Concerns, Activities and Needs. National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-F/SPO-89.

Platts, W.S. 1991. Livestock grazing. In: Influence of forest and rangeland management on Salmonid fishes and their habitats. American Fisheries Society, Special Publication 19:389-423.

Poole, G.C., and C.H. Berman. 2001. An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-caused thermal degradation. Environmental Management 27:787-802. 423.

Reeves, G.H., J.D. Hall, T.D. Roelofs, T.L. Hickman, and C.O. Baker. 1991. Rehabilitating and modifying stream habitats. Pages 519-557 in W.R. Meehan, editor. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication 19. 751 pages.

Ruggiero, P., C.A. Brown, P.D. Komar, J.C. Allan, D.A. Reusser, H. Lee, S.S. Rumrill, P. Corcoran, H. Baron, H. Moritz, J. Saarinen. 2010. Impacts of climate change on Oregon's coasts and estuaries. Pages 241-256 in K.D. Dellow and P.W. Mote, editors. Oregon Climate Assessment Report. College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, Oregon.

Rich, A.A. 2000. Fishery resource conditions of the Corte Madera Creek watershed, Marin, County, California. A.A. Rich and Associates. San Anselmo, California. November 10.

Ross Taylor and Associates. 2006. Corte Madera Stream Crossing Inventory and Fish Passage Evaluation. Prepared for the Friends of Corte Madera Creek Watershed. February.

Ross Taylor and Associates. 2012. Lansdale Avenue Fish Passage Improvement Project. Final Report: Appendix C: Summary of Fish Capture and Relocation. June.

Santer, B.D., C. Mears, C. Doutriaux, P. Caldwell, P.J. Gleckler, T.M.L. Wigley, S. Solomon, N.P. Gillett, D. Ivanova, T.R. Karl, J.R. Lanzante, G.A. Meehl, P.A. Stott, K.E. Talyor, P.W. Thorne, M.F. Wehner, and F.J. Wentz. 2011. Separating signal and noise in atmospheric temperature changes: The importance of timescale. Journal of Geophysical Research 116: D22105.

Scavia, D., Field, J.C., Boesch, D.F., Buddemeier, R.W., Burkett, V., Cayan, D.R., Fogarty, M.A., Harwell, R.W., Howarth, C.M., Reed, D.J., Royer, T.C., Sallenger, A.H., Titus, J.G. 2002. Climate change impacts on U.S. coastal and marine ecosystems. Estuaries 25(2):149-164.

Schneider, S.H. 2007. The unique risks to California from human-induced climate change. Source: www.climatechange.ca.gov; presentation on May, 22, 2007, by Stephen H.

Schneider, Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies; Professor, Department of Biological Sciences; Senior Fellow, Woods Institute for the Environment Stanford University. (PDF file, 23 pg., 974 kb)

Servizi, J.A., and D.W. Martens. 1992. Sublethal responses of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences 49:1389-1395.

Shapovalov, L., and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (Salmo gairdneri gairdneri) and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. California Department of Fish and Game, Fish Bulletin 98:1-375.

Shirvell, C.S. 1990. Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) cover habitat under varying stream flows. Canadian Journal of Fisheries and Aquatic Sciences 47:852-860.

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

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services, Inc. Corvallis, Oregon. December. Report. National Marine Fisheries Service, Portland, Oregon.

Spence, B.C., and coauthors. 2008. A Framework for Assessing the Viability of Threatened and Endangered Salmon and Steelhead in the North-Central California Coast Recovery Domain U.S. Department of Commerce, National Marine Fisheries Service, Southwest Fisheries Service Center, NOAA-TM-NMFS-SWFSC-423, Santa Cruz, CA.

Spence, B.C., E.P. Bjorkstedt, S. Paddock, and L. Nanus. 2012. Updates to biological viability criteria for threatened steelhead populations in the North-Central California Coast Recovery Domain. National Marine Fisheries Service. Southwest Fisheries Science Center, Fisheries Ecology Division. March 23.

Thomas, V.G. 1985. Experimentally determined impacts of a small, suction gold dredge on a Montana stream. North American Journal of Fisheries Management 5:480-488.

Turley, C. 2008. Impacts of changing ocean chemistry in a high-CO2 world. Mineralogical Magazine 72(1):359-362.

Velagic, E. 1995. Turbidity study: a literature review. Prepared for Delta planning branch, California Department of Water Resources by Centers for Water and Wildland Resources, University of California, Davis.

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

Weitkamp, L., A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope, and R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Department Of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-24.

Wesche, T.A., C.M. Goertler, and C.B. Frye. 1987. Contribution of Riparian Vegetation to Trout Cover in Small Streams. North American Journal of Fisheries Management 7:151- 153.

Westerling, A.L., B.P. Bryant, H.K. Preisler, T.P. Holmes, H.G. Hidalgo, T. Das, and S.R. Shrestha. 2011. Climate change and growth scenarios for California wildfire. Climate Change 109(1):445-463.

Williams, T.H, S.T. Lindley, B.C. Spence, and D.A. Boughton. 2011. Status review update for Pacific salmon and steelhead under the Endangered Species Act: Southwest. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California. 98 pages.

Williams, T.H., B.C. Spence, D.A. Boughton, R.C. Johnson, L. Crozier, N. Mantua, M. O’Farrell, and S.T. Lindley. 2016. Viability assessment for Pacific salmon and steelhead listed under the Endangered Species Act: Southwest. 2 February 2016 Report to National Marine Fisheries Service – West Coast Region from Southwest Fisheries Science Center, Fisheries Ecology Division 110 Shaffer Road, Santa Cruz, California 95060.