**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

August 31, 2022 **Refer to NMFS No:** WCRO-2022-00557

James Mazza
Regulatory Division Chief
U.S. Army Corps of Engineers, San Francisco District
450 Golden Gate Avenue, 4th Floor, Suite 0134
San Francisco, California 94102-3406

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Mindego Creek Fish Passage Project (Corps File No. SPN-2022-00071)

Dear James Mazza:

Thank you for the U.S. Army Corps of Engineers'(Corps) letter of March 7, 2022, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Mindego Creek Fish Passage Project (Project).

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019). This consultation was initiated when the 2019 regulations were still in effect. As reflected in this document, we are now applying the section 7 regulations that governed prior to adoption of the 2019 regulations. For purposes of this consultation, we considered whether the substantive analysis and its conclusions regarding the effects of the proposed actions articulated in the biological opinion and incidental take statement would be any different under the 2019 regulations. We have determined that our analysis and conclusions would not be any different.

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

The enclosed biological opinion is based on our review of the Corps' proposed Project and describes NMFS' analysis of potential effects on threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*), endangered Central California Coast (CCC) coho salmon (*O. kisutch*), and designated critical habitat for CCC steelhead and CCC coho salmon in accordance with section 7 of the ESA. NMFS concludes the Project is not likely to jeopardize the continued existence of endangered Central California Coast (CCC) coho salmon or threatened CCC steelhead, nor is the Project likely to result in the destruction or adverse modification of critical habitat for CCC coho salmon or CCC steelhead. However, NMFS anticipates take of CCC steelhead and CCC coho salmon will occur due to Project construction and maintenance. An

incidental take statement with non-discretionary terms and conditions is included with the enclosed biological opinion.

Regarding EFH, NMFS determined the anticipated effects on the EFH of Pacific Coast Salmon FMP are minor, temporary, or localized and the project will likely improve fish passage for coho salmon. Therefore, we have no practical EFH Conservation Recommendations to provide and no EFH Conservation Recommendations are included in this document.

Please contact Tom Wadsworth, Central Coast Branch Office in Santa Cruz, at (831) 713-7620 or Thomas.Wadsworth@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: Elise Piazza, Corps San Francisco District, Elise.H.Piazza@usace.army.mil
Amy Kaeser, San Mateo Resource Conservation District, amy@sanmateorcd.org
Stephanie MacDonald, San Mateo Resource Conservation District, Stephanie@sanmateorcd.org
Steve Arcelona, City and County of San Francisco, Steve.Arcelona@SFgov.org
Copy to ARN File # 151422WCR2022SR00050

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

Mindego Creek Fish Passage Project
NMFS Consultation Number: WCRO-2022-00557
Action Agency: U.S. Army Corps of Engineers, Regulatory Division, San Francisco District

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 | Yes | No |
| Central California Coast coho salmon (*O. kisutch*) | Endangered | Yes | No | Yes | No |

Essential Fish Habitat and NMFS' Determinations:

| Fishery Management Plan That Identifies EFH in the Project Area | Does Action Have an Adverse Effect on EFH? | Are EFH Conservation Recommendations Provided? |
|---|---|---|
| Pacific Coast Salmon | Yes | No |

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

**Issued By**:

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

**Date**: August 31, 2022

## Table of Contents

# 1 INTRODUCTION

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

## 1.1 Background

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, as amended.

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

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

## 1.2 Consultation History

On March 7, 2022, NMFS received an email from the Army Corps of Engineers (Corps) that included: 1) a letter requesting initiation of formal Section 7 consultation for potential impacts on CCC steelhead, due to implementation of the proposed Project; 2) the April 2020 Biological Resources Evaluation (BRE) for the Project, authored by the applicant, San Mateo Resource Conservation District (SMRCD). The Corps letter and BRE included a determination for CCC steelhead and its critical habitat, but not for CCC coho salmon and its critical habitat. As CCC coho salmon critical habitat exists in the Project area and coho salmon may be present, NMFS included determinations for these in this biological opinion. The Corps did not request an EFH consultation in their incoming request letter; however, because EFH exists at the Project site, affect to EFH were included in the biological opinion.

On March 21, 2022, NMFS requested additional information regarding: the proposed water diversion rate at the site, the minimum bypass flow in the creek for the diversion, the proposed process for removing the dam and fishway, as well as the amount, composition and fate of sediment behind the dam. In this communication, NMFS also indicated the action area is within coho critical habitat and Pacific Salmon EFH, and that CCC coho could be present during construction. The Corps responded to NMFS' request via email on March 30, 2022, and asked that SMRCD respond about the presence of coho, coho critical habitat, and EFH in the action area. A response regarding adding these aspects to the consultation was never received by

NMFS; however, impacts to coho, coho critical habitat, and EFH were analyzed in the opinion. On March 30, 2022, NMFS sent an email to the Corps requesting that the City and County of San Francisco (San Francisco), as an owner/operator of the diversion, be added as a co-applicant on the Federal action. SMRCD responded on April 15, 2022, with a Corps permit application stating that San Francisco had signed as a co-applicant on the Project.

On April 18, 2022, a meeting was held to discuss the Project. Representatives from NMFS, Corps, and SMRCD were in attendance. At the meeting, NMFS requested that SMRCD provide any information they had regarding the monthly amount of water that San Francisco can legally divert from Mindego Creek at the Project site. SMRCD responded to this request with information explaining some of San Francisco's water rights on April 18; however, the information did not explain all of San Francisco's water rights and diversion operations. NMFS contacted the State Water Resources Control Board (SWRCB) on April 28, 2022 to inquire about San Francisco's water rights on Mindego Creek. SWRCB replied on April 28 with some information but referred NMFS to the San Gregorio Creek Watermaster (Watermaster). NMFS contacted the Watermaster on April 28 to inquire further about San Francisco's water rights. The Watermaster replied on April 29 with the requested information.

NMFS conducted a site visit on May 6, 2022 with representatives from SMRCD and Waterways Inc. During the site visit, potential design changes were discussed and afterwards NMFS requested that SMRCD provide an updated design plan. On June 3, 2022, SMRCD provided the updated design. NMFS initiated consultation on June 8, 2022.

On July 13, 2022, NMFS contacted SMRCD to inquire about the minimum flow for Mindego Creek that would enable the planned new diversion intake to operate. SMRCD responded with the requested information on July 15.

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019). This consultation was initiated when the 2019 regulations were still in effect. As reflected in this document, we are now applying the section 7 regulations that governed prior to adoption of the 2019 regulations. For purposes of this consultation, we considered whether the substantive analysis and its conclusions regarding the effects of the proposed actions articulated in the biological opinion and incidental take statement would be any different under the 2019 regulations. We have determined that our analysis and conclusions would not be any different.

### 1.3 Proposed Federal Action

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

The SMRCD proposes to remove a dam and fishway on Mindego Creek, as well as relocate and reconstruct an existing water diversion intake operated by San Francisco. The intake facility, dam, and fishway are owned by San Francisco's Department of Juvenile Probation (Probation

Department). The diversion provides water to a nearby facility owned by San Francisco and is used for domestic water supply and irrigation. San Francisco intends to continue to operate and maintain the diversion intake. The purpose of the proposed action is to improve fish passage for salmonids at the site and to provide the continued ability for San Francisco to divert surface water at the site. The Project is located on Mindego Creek approximately 0.75 miles upstream of the confluence with Alpine Creek, the main tributary to San Gregorio Creek, San Mateo County, California. The Project includes: (1) site dewatering and fish relocation; (2) demolition and construction; (3) restoration of the creek channel; and (4) maintenance and operation of the water diversion.

### 1.3.1 Site Dewatering and Fish Relocation

To facilitate construction activities, SMRCD proposes to dewater approximately 355 linear feet (lf) of creek during June 15 and November 1. The installation of the dewatering and stream bypass system will be the first construction activity in the stream channel. A cofferdam will be installed to bypass streamflow around the construction site. The cofferdam will consist of clean gravel-filled bags. Gravity-fed bypass piping will be installed to divert streamflow around the Project site. The ends of the diversion pipes will be screened according to NMFS screening guidelines to prevent fish entrainment (NMFS 1997a). Remaining water within the dewatered reach will be removed from the construction area using screened pumps. Screens will meet "fry-size" criteria for NMFS (1997a). Water pumped from the construction area will be transferred to a settling basin before being discharged into Mindego Creek downstream. The bypass system and cofferdam will be sized appropriately to handle expected summer base flow conditions. Once construction activities are complete, gradual re-watering and removal of cofferdams will minimize disturbance to the stream channel.

To reduce fish injury and mortality, a qualified biologist will capture and relocate fish outside of the construction area before and during dewatering activities. After isolating the construction area with block nets, the biologist will use a combination of NMFS-approved methods to capture, handle, and transport fish to the release location. Fish will be captured by seining, dip netting, or electrofishing. The biologist will place captured fish in a bucket filled with cool, aerated creek water. Captured fish will then be transported in the buckets by foot and released into suitable habitats upstream and/or downstream of the work area. The biologist will determine release locations prior to capture activities.

### 1.3.2 Demolition and Construction

The Project aims to improve fish passage conditions by removing the channel-spanning dam and the functionally compromised fishway. Once the channel is completely dewatered, the existing dam and fishway will be demolished. An excavator will accomplish this with a breaker bar or a jackhammer operated by hand may be used to break up the concrete. Large pieces of broken concrete and all steel from the dam and fishway will be removed from the site for disposal. Smaller pieces (< 6 inches) of concrete or mortar from the dam will be mixed with the stream simulation material and left in the channel.

The existing water diversion intake and submersible pump system will be relocated within the site and reconstructed with a screened intake and gravity flow system. A concrete diversion structure will be installed in the creek bank adjacent to the new intake. An adjustable weir plate located within the structure will be used to regulate the diversion flow rate. The new intake structure configuration (weir plate and pump) does not enable diversions when flow in Mindego Creek at the intake is less than 2 cubic feet per second (cfs).

With the dam and fishway removed, the channel will be restored using a variety of techniques to develop instream habitat for salmonids and protect the diversion intake structure. The proposed channel will be sloped toward the center with the bottom width ranging from 14-16 feet, reflecting similar bed width and gradation found in the reach immediately downstream of the restored channel. Stream simulation material will be placed along the restored channel bed and extended up the banks to conform to existing slopes in a manner that will limit the extent of bank disturbance. The stream simulation material will be water-jetted to lock in the finer particles, improve channel stability and reduce the risk of water going subsurface during low flow conditions. The approximately 250 cubic yards of alluvial sediment stored upstream of the dam, including fines to small boulders, will be blended into the stream simulation material that will line the reconstructed channel bed and bank.

Two pools will be created to provide potential resting and rearing areas for fish, as well as a stable location to install the diversion intake. Boulder weirs will be installed at the upstream extent of each pool to provide grade control and create a local constriction and hydraulic drop to promote scour. Pool side slopes and outlets will be constructed using large boulders to provide stability. Boulder weirs will be constructed to fortify the pools and maintain their position, and will allow for fish passage. The pools will be constructed using boulders of 3+ feet in diameter to create 2.5 feet deep pools with hydraulic drops of 0.5 feet. The boulders will be individually placed to achieve precise grade and promote long-term stability of these features.

About 75 lf of rock slope protection (RSP) is proposed at the upstream end of the restored channel along the left bank to buttress an area of unstable bank and constrain the channel upstream of the pool that will contain the screened diversion. About 30 lf of rock slope protection will also be installed along the left bank to protect and stabilize the pumphouse.

Approximately three logs and fallen trees located within the limits of disturbance will be salvaged with their rootwads intact. Two log structures are proposed along the left bank to provide habitat complexity and provide areas of cover. The upstream structure will be incorporated into the RSP and extend into the channel and the second structure will be installed in the downstream pool. A large fallen redwood, located upstream of the pumphouse, will be cut into smaller segments for use in the proposed log structures. Each structure will be anchored to boulders; ballasting requirements will be finalized at the time of construction based on the log dimensions.

The demolition of the dam and fishway, restoration of the channel and reconstruction of the diversion intake will be completed between June 15th and November 1st.

### 1.3.3 Maintenance

San Francisco will conduct regular maintenance procedures that include, but are not limited to, sediment and debris removal, structural repairs, and replacement of damaged parts. During routine inspections, less than approximately one cubic yard of boulders, cobbles, sediment, and woody debris may be hand-removed from the diversion structure. The intake structure will not be dewatered to accomplish these maintenance activities, and fish relocation will therefore not occur. Machinery will not be used in the creek for these maintenance tasks.

### 1.3.4 Operations

Following construction of the new intake structure, San Francisco would continue their diversions from Mindego Creek in accordance with their existing water rights. San Francisco possesses the following water rights for the site, as described below and in Table 1:

1. SWRCB appropriative water right permit (#28538; SWRCB 1993). The permit is limited to a total diversion rate of 0.04 cfs or 25,852 gallons per day (gpd)[1] and a total annual diversion volume of 16.6 acre-feet per year (afy) from November 1 – May 30. As a condition of the permit, minimum bypass flows are required to protect aquatic species, as measured at the United States Geological Survey (USGS) gage on San Gregorio Creek, as follows:

    a. From November 1-November 30: 2 cfs, or the entire streamflow, whichever is less;
    b. From December 1-April 30: 10 cfs, except the entire creek flow shall be bypassed for five consecutive days after a Pacific storm causes streamflow to rise above 50 cfs;
    c. From May 1-May 30: 10 cfs when the sandbar at the mouth of San Gregorio creek is open, 2 cfs when the sandbar is closed.

2. Water transfer approved by the County of San Mateo Superior Court on September 13, 1993 (County of San Mateo 1993a). The transfer allowed for diversion of 15,000 gpd, or 0.02 cfs, during June 1 – October 31 for 20 years with an option to renew for an additional 10 years. This water right is not subject to minimum bypass flows in Mindego Creek. This transfer right was renewed by San Francisco, but is now set to expire September 13, 2023.

3. Water rights granted through a County of San Mateo Superior Court Decree (Decree; County of San Mateo 1993b). The Decree granted San Francisco an additional 9,600 gpd, or 0.015 cfs, to divert year-round for domestic water use. This right is not subject to minimum bypass flows in Mindego Creek.

[1] For reference, 1 cubic foot per second is equal to approximately 646,316 gallons per day

4. The Decree also granted San Francisco 10,000 gpd, or 0.015 cfs for irrigation use during April 1 – November 1. This right is not subject to minimum bypass flows in Mindego Creek.

The above diversion rates would not be restricted by the intake pipe structure as specified in the Project plans because they are less than the maximum possible intake capacity of the intake pipe (0.5 cfs).

During the timeframe of water right permit #28538 (November 1-May 30), if the permit minimum bypass flow requirements are met, San Francisco can divert the following cumulative volumes allowed by the water rights referenced above (#1, #3, and #4):

- November 1- March 31, up to 35,452 gpd (or 0.05 cfs); and
- April 1 -May 30, up to 45,452 gpd (or 0.07 cfs).

Outside of their water right permit #28538 timeframe (June 1 – October 31), per rights #2-#4 referenced above, San Francisco may divert:

- In 2023: up to 34,600 gpd (or 0.05 cfs) during June 1 – September 13 regardless of flow conditions in Mindego Creek; September 14- October 31 up to 0.03 cfs;
- Post-2023: up to 19,600 gpd (or 0.03 cfs) during June 1 – October 31 regardless of flow conditions in Mindego Creek.

**Table 1.** Depiction of maximum diversion rates by month for San Francisco's water rights in the action area. Totals sum maximum diversion rates across water rights for each month through September 13, 2023 as well as after this date (before and after expiration of Water Right #2).

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Right #1 | 0.04 cfs or 25,852 gpd | | | | | | | | | | 0.04 cfs | |
| Water Right #2 | | | | | | 0.02 cfs or 15,000 gpd | | | | | | |
| Water Right #3 | 0.015 cfs or 9,600 gpd | | | | | | | | | | | |
| Water Right #4 | | | | 0.015 cfs or 10,000 gpd | | | | | | | | |
| Total through Sep 2023 (cfs) | 0.055 | 0.055 | 0.055 | 0.07 | 0.07 | 0.05 | 0.05 | 0.05 | 0.05* | 0.03 | 0.055 | 0.055 |
| Total post-Sep 2023 (cfs) | 0.055 | 0.055 | 0.055 | 0.07 | 0.07 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.055 | 0.055 |
| Total post-Sep 2023 (cfs) if below minimum bypass flows** | 0.015 | 0.015 | 0.015 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.015 | 0.015 |

* Water right will expire approximately September 13, 2023

** Maximum authorized cumulative diversion during periods when Mindego Creek flow is below minimum bypass flows

Water rights 1-4 were intended to divert creek water to the San Francisco Probation Department's Log Cabin Ranch, which suspended operations on June 22, 2018. As a result, diversions at this site did not occur in recent years. However, San Francisco plans to retain the diversion and may sell the property (with the diversion included) in the near future. Because

water right #2 expires in September 2023, impacts from diverting under this right were only analyzed for June – September 13, 2023 in this opinion. Otherwise, this opinion assumes the diversion would be operated to the full legal extent for all water rights in future years. The new intake structure configuration (weir plate and pump) does not allow diversions when flow in Mindego Creek at the intake is less than 2 cfs, which will constrain diversions during the dry season.

### 1.3.5 Proposed Avoidance and Minimization Measures

The project has been designed to limit disturbance to the upper bank areas and to protect existing vegetation to the maximum extent feasible, and to allow for the quick reestablishment of plant rooting in the lower banks to provide root reinforcement at locations disturbed by project construction. As part of the proposed action, SMRCD and contractors plan to use several avoidance and minimization measures (AMMs) to protect aquatic species and habitats during construction and maintenance activities. A full list of AMMs, typically described as best management practices (BMPs), is provided in the BRE (SMRCD 2020).

Measures to protect aquatic species include the use of a seasonal work window for in-channel work from June 15 through November 1 or the first significant rainfall, whichever comes first. In-water work is expected to start in August. Fish exclusion screens will be used upstream and downstream of the construction area.

To reduce sedimentation and erosion during and after the Project, AMMs will include:

- stabilizing exposed soil on disturbed slopes against erosion prior to beginning work;
- use of erosion control materials free of plastic monofilament type netting;
- protecting exposed soil during and after construction using mulch and/or planting of native vegetation;
- dewatering the Project creek reach prior to beginning demolition and construction;
- discharging water from the dewatered construction site in a manner that prevents excessive turbidity from entering the creek and prevents scour and erosion;
- grading modified areas to minimize runoff;
- use of clean river run gravel in sandbags for the temporary cofferdam construction;
- turbidity will be monitored upstream and downstream during the project;
- if access points other than existing roads to Project sites are created these will be located at stable stream bank locations that minimize riparian disturbance;
- vegetation removal and land exposure will be minimized to the maximum extent feasible;
- if vegetation at the site is significantly impacted the area will be replanted; and
- sediment and debris removed during the project will be disposed at a location where it will not re-enter the creek.

To reduce contaminants entering the stream during and after construction, AMMs will include: staging/storing/refueling equipment outside of the stream's high water channel and associated riparian area; storing materials/chemicals where they cannot spill into the creek; positioning

stationary equipment at the Project site over drip pans; checking and maintaining equipment on a daily basis to prevent leaks; and not operating equipment in the flowing stream except as may be necessary to construct cofferdams to divert stream flow and isolate the work site. Due to these measures, conveyance of toxic materials into Mindego Creek during project implementation is not expected to occur. However, prior to the onset of work, SMRCD will ensure a plan is in place for prompt and effective response to any accidental spills that do occur (SMRCD 2020).

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). We considered, under the ESA, whether or not the proposed action would cause any interrelated or interdependent actions and determined that it would not.

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

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

## 2.1 Analytical Approach

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

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214, February 11, 2016).

The designations of critical habitat for CCC steelhead and CCC coho use the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

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

## 2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

### 2.2.1 Species Description and Life History

The biological opinion analyses the effects of the federal action on the following federally listed species (Distinct Population Segment [DPS] or Evolutionarily Significant Unit [ESU]) and designated critical habitat:

**Threatened Central California Coast (CCC) steelhead DPS** (*O. mykiss*)
Threatened (71 FR 834, January 5, 2006);
Critical habitat (70 FR 52488, September 2, 2005);

**Endangered Central California Coast (CCC) coho salmon ESU** (*O. kisutch*)
Endangered (70 FR 37160; June 28, 2005);
Critical habitat (64 FR 24049; May 5, 1999).

The CCC steelhead DPS includes steelhead in coastal California streams from the Russian River to Aptos Creek, and the drainages of Suisun, San Pablo, and San Francisco Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers. In addition, the DPS includes steelhead from one active artificial propagation program, the Don Clausen Fish Hatchery Program.[2]

The CCC coho salmon ESU includes coho salmon from Punta Gorda in northern California, south to, and including, Aptos Creek in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River System. In addition, the ESU includes coho salmon from the following artificial propagation programs: the Russian River Coho Salmon Captive Broodstock Program[3], and the Southern Coho Salmon Captive Broodstock Program.[4]

The action area is within designated critical habitat for CCC steelhead and CCC coho salmon. CCC steelhead critical habitat is designated from the Russian River to Aptos Creek to a lateral extent of ordinary high water in freshwater stream reaches, and to extreme high water in estuarine areas. CCC coho salmon critical habitat is designated to include all river reaches assessable to listed coho salmon from Punta Gorda in northern California south to the San Lorenzo River in central California, and includes two tributaries to San Francisco Bay, Arroyo Corte Madera Del Presidio and Corte Madera Creek. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats).

#### *2.2.1.1 Steelhead Life History*

Steelhead are anadromous forms of *O. mykiss*, spending some time in both fresh- and saltwater. Juveniles migrate to the ocean where they mature. Adult steelhead return to freshwater rivers and streams to reproduce, or spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning in multiple years before death (Busby et al. 1996; Moyle 2002). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in central California coastal streams. Eggs (laid in gravel

[2] Kingfisher Flat Hatchery previously had a small CCC steelhead hatchery program that released steelhead smolts into Scott Creek and the San Lorenzo River. This program was terminated in 2014.

[3] Formerly referred to as the Don Clausen Fish Hatchery Captive Broodstock Program.

[4] Formerly referred to as the Scott Creek/King Fisher Flats Conservation Program and the Scott Creek Captive Broodstock Program.

nests called redds), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels), and other juvenile life stages all rear in freshwater until they migrate to the ocean where they reach maturity.

*O. mykiss* exhibit a variable life history. Coastal *O. mykiss* populations in central and southern California are classified into three principle life history strategies: fluvial-anadromous, lagoon anadromous, and freshwater resident or non-anadromous (Boughton et al. 2007). The anadromous forms of CCC steelhead are classified as "winter-run" steelhead because they emigrate from the ocean to their natal streams to spawn annually during the winter; although run times can extend into spring (Moyle 2002). Within the CCC steelhead DPS, adults typically enter freshwater between December and April, with peaks occurring in January through March (Wagner 1983; Fukushima and Lesh 1998). It is during this time that streamflow (depth and velocity) are suitable for adults to successfully migrate to and from spawning grounds. The minimum stream depth necessary for successful upstream migration is about 13 centimeters (cm), although short sections with depths less than 13 cm are passable (Thompson 1972). More optimal water velocities for upstream migration are in the range of 40-90 cm/s, with a maximum velocity beyond which upstream migration is not likely to occur of 240 cm/s (Thompson 1972).

Redds are generally located in areas where the hydraulic conditions limit fine sediment accumulations. Reiser and Bjornn (1979) found that gravels of 1.3-11.7 cm in diameter were preferred by steelhead. Survival of embryos is reduced when fines smaller than 6.4 mm comprise 20 to 25 percent of the substrate. This is because, during the incubation period, the intragravel environment must permit a constant flow of water in order to deliver dissolved oxygen and remove metabolic wastes. Studies have shown embryo survival is higher when intragravel velocities exceed 20 cm/hour (Coble 1961; Phillips and Campbell 1961). The number of days required for steelhead eggs to hatch is inversely proportional to water temperature and varies from about 19 days at 15.6˚ degrees (°) Celsius (C) to about 80 days at 5.6°C. Fry typically emerge from the gravel two to three weeks after hatching (Barnhart 1986). Other intragravel parameters such as the organic material in the substrate affect the survival of eggs to fry emergence (Shapovalov and Taft 1954; Everest et al. 1987; Chapman 1988).

Once emerged from the gravel, steelhead fry rear in edgewater habitats along the stream and gradually move into pools and riffles as they grow larger. Cover, sediment, and water quality are important habitat components for juvenile steelhead. Cover in the form of woody debris, rocks, overhanging banks, and other in-water structures provide velocity refuge and a means of avoiding predation (Shirvell 1990; Bjornn and Reiser 1991). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. In winter, juvenile steelhead become less active and hide in available cover, including gravel or woody debris. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperature can influence the metabolic rate, distribution, abundance, and swimming ability of rearing juvenile steelhead (Barnhart 1986; Bjornn and Reiser 1991; Myrick and Cech 2005). Optimal temperatures for steelhead growth range between 10 and 19°C (Hokanson et al. 1977; Wurtsbaugh and Davis 1977; Myrick and Cech 2005). Fluctuating diurnal water temperatures are also important for the survival and growth of salmonids (Busby et al. 1996).

Although variation occurs, CCC juvenile steelhead that exhibit an anadromous life history strategy usually rear in freshwater for 1-2 years (NMFS 2016a). CCC steelhead smolts emigrate episodically from freshwater in late winter and spring, with peak migrations occurring in April and May (Shapovalov and Taft 1954; Fukushima and Lesh 1998; Ohms and Boughton 2019). Steelhead smolts in California range in size from 120 to 280 mm (fork length) (Shapovalov and Taft 1954; Barnhart 1986). Smolts migrating from the freshwater environment may temporarily utilize the estuarine habitats for saltwater acclimation and feeding prior to entering the ocean.

Juvenile steelhead of the lagoon-anadromous life history rear in lagoons for extended periods (Smith 1990; Boughton et al. 2006; Hayes et al. 2008). Lagoons are a specific type of estuarine habitat where a seasonal impoundment of water develops after a sandbar forms at the mouth of the watershed, temporarily separating the fresh and marine environments (Smith 1990). Like other estuary types, bar-built lagoons can serve as important rearing areas for many fish and invertebrate species—including juvenile steelhead (Simenstad et al. 1982; Smith 1990; Robinson 1993; Martin 1995). Due to the combination of high prey abundance and seasonally warmer temperatures, juvenile steelhead that rear in lagoons have been found to achieve superior growth rates relative to upstream fish of the same cohort, and can therefore disproportionally represent future adult steelhead returns (Bond et al. 2008; Hayes et al. 2008). This is especially important considering that lagoon habitats often represent a fraction of the watershed area.

#### *2.2.1.2 Coho Salmon Life History*

Coho salmon in California generally exhibit a relatively simple three-year life cycle (Shapovalov and Taft 1954; Hassler 1987; Weitkamp et al. 1995). Adult salmon typically begin the immigration from the ocean to their natal streams after heavy late-fall or winter rains breach the sand bars at the mouths of coastal streams (Sandercock 1991). Coho salmon are typically associated with small to moderately-sized coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates (Sandercock 1991). Immigration continues into March, generally peaking in December and January, with spawning occurring shortly after arrival at the spawning ground (Shapovalov and Taft 1954).

When in freshwater, essential habitat features for coho salmon include: (1) deep complex pools; (2) adequate quantities of cool water [Welsh et al. (2001) indicated coho were absent when maximum weekly average water temperatures exceed 18°C, while 12-14° C is preferred, and the upper lethal limit is 25-26°C]; (3) unimpeded passage to spawning grounds (adults) and back to the ocean (smolts); (4) adequate quantities of clean spawning gravel; and (5) access to floodplains, side channels and low velocity habitat during high flow events. When the habitat features listed above are at a properly functioning condition, other requirements (e.g., adequate quantities of food, dissolved oxygen, low turbidity, etc.) are generally met.

The eggs generally hatch after four to eight weeks, depending on water temperature. Survival and development rates depend, in part, on fine sediment levels within the redd. Under optimum conditions, mortality during this period can be as low as 10 percent; under adverse conditions of high scouring flows or heavy siltation, mortality may be close to 100 percent (Baker and

Reynolds 1986). McMahon (1983) found that egg and fry survival drops sharply when fines make up 15 percent or more of the substrate. The newly-hatched fry remain in the redd from two to seven weeks before emerging from the gravel (Shapovalov and Taft 1954). Upon emergence, fry seek out shallow water, usually along stream margins. As they grow, juvenile coho salmon often occupy habitat at the heads of pools, which generally provide an optimum mix of high food availability and good cover with low swimming cost (Nielsen 1992). In the spring, as yearlings, juvenile coho salmon undergo a physiological process, or smoltification, which prepares them for living in the marine environment. Emigration timing is correlated with precipitation events and peak upwelling currents along the coast. Entry into the ocean at this time facilitates more growth and, therefore, greater marine survival (Holtby et al. 1990).

### 2.2.2 Status of the Listed Species

NMFS assesses four population viability[5] parameters to discern the status of the listed ESUs and DPSs and to assess each species 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 data to evaluate these population viability parameters quantitatively, NMFS has used existing information to determine the general condition of the populations in the CCC steelhead DPS, the CCC coho salmon ESU, and factors responsible for the current status of these listed species.

The population viability parameters are used as surrogates for numbers, reproduction, and distribution, which are included in the regulatory definition of "jeopardize the continued existence of" (50 CFR 402.02). For example, abundance, population growth rate, and distribution are surrogates for numbers, reproduction, and distribution, respectively. The fourth parameter, diversity, is related 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.

#### *2.2.2.1 CCC Steelhead DPS*

Historically, approximately 70 populations of steelhead existed in the CCC steelhead DPS (Spence et al. 2008; Spence et al. 2012). Many of these populations (about 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 (McElhaney et al. 2000, Bjorkstedt et al. 2005).

While historical and present data on abundance are limited, CCC steelhead 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). More recent estimates for the Russian

[5] NMFS defines a viable salmonid population as "an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100- year time frame" (McElhany et al. 2000).

River are on the order of 4,000 fish (NMFS 1997b). 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, Pudding, and Caspar creeks) of individual run sizes of 500 fish or less (62 FR 43937; August 18, 1997). 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 fragmented habitat conditions has likely also depressed genetic diversity of CCC steelhead.

CCC steelhead long-term population trends suggest a negative growth rate, indicating the DPS may not be viable in the long-term. 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 remain present in most streams throughout the DPS, roughly approximating the known historical range, CCC steelhead likely possess a resilience that has slowed their rate of decline relative to other salmonid species. 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). On January 5, 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834).

The most recent status update concludes that steelhead in the CCC DPS remains "likely to become endangered in the foreseeable future", as new and additional information available since Williams et al. (2011) does not appear to suggest a change in extinction risk (Williams et al. 2016). In the most recent status review, NMFS concluded that the CCC steelhead DPS should remain listed as threatened (NMFS 2016b).

#### *2.2.2.2 CCC Coho Salmon ESU*

Historically, the CCC coho salmon ESU was comprised of approximately 76 coho salmon populations. Most of these were dependent populations that needed immigration from other nearby populations to ensure their long-term survival. Historically, there were 11 functionally independent populations and 1 potentially independent population of CCC coho salmon (Spence et al. 2008, Spence et al. 2012). Most of the populations in the CCC coho salmon ESU are currently doing poorly as a result of low abundance, range constriction, fragmentation, and loss of genetic diversity, as described below.

Brown et al. (1994) estimated that annual spawning numbers of coho salmon in California ranged between 200,000 and 500,000 fish in the 1940s, which declined to 100,000 fish by the 1960s, followed by a further decline to 31,000 fish by 1991. More recent abundance estimates vary from approximately 600 to 5,500 adults (Good et al. 2005). Williams et al. (2011) indicated that CCC coho salmon are likely to continue to decline in number. CCC coho salmon have also experienced acute range restriction and fragmentation. Adams et al. (1999) found that in the mid-1990's coho salmon were present in 51 percent (98 of 191) of the streams where they were historically present. At the same time, coho presence was documented in an additional 23 streams within the CCC coho salmon ESU where there were no historical records. More recent genetic research has documented reduced genetic diversity within subpopulations of the CCC

coho salmon ESU (Bjorkstedt et al. 2005). The influence of hatchery fish on wild stocks has likely also contributed to the lack of diversity through outbreeding depression and disease.

Available data from the few remaining independent populations suggests population abundance continues to decline, and many independent populations that in the past supported the species overall numbers and geographic distributions have been extirpated. This suggests that populations that historically provided support to dependent populations via immigration did not provide enough immigrants for many dependent populations in recent decades. The near-term (10-20 years) viability of many of the extant independent CCC coho salmon populations is of serious concern. These populations may not have enough fish to survive additional natural and human caused environmental change.

The CCC coho salmon ESU also includes coho salmon from the following conservation hatchery programs: the Russian River Coho Salmon Captive Broodstock Program at Don Clausen Fish Hatchery in Sonoma County, California, and the smaller Southern Coho Salmon Captive Broodstock Program at Kingfisher Flat Hatchery on Big creek, Santa Cruz County, California. While differing in size and funding, both programs were initiated in 2001 in response to severely depressed coho salmon abundance. Fish are collected from the wild, brought into the hatcheries, genetically tested, and spawned to maximize diversity and prevent inbreeding. In the hatchery, fish are raised to various ages, fed krill, tagged, and released into streams throughout the watersheds. This release strategy allows the fish to imprint on the creek with the aim that they will return to these streams as adults so they can spawn naturally. Coho salmon juveniles and smolts have been released into several Russian River tributaries and coastal watersheds in San Mateo and Santa Cruz counties.

None of the five diversity strata defined by Bjorkstedt et al. (2005) currently support viable coho salmon populations. According to Williams et al. (2016), recent surveys suggest CCC coho salmon abundance has improved slightly since 2011 within several independent populations (mainly north of San Francisco Bay), although all populations remain well below their high-risk dispensation thresholds identified by Spence et al. (2008). The Russian River and Lagunitas Creek populations are relative strongholds for the species compared to other CCC coho populations. The coho population in the Russian River is maintained predominantly due to out-planting of hatchery-reared juvenile fish from the Russian River Coho Salmon Captive Broodstock Program. The most recent status review documents conditions for CCC coho salmon did not improve since the previous status review in 2011 (NMFS 2016c). The overall risk of CCC coho salmon extinction remains high, and the most recent status review reaffirmed the ESU's endangered status (NMFS 2016c). NMFS' recovery plan for the CCC coho salmon ESU identified the major threats to population recovery (NMFS 2012). These major threats include roads, water diversions and impoundments, and residential development.

### 2.2.3 Status of CCC Steelhead and CCC Coho Salmon Critical Habitat

PBFs for CCC steelhead critical habitat 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.

PBFs for CCC steelhead critical habitat within estuarine areas include: areas free of obstruction and excess predation with: water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

For CCC coho salmon critical habitat, the following essential features have been identified: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas (64 FR 24049). PBFs for coho salmon 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 24049).

The condition of CCC steelhead, and CCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS determined currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[6]: logging, urban and agricultural land development, mining, stream channelization, and bank stabilization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Habitat impacts of current concern include altered streambank 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 streamflow, has dramatically altered the natural hydrologic cycle in many of the streams within the CCC steelhead DPS and CCC coho ESU, which can delay or preclude migration and dewater aquatic habitat. Stream

[6] 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.

channelization, commonly caused by streambank hardening and stabilization, represents a very high threat to instream and floodplain habitat throughout much of the designated critical habitat for both species, as detailed within the CCC steelhead and CCC coho salmon recovery plans (NMFS 2012, 2016b). Streambank stabilization confines stream channels and precludes natural channel movement, resulting in increased streambed incision and reduced habitat volume and complexity.

Overall, the current condition of CCC steelhead and CCC coho salmon critical habitat is degraded, and does not provide the full extent of conservation value necessary for the recovery of the species.

### 2.2.4 Global Climate Change

Another factor affecting the rangewide status of CCC steelhead and CCC coho salmon and aquatic habitat at large is climate change. Recent work by the NMFS Science Centers ranked the relative vulnerability of west-coast salmon and steelhead to climate change (Crozier et al 2019). In coastal California, CCC coho salmon will likely have a very high vulnerability to climate change impacts relative to other salmonid species. CCC steelhead in coastal California were rated at moderate vulnerability to climate change impacts.

Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level increased in California over the last century (Kadir et al. 2013). Snowmelt from the Sierra Nevada has declined (Kadir et al. 2013). Although CCC steelhead and CCC coho salmon are not dependent on snowmelt driven streams, they have likely already experienced some detrimental impacts from climate change through lower and more variable stream flows, warmer stream temperatures, and changes in ocean conditions. California experienced well below average precipitation during the 2012-2016 drought, as well as record high surface air temperatures in 2014 and 2015, and record low snowpack in 2015 (Williams et al. 2016). Paleoclimate reconstructions suggest the 2012-2016 drought was the most extreme in the past 500 to 1000 years (Williams et al. 2016). Anomalously high surface temperatures substantially amplified annual water deficits during 2012-2016. California entered another period of drought in 2020. These drought periods are now likely part of a larger drought event (Williams et al. 2022). This recent long-term drought, as well as the increased incidence and magnitude of wildfires in California, have likely been exacerbated by climate change (Williams 2022, Diffenbaugh et al. 2015, Williams et al. 2019).

The threat to CCC steelhead and CCC coho salmon from global climate change is expected to 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 and the magnitude and frequency of dry years may increase (Lindley et al. 2007; Schneider 2007; Moser et al. 2012). Similarly, wildfires are expected to increase in frequency and magnitude (Westerling et al. 2011; Moser et al. 2012). Increases in wide year-to-year variation in precipitation amounts (droughts and floods) are projected to occur in California

as a result of climate change (Swain et al. 2018). 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). Some of these changes, including an increased incidence of marine heat waves, are likely already occurring, and are expected to increase (Frolicher, et al. 2018). In fall 2014, and again in 2019, a marine heatwave, known as "The Blob"[7], formed throughout the northeast Pacific Ocean, which greatly affected water temperature and upwelling from the Bering Sea off Alaska, south to the coastline of Mexico. The marine waters in this region of the ocean are utilized by salmonids for foraging as they mature (Beamish 2018). Although the implications of these events on salmonid populations are not fully understood, they are having considerable adverse consequences to the productivity of these ecosystems and presumably contributing to poor marine survival of salmonids.

In the San Francisco Bay region (and other areas of the central California coast), warm temperatures generally occur in July and August, but with climate change these events will likely begin in June and could continue through September (Cayan et al. 2012). Climate simulation models indicate the San Francisco region will maintain its Mediterranean climate regime for the 21st century; however, these models predict a high degree of variability in annual precipitation through at least 2050, leaving the region susceptible to drought (Cayan et al. 2012). These models of future precipitation suggest that, during the second half of the 21st century in this region, most years will be drier than the historical annual average (1950-1999).

## 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 encompasses the streambed and banks of Mindego Creek, the active channel where in-water work will occur and the riparian zone impacted by construction. The area of Mindego Creek directly impacted from construction activities is 355 feet of the channel and approximately 500 feet immediately downstream of the dewatered area where temporary construction effects of increased turbidity and sedimentation due to the Project may occur. The construction site includes the dewatered area and associated north and south bank hillside up to mean high-water mark (MHWM). The action area also includes the area of creek from the action area to the confluence with Alpine Creek where San Francisco's water diversion may cause effects on instream flow.

## 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

[7] https://www.fisheries.noaa.gov/feature-story/new-marine-heatwave-emerges-west-coast-resembles-blob

proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

### 2.4.1 Description of the Mindego Creek Watershed and the Action Area

Mindego Creek is the easternmost sub-basin within the San Gregorio Watershed, draining a sub-basin of nearly 6,000 acres (9.4 square miles; Stillwater Sciences et al. 2010). Mindego Creek drains the northern half of the sub-basin and is a perennial tributary to Alpine Creek. The National Heritage Foundation (Stillwater Sciences et al. 2010) describes the mainstem San Gregorio Creek as flowing 12 miles from its origination point at the confluence of Alpine and La Honda creeks before discharging into a seasonal coastal lagoon at the Pacific Ocean (Stillwater Sciences et al. 2010). San Gregorio Creek drains a watershed of approximately 33,290 acres (52 square miles). Dominant soil types include stony-loams and clay-loams on moderate to steep slopes, with landslide-prone areas at mid-elevations (NRCS 2009). The Mindego formation supplies much of the large sediment to the Mindego Creek watershed (Brabb et al. 1998).

The creek within the action area is a meandering low-gradient stream with boulder and cobble dominated pool-riffle habitat, high amounts of large woody debris, and areas of exposed bedrock (SMRCD 2020). A canyon with steep walls surrounds the creek at this location. The area is heavily wooded with a variety of riparian vegetation including mature coast redwood, Douglas fir and tanoak.

The action area land is owned by San Francisco City and County (San Francisco). A roughly 10-foot high, channel spanning dam is located at approximately stream mile 0.75 (Becker and Reining 2008). Below the dam is a large plunge pool approximately 30 feet long, 20 feet wide and five feet deep. A metal Denil fishway (fishway) is located at the face of the dam, extending from the plunge pool below to the creek above the dam. This structure does not meet NMFS' fish passage guidelines and this type of fishway is intended to be used when it can be closely monitored for debris (NMFS 2008). Because of the arrangement of their baffles and narrow flow paths, Denil fishways are especially susceptible to debris accumulation. As it is not regularly maintained, the fishway is often choked with debris and not passable for adult salmonids (SMRCD 2020). A water diversion owned by San Francisco exists at the site just upstream of the dam. The diversion consists of a submersible pump installed in the creek channel, a large concrete water storage and pump house on the creek bank, as well as pipes and associated infrastructure for conveying water over the creek and up the western canyon wall to the San Francisco Log Cabin Ranch Juvenile Detention facility and grounds over the ridge.

A small number of water diversions from Mindego Creek have operated according to historic reports. San Francisco's diversion associated with the Project site certainly existed in 1973 (CDFW 1973); however, the diversion was apparently in place for roughly 30 years prior (City and County of San Francisco 1993). A diversion pipe was reported in 1973 near an 'earthfill dam' at RM 1.35, but the diversion rate and ownership was unclear (CDFW 1973). As of June 2022, four active (licensed or permitted) diversions exist on record with the SWRCB. Aside from San Francisco's diversion at the Project site, the other three diversions are owned by a different

entity located upstream at approximately RM 1.5, and total 118.7 acre feet per year. These latter water rights (not owned by San Francisco) are not permitted to operate during June-September based on rights licensed/permitted by the SWRCB; however, a Decree associated with these rights grants diversion of up to 30-acre feet per year from Mindego Creek year round (County of San Mateo 1993b).

New appropriative or unexercised riparian diversions from Mindego Creek to be licensed to any entity by SWRCB after the Decree (1993) are subject to terms of the Decree, including minimum bypass flows (County of San Mateo 1993b). Minimum bypass flows, as measured at the USGS gage on San Gregorio Creek, are defined in the Decree as follows: (a) December 1 to April 30: 10 cfs; except the entire creek flow shall be bypassed for 5 consecutive days after a Pacific storm causes streamflow to rise above 50 cfs; (b) May 1 to June 15: 10 cfs when the sandbar at the mouth of San Gregorio Creek is open; 2 cfs when the sandbar is closed; and (c) June 16 to November 30: 2 cfs or the entire streamflow, whichever is less. These minimum bypass flows do not apply to water rights, such as San Francisco's diversion, that were already in use and allotted to claimants by the Decree. This exception applies to San Francisco's water rights 2-4 as summarized in section 1.3.4.

The rate of San Francisco's water diversion within the action area likely varied considerably since it began in the 1940s. San Francisco acquired various water rights for the diversion in 1993. Regardless of which right was used to divert from the creek, San Francisco is required to report diversion amounts to the SWRCB. Approximately 8,523 gpd (0.01 cfs) was diverted on average in 2007 and 2008 based on reports to SWRCB (NMFS 2009). The most recent report to SWRCB by San Francisco was in 2021 for water diversions during 2020; the report indicated zero water was diverted from Mindego Creek. No reports were available for water diverted (if any) in 2019 or 2018. In 2017, a report from San Francisco to SWRCB indicated 1 acre-foot (0.001 cfs daily average) was diverted in that year and the highest diversion rates were in June at 0.004 cfs (averaged). During 2016, an average of 0.003 cfs was diverted daily in Mindego Creek by San Francisco, with the highest diversion rates in August-October at 0.007 cfs (averaged). In 2015, 0.008 cfs was diverted daily on average, with the highest rates in August at 0.01 cfs (averaged).

There is not a stream flow gage currently located within the action area; the closest known location with stream flow data available is a USGS gage at RM 1.4 on San Gregorio Creek. Historically, stream flow was measured intermittently within different reaches of Mindego Creek, primarily near the confluence with Alpine Creek or near the Project site. Measurements were taken during 1973, 1974, 1981 and 1996, mostly during the summer low-flow period. No known stream flow measurements have been recorded in Mindego Creek since 1996. It is not clear whether and how much of the creek was being diverted at the time of historic flow measurements by landowners at or upstream of these sites. Given these limited direct flow measurements, various flow estimation methods were compared to historical measurements to determine the most appropriate flow estimates.

In this opinion, flow data derived from the Nature Conservancy's Natural Flows Database (NFD) was used to estimate flow for Mindego Creek. The NFD is based on a Grantham et al. (2022)

model that uses streamflow gage data from a well-distributed range of stream types throughout California, including San Gregorio Creek. Sites were excluded from the model if the watershed above the gage had significant human activities, including water diversions and storage reservoirs, intensive agriculture and forestry practices, dense road networks, and extensive impervious surfaces (Grantham et al. 2022). The NFD provides metrics for each month of each year for a given stream, including the mean, minimum and maximum of the "estimated" value as well as the 10th and 90th percentiles to represent lower and upper confidence bounds ("P10" and "P90"). NMFS' analysis indicated the NFD 'P90 mean' flow estimate metric correlated the best with historical flow measurements. Data from the NFD P90 flows for 2010-2021 (most recent time-frame that included at least two of each water year type) were used for characterizing expected flows for each water year type: normal, wet and dry (Table 2). Although one dry year (1981) was included in historical measurements, that year did not occur during a multi-year drought similar to droughts that have affected creeks on the central California coast in recent decades. Therefore, it is reasonable to expect that flows lower than those predicted by the NFD P90 monthly mean may occur in Mindego Creek.

**Table 2.** NFD P90 monthly mean flow estimates in Mindego Creek. Values are averaged across water years (October 1 – September 30) within each water year type. Water year types were characterized based on relative rainfall records as described in Exponent (2019) and California Department of Water Resources (2021) reports as follows: 2010 and 2016 were normal years; 2011, 2017 and 2019 were wet years; 2014-15, 2018, and 2020-21 were dry years.

| Month | Mean Flow (cfs) in Normal Water Years | Mean Flow (cfs) in Wet Water Years | Mean Flow (cfs) in Dry Water Years |
|---|---|---|---|
| January | 19.19 | 28.63 | 6.30 |
| February | 12.63 | 42.65 | 5.94 |
| March | 15.23 | 16.71 | 4.70 |
| April | 11.70 | 7.12 | 2.42 |
| May | 2.81 | 3.95 | 0.77 |
| June | 1.33 | 1.58 | 0.55 |
| July | 0.66 | 0.76 | 0.38 |
| August | 0.38 | 0.43 | 0.16 |
| September | 0.25 | 0.27 | 0.21 |
| October | 1.12 | 1.03 | 0.55 |
| November | 1.12 | 2.51 | 1.01 |
| December | 4.16 | 10.07 | 6.33 |

Flow measurements at the USGS gage on San Gregorio Creek were not used as estimates of Mindego Creek flow directly; however, these data were reviewed to determine the likelihood that flows will be above minimum bypass flow rates. The USGS gage on San Gregorio Creek is used to determine whether minimum bypass flows on Mindego Creek are achieved, allowing for San

Francisco to divert at higher rate during November-May (see Section 1.3.4). Mean flow across years in NMFS analysis of the gage data on San Gregorio Creek was generally above minimum bypass flow thresholds set for Mindego Creek during each month in November-May (Table 3). In normal and dry years, data indicate mean flow in San Gregorio may drop below minimum bypass flow thresholds in May and November. Based on data from years included in NMFS' analysis, in years with the lowest mean flow by month (i.e., driest years) minimum bypass flows are unlikely to be achieved (see minimum mean flow data in Table 3). In summary, San Francisco will often be able to divert at the higher rates allowed when flow is above minimum bypass flow thresholds during November-May, but in the driest years flows will likely be below these thresholds and maximum diversion rates would be lower.

Flow data from San Gregorio Creek was also used to further evaluate the accuracy of the NFD flow estimates for Mindego Creek. In most months the San Gregorio Creek mean monthly flow is greater than flows in Mindego Creek, as would be expected since San Gregorio is a larger, first order stream. In June – October, the magnitude of difference between San Gregorio Creek and Mindego Creek flows diminishes significantly. In the driest years, flow data indicate San Gregorio Creek was at 0 cfs during July-October, and below 0.2 cfs in June (Table 3). These data suggest that P90 mean flow estimates for Mindego Creek, which are always above 0 cfs and nearly always above 0.2 cfs, may overestimate flows during summer months in the driest years. Based on available data, a more likely explanation for the apparent lower dry season flows in San Gregorio Creek is that the upper tributaries, such as Mindego Creek, may retain higher baseflows during the dry season for one or more of the following reasons: less diversion impacts, closer proximity to springs, steeper shadier stream reaches and different geology. Historic measurements of flow in Mindego Creek during a dry year (1981) in August and September were very similar to P90 mean flows during those months. A more recent survey indicated flow was likely occurring at low levels in Mindego Creek in July and August of 2006-08 and 2015 (dry years), based on pool tail depths that were quite shallow but above zero (Brian Spence, NMFS SWFSC, Fisheries Ecology Division, unpublished data). Taken together, this information supports a conclusion that flow may be continual, if very low, in Mindego Creek throughout the dry season even in the driest years.

**Table 3.** Streamflow (cfs) as measured at the USGS gage on San Gregorio Creek, averaged for each month of each water year (October 1 – September 30) in 2010-2021. Water type years were characterized based on criteria as described in Table 2. Minimum mean values represent the year with the lowest monthly mean flow for each water year type. Values below minimum bypass flows (see section 1.3.4) are in bold. Note: minimum bypass flows in May would be 2 cfs if the sandbar at the creek mouth is closed. Note: minimum bypass flows are not established for June-October.

| Month | Normal Water Years | | Wet Water Years | | Dry Water Years | |
|---|---|---|---|---|---|---|
| | Mean Flow | Min. Mean Flow | Mean Flow | Min. Mean Flow | Mean Flow | Min. Mean Flow |
| January | 115.10 | 104.80 | 138.33 | 29.40 | 15.32 | **0.68** |
| February | 47.80 | 29.90 | 272.20 | 80.20 | 18.69 | **5.91** |
| March | 138.80 | 70.60 | 179.80 | 98.80 | 17.10 | **5.69** |
| April | 51.40 | 27.60 | 62.43 | 43.00 | 18.82 | **2.43** |
| May | 14.60 | 12.40 | 28.03 | 17.60 | **3.62** | **1.11** |
| June | 6.86 | 5.58 | 14.53 | 13.20 | 1.62 | 0.15 |
| July | 3.54 | 2.60 | 7.79 | 7.15 | 0.58 | 0.00 |
| August | 2.17 | 1.44 | 4.75 | 4.44 | 0.28 | 0.00 |
| September | 1.79 | 1.46 | 3.23 | 2.90 | 0.18 | 0.00 |
| October | 3.54 | 0.04 | 2.83 | 0.51 | 0.85 | 0.00 |
| November | **1.74** | **1.24** | 5.39 | 3.61 | 2.66 | **0.63** |
| December | 20.43 | **5.45** | 56.34 | **4.81** | 39.26 | **1.49** |

### 2.4.2 Status of CCC Steelhead in the Action Area

The San Gregorio Creek watershed (including Mindego Creek), supports a CCC steelhead population that is functionally independent and considered essential to recovering the DPS (NMFS 2016b). Recovery criteria for the CCC steelhead San Gregorio population is a spawner density target of 1,700 (NMFS 2016b).

Complete annual estimates of adult steelhead escapement to the San Gregorio Creek watershed (including Mindego Creek) do not exist. Historical abundance levels prior to the 1990s are unknown; however the first known survey of salmonids and habitat in Mindego Creek was in 1964. The 1964 survey noted Mindego Creek "contributes approximately 1/2 mile of fair silver salmon [i.e., coho salmon] and steelhead trout spawning grounds to [the] San Gregorio river system" and found juvenile steelhead below and above the dam at San Francisco's Log Cabin Ranch (CDFW unpublished data cited in Zatkin 2014). A survey of two relatively small sites in Mindego Creek completed by the California Conservation Corps (CC Corps) in September 1996 found 38 juvenile steelhead at or very near the action area, and 40 steelhead at RM 0.29 (CC Corps 1996 unpublished data cited in Zatkin 2014). A NOAA Southwest Fisheries Science Center (SWFSC) snorkel survey of the lower approximately 0.5 miles of Mindego Creek was undertaken in 2006-2008 and 2015. The SWFSC survey counted steelhead during summer months in pool habitats only and only surveyed in every other pool (fish were not counted in

2006). If more than 20 steelhead were observed in a pool, they were recorded as '>20' and not counted. In 2007, 2008 and 2015 there were 157, 183 and 129 juvenile steelhead young-of-the-year (YOY) counted. In these years there were also 24, 36 and 6 age-1+ and age-2+ steelhead, and 1 adult kelt in 2007 and 2008. To estimate expected steelhead density in the action area, a buffer was added to SWFSC survey undercounts of steelhead in pools above 20 fish, estimates were extrapolated based on the survey area compared to the action area linear creek distance, and then results were averaged for the three survey years. Based on the information discussed above, CCC steelhead are expected to occur in the action area year round. During the proposed in-water work window of August 1 to November 1, juvenile steelhead are expected to be present at a density of approximately 56 fish per 100 lf of creek distance.

### 2.4.3 Status of CCC Coho Salmon in the Action Area

Until the mid-1970's CCC coho salmon were present in 13 streams south of San Francisco (all in Santa Cruz County), including the San Gregorio Creek watershed (Bryant 1994). As of 2012, only Scott Creek supported all three CCC coho cohorts in streams south of San Francisco, mainly due to releases from Kingfisher Flat Restoration Hatchery (NMFS 2012). The San Gregorio Creek population of CCC coho salmon (including Mindego Creek) is a dependent population with a delisting spawner target density of 1,363 (NMFS 2012). Coho salmon in the San Gregorio Creek watershed have rarely been observed during recent decades. The first known survey of salmonids and habitat in Mindego Creek in 1964 suggests coho occurrence in Mindego Creek (CDFW unpublished data cited in Zatkin 2014). During a SWFSC snorkel survey in 2008, 167 juvenile coho were observed in Alpine Creek near the confluence with Mindego Creek (Brian Spence, NMFS SWFSC, Fisheries Ecology Division, unpublished data). Coho were not observed in the San Gregorio Creek watershed during similar SWFSC surveys in 2006-2007 or 2016.

Several fish surveys using different methods were conducted in Mindego Creek. A 1964 DFG survey did not observe coho salmon, but mentioned coho spawning grounds occurred in the creek, indicating coho were known to inhabit the creek (CDFW unpublished data cited in Zatkin 2014). Coho salmon were not observed in Mindego Creek in a survey conducted by CDFW in September 1973 from the confluence with Alpine Creek to river mile 4.25; however, the survey apparently used only above water visual methods and noted that juvenile salmonids observed (only above river mile 1.35) were 'most probably' steelhead (CDFW unpublished data cited in Zatkin 2014). A survey for adult coho was conducted by CDFG in an unknown portion of Mindego Creek in January 1978; the survey did not find live coho or carcasses, but noted the stream was highly turbid, making observations difficult (CDFW unpublished data cited in Zatkin 2014). A survey in September 1996, conducted using electrofishing by the CC Corps, did not observe coho (CC Corps unpublished data cited in Zatkin 2014). Snorkel surveys conducted by the SWFSC (referenced above) in 2006-2008 and 2016 in Mindego Creek did not observe coho (Brian Spence, NMFS SWFSC, Fisheries Ecology Division, unpublished data). Despite lack of evidence of coho presence in Mindego Creek in recent years, indications are that coho likely used the creek historically and could do so again as no known barriers to migration exist downstream of the dam and fishway (RM 0.75). Wild coho or hatchery strays from the Southern

Coho Salmon Captive Broodstock Program have the potential to enter and spawn in Mindego Creek in any given year. Although the occurrence of juvenile coho salmon would be rare at the Project site, there is potential for a small number of fish to be present during in-water operations.

### 2.4.4 Status of Critical Habitat in the Action Area

The action area is designated critical habitat for CCC steelhead and CCC coho salmon, and supports spawning, rearing, and migration of these listed species. PBFs include substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. NMFS (2008) estimates approximately 2.1 miles of Intrinsic Potential coho salmon habitat in the Mindego Creek watershed. A 1996 stream survey by CDFW suggested a lack of habitat complexity and in-stream cover, lack of summer and winter rearing habitat, and insufficient spawning substrates may be limiting coho salmon and steelhead spawning and juvenile rearing success (Stillwater Sciences et al 2010). During a site visit in May 2022, NMFS observed high quality habitat with large amounts of in-stream large woody debris and mature riparian vegetation that provides shade to the creek.

According to the CDFW Passage Assessment Database (PAD) (2013) and NMFS' observations in May 2022, the existing fishway and concrete dam are a partial barrier to upstream migration of coho salmon and steelhead in Mindego. In 1996, CDFW noted the dam was a partial barrier for fish passage. The dam is likely passable without use of the fishway only during very high winter flows. The fishway is not regularly maintained so is likely unusable due to debris for most of the year. Although juvenile salmonids were observed in Mindego Creek upstream of the dam and fishway in 1973, since that time surveys have not been conducted above this partial barrier, so it is unclear whether steelhead or coho salmon may be found in that area. A nine-foot waterfall at approximately RM 2.6 serves as a likely upper end to anadromous fish passage (CDFW unpublished data cited in Zatkin 2014).

WSP/AmeriCorps conducted habitat typing on Mindego Creek from the confluence with Alpine Creek to RM 3.96 in 1996. The lower 0.73 miles of creek was characterized as moderately entrenched, moderate gradient, riffle dominated with infrequent pools, stable plane profile and banks, and sand substrate (WSP/AmeriCorps unpublished data cited in Zatkin 2014). The remaining portion of the creek surveyed was entrenched meandering riffle/pool channels on low gradients with high width to depth ratio and boulder dominated substrate. Based on length, the habitat types surveyed included: 17% riffle, 37% flatwater, and 46% pools.

The long-term effects of climate change were presented above (section 2.2.4), and include changes to air and water temperature and the timing and magnitude of precipitation events that may affect steelhead, coho salmon, and critical habitat by changing water quality, streamflow levels, and salmonid migration in the action area. The threat to salmonids in the action area from climate change will likely mirror what is expected for the rest of Central California. NMFS expects that average dry season air temperatures in the action area will continue to increase, heat waves will become more extreme, and droughts and wildfire will occur more often (Hayhoe et al. 2004; Lindley et al. 2007; Schneider 2007; Westerling et al. 2011; Moser et al. 2012; Kadir et al. 2013). Many of these changes are likely to further degrade CCC steelhead and CCC coho

salmon critical habitat within the action area by reducing streamflow, canopy cover and large wood recruitment, as well as increasing water temperatures and fine sediment yield in Mindego Creek.

### 2.4.5 Previous ESA Section 7 Consultations and Section 10(a)(1)(A) Permits in the Action Area

In 2009, NMFS and the Corps completed formal ESA section 7 consultation on San Francisco's road repair, bank stabilization and bridge stabilization to ensure continued access to their water diversion. NMFS issued a biological opinion on October 30, 2009 (NMFS 2009). NMFS concluded the action would not jeopardize CCC steelhead or adversely modify designated critical habitats for CCC steelhead and CCC coho salmon.

NMFS has issued section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions for scientific research and monitoring that occur in the action area. 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. NMFS determined these research activities are unlikely to affect future adult returns.

## 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.

Construction activities as well as continued diversion of surface water associated with the proposed Project may affect CCC steelhead and CCC coho salmon and their critical habitat. The following may result from construction activities: unintentional direct injury or mortality during fish collection, relocation, and dewatering activities; increases in suspended sediments and turbidity; contaminants from operations during construction; reductions in riparian vegetation and habitat loss; altered channel morphology and fish passage condition; and future operation and maintenance of the water diversion. Project effects are described in more detail below.

### 2.5.1 Fish Collection and Relocation

To facilitate completion of the project, a portion of Mindego Creek will be dewatered. As discussed above, approximately 355 lf will be dewatered. SMRCD proposes to collect and relocate fish in the work areas prior to, and during dewatering, to avoid fish stranding and exposure to demolition and construction activities. Before and during dewatering of the construction site, juvenile steelhead and coho salmon will be captured by a qualified biologist using one or more of the following methods: dip net, seine, thrown net, block net, minnow trap, and electrofishing. Collected steelhead and coho will be relocated to an appropriate stream reach that will minimize impacts to captured fish, and to fish that are already residing at the release site(s).

Relocation activities will occur between August 1 and October 31. This timeframe is after emigrating coho salmon smolts have left the area and before adults have immigrated for spawning (Osterback et al. 2018). A small number of steelhead adults (including kelts) may also be in the action area during this timeframe, based on previous surveys of Mindego Creek (Brian Spence, NMFS SWFSC, Fisheries Ecology Division, unpublished data). Therefore, NMFS expects young-of-the-year (YOY) juvenile steelhead and coho salmon, as well as steelhead kelts, to be in the action area during the construction period. Based on the estimated number of steelhead that may occur in the action area, we anticipate up to 200 individual juvenile steelhead, and 1 adult (kelt) steelhead, may be encountered during the work season. Based on the estimated number of coho that may occur in the action area, we anticipate up to 10 individual juvenile coho salmon may be encountered during the work season.

Fish collection and 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 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. Since fish relocation activities will be conducted by qualified fisheries biologists following NMFS electrofishing guidelines (NMFS 2000), injury and mortality of juvenile salmonids during capture and relocation will be minimized. Based on prior experience with current relocation techniques and protocols likely to be used to conduct the fish relocation, unintentional mortality of listed juvenile salmonids expected from capture and handling procedures during the Project is not likely to exceed two percent (four steelhead and one coho salmon). We do not expect any mortality for adult steelhead.

Relocated fish may have to compete with other fish, causing increased competition for available resources such as food and habitat. To reduce the potential for competition, fish relocation sites will be pre-approved by NMFS to ensure the sites have adequate habitat to allow for survival of transported fish and fish already present. Nonetheless, crowding could occur which would likely result in increased inter- and intraspecific competition at those sites. Responses to crowding by salmonids include self-thinning, resulting in emigration and reduced salmonid abundance with increased individual body size within the group, and/or increased competition (Keeley 2003). Relocation sites will be selected to ensure they have similar water temperatures as the capture sites, and adequate habitat to allow for survival of transported fish and fish already present. However, 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 fish. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse. In some instances, relocated fish may endure some short-term stress from crowding at the relocation sites. Such stress is not likely to be sufficient to reduce their individual fitness or performance. NMFS cannot accurately estimate the number of fish likely to be exposed to competition, but does not expect this short-term stress to reduce the individual performance of juvenile salmonids, or cascade through the watershed population of these species. Fish that avoid capture during relocation may be exposed to risks described in the following section on dewatering (see section 2.5.2 below).

### 2.5.2 Dewatering

Once initial fish capture and relocation efforts are complete, cofferdams and a series of pipes will be used to temporarily divert flows around the work site during construction. Dewatering of the channel is estimated to affect 355 lf of Mindego Creek. NMFS anticipates temporary changes to instream flow within, and downstream of, the Project site during installation of the diversion system, and during dewatering operations. Once installation of the diversion systems is complete, stream flow above and below the work sites should be the same as free-flowing pre-project conditions, except within the dewatered reaches where stream flow is bypassed and/or pools are dewatered. These fluctuations in flow are anticipated to be small, gradual, and short-term, but are expected to cause a temporary loss, alteration, and reduction of aquatic habitat.

Stream flow diversion and dewatering could harm any rearing steelhead or coho individuals by concentrating or stranding them in residual wetted areas. Juvenile salmonids that avoid capture in the action area prior to dewatering will likely die due to desiccation, thermal stress, or may be crushed by equipment or foot traffic if not found by biologists as water levels within the reach recede. The pre-dewatering fish relocation efforts at the project site will be performed by qualified biologists, therefore NMFS expects few juvenile salmonids will avoid capture prior to dewatering. NMFS expects no more than one percent of the steelhead and coho within the work site prior to dewatering will be killed as a result of stranding during dewatering activities (two steelhead and one coho salmon).

Dewatering operations may affect juvenile salmonids by temporarily preventing access to the action area for forage; and dewatering activities may affect the function of critical habitat by reducing forage for juveniles in the dewatered area. Dewatering operations at the work site may kill or reduce the abundance of benthic (bottom dwelling) aquatic macroinvertebrates, an important food source for juvenile salmonids (Cushman 1985). However, effects to aquatic macroinvertebrates resulting from stream flow diversion and dewatering activities will be temporary because construction activities will be short lived, and the dewatered reach will not exceed 355 lf within Mindego Creek. Rapid recolonization (typically one to two months) of disturbed areas by macroinvertebrates is expected following rewatering (Cushman 1985; Thomas 1986; Harvey 1986). For this reason, we expect the function of critical habitat will return to its pre-Project level before adults and smolts use the action area for migration. In addition, the effect of macroinvertebrate loss on juvenile salmonids is likely to be negligible because food from upstream sources (via drift) will be available downstream of the dewatered areas via streamflow diverted around the project work site or from terrestrial sources.

Dewatering the work site and screening of the stream diversion will restrict movement of listed salmonids through approximately 355 feet of Mindego Creek. However, this situation may resemble isolation of pools by intermittent flow conditions that typically occurs during summer within some streams throughout the range of CCC steelhead and CCC coho salmon. Because habitat in and around the action area is adequate to support steelhead and coho salmon, NMFS expects salmonids will be able to find food both up- and downstream of the action area as needed during dewatering activities. Based on the small area of impact and temporary nature of the action, we anticipate the impacts to PBFs for rearing habitat will be minimal and restored quickly after the dewatering system is removed.

### 2.5.3 Increased Sediment Mobilization

Construction activities related to the proposed Project will result in the disturbance of the creek bed and banks due to: equipment/personnel access, dewatering/diversion of the creek during construction, dam and fishway removal and subsequent mobilization of material in the stream bed above the dam, and channel modification/restoration activities. These types of activities result in temporary increases in turbidity (Reeves et al. 1991; Spence et al. 1996). Following construction, disturbed substrate could affect water quality and critical habitat in the action area in the form of small, short-term increases in turbidity during cofferdam removal and subsequent rainfall events.

Sediment may affect salmonids in several ways. High concentrations of suspended sediment can disrupt normal feeding behavior and efficiency (Cordone and Kelly 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 lower dissolved oxygen in the water column, reduce respiratory function, lower disease tolerance, and even cause fish mortality (Sigler et al. 1984; Berg and Northcote 1985; Gregory and Northcote 1993; Velagic 1995; Waters 1995). Even small pulses of turbid water may cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing survival. In addition, increased sediment deposition can fill pools and reduce the amount of cover available to fish, decreasing the survival of juvenile salmonids (Alexander and Hansen 1986).

Chronic elevated sediment and turbidity levels may adversely affect salmonids and their critical habitat; however, the temporary increases in sedimentation and turbidity levels associated with the Project are not expected to rise to a level that would alter behavior, injure, or kill salmonids present in the action area. SMRCD has proposed several measures to stabilize and prevent the mobilization of sediment during the project. These measures include the following BMPs (section 1.3.5).

The Project's removal of the dam and fishway, as well as the planned channel restoration, will mobilize sediment; however, this may provide benefits to salmonids and their critical habitat over time. The mixed-grade sediment and debris currently held behind the dam (estimated at 250 cubic yards) could provide spawning gravel, nutrients and habitat features for the creek below the dam. These materials will be used by the Project for channel restoration to some degree. Removing the dam and restoring the channel will allow for more natural transport of sediment and woody debris to the lower portion of the creek in the future. Such transport processes are essential to maintaining many of the habitat benefits of spawning streams that salmonids require.

NMFS expects any sediment or turbidity generated by construction activities would be minor and localized (not extend more than 500 feet downstream of the work site), below levels known to cause injury or harm to salmonids. NMFS does not anticipate harm, injury, or behavioral impacts to CCC steelhead or CCC coho salmon associated with exposure to elevated suspended sediment from Project activities. Regarding critical habitat, the temporary exposure of habitats to increased sedimentation or turbidity is not expected to reach the scale where the PBFs of critical

habitat will be altered. Removal of the dam and restoration of the channel by the Project are expected to provide long-term benefits for critical habitat through improved transport of sediment and woody debris within the creek. Therefore, the ability of critical habitat to support salmonid conservation needs in the action area will be maintained.

### 2.5.4 Construction-related Contaminants

Construction in, over, and near surface water have the potential to release debris, hydrocarbons, concrete/cement, and similar contaminants into surface waters. Potential contaminants that could result from projects like these include wet and dry concrete debris, fuel and lubricant for construction equipment, and various construction materials. If introduced into aquatic habitats, debris could impair water quality by altering the pH, reducing oxygen concentrations as the debris decompose, or by introducing toxic materials such as hydrocarbons or metals into the aquatic habitat. Oils and similar substances from construction equipment 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).

Use of heavy equipment and storage of materials is required for the construction of the Project. As a result, if not properly contained, contaminants (e.g., fuels, lubricants, hydraulic fluids, concrete) could be introduced into the water system, either directly or through surface runoff. The effects described above for contaminants have the potential to temporarily degrade habitat and harm exposed fish. However, AMMs proposed at the work site will substantially reduce or eliminate the potential for construction materials and debris to enter waterways (section 1.3.5).

### 2.5.5 Vegetation Removal

The Project will result in temporary and permanent reductions in riparian vegetation in the action area. Riparian vegetation helps maintain stream habitat conditions necessary for salmonid growth, survival, and reproduction. Riparian zones and wetland/aquatic vegetation serve important functions in stream ecosystems. Removal of riparian vegetation that provides shade increases stream exposure to solar radiation, leading to increases in stream temperatures (Poole and Berman 2001). Additional benefits from riparian vegetation includes: 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 streambank stability (Platts 1991), source of woody debris that creates fish habitat diversity (Bryant 1983, Lisle 1986, Shirvell 1990), and providing 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.

As a result of the project, some riparian habitat will be temporarily impacted to provide access for construction equipment while other habitat will be permanently impacted due to the placement of RSP. Access for maintenance is not expected to include large equipment that would cause damage to the riparian vegetation. The use of RSP for bank stabilization can limit establishment of riparian vegetation, escape cover and food production utilized by salmonids (Schmetterling et al. 2001). The removal of riparian vegetation will result in reductions in shade and cover for fish, will remove sources of woody debris that may contribute to habitat diversity

and complexity, and may result in increased stream temperatures. However, Project plans indicate that tree and vegetation removal will be minimized to the maximum extent feasible to prevent erosion and to reduce potential impacts on salmonids (SMRCD 2020). Additionally, large woody debris will be installed in the action area as part of the channel restoration component of the Project. In temporarily impacted areas, trimmed vegetation is expected to grow back and, where vegetation is removed, native vegetation will be planted following Project completion. However, the services provided by vegetation such as shade and cover, sediment storage and filtering, nutrient inputs, sources of woody debris, and habitat complexity (i.e., cover) will remain degraded at the site until new vegetation is replanted and becomes established. When considering complete removal of trees, we expect riparian vegetation attributes on-site will return to pre-project levels after native trees are replanted and established, which will take many years (if successful). Smaller vegetation is expected to recover within one to two years. Although shading of the creek will likely be reduced overall in the action area due to riparian vegetation removal and trimming, after a couple of years cover and shade in the creek will return to pre-Project levels, and may actually increase above pre-Project levels as a result of revegetation and large woody debris installation. While vegetation becomes re-established and new woody debris is recruited, individual salmonids may seek alternative areas for cover and forage. Additionally, a number of individuals could remain in the area where vegetation is either temporarily or permanently impacted by the Project. For individuals that return to and stay in the action area post-construction, the impacts from removal of riparian vegetation is not expected to significantly reduce their performance. Riparian clearing is expected to be minimal, and full recovery is expected in temporary impact areas post-construction, while permanent riparian losses due to RSP placements will be small scale in the action area. Therefore, riparian impacts from the Project to salmonids are likely to be minor and localized. NMFS does not expect minor vegetation removal from the Project will diminish the value of critical habitat PBFs in the action area, including rearing capacity for juvenile CCC steelhead or coho salmon.

### 2.5.6 Channel Modification and Addition of Hardscape

Construction of the Project will include grading of the channel bed and banks, construction of rock weirs and installation of RSP. Maintenance activities will include the removal of accumulated sediment and debris from the intake pool. Access for maintenance is not expected to include large equipment that would disturb channel substrate or modify the channel. For construction of the Project, RSP is proposed at the upstream end of the restored channel along the left bank to buttress an area of unstable bank and constrain the channel upstream of the pool that will contain the screened diversion. This RSP is intended to reduce the input of fine sediment into the creek, constrict flow and promote scour in the pool, helping to keep the intake screen free from debris and sediment. RSP has also been proposed along the bank to protect and stabilize the pumphouse.

RSP additions during construction will permanently cover existing in-stream benthic habitat and destroy or displace associated invertebrates and aquatic plants. Although the disruption to benthic habitat will reduce foraging ability of juvenile salmonids in the action area, the amount of RSP would be relatively small and suitable benthic habitat is available nearby. Therefore,

effects to salmonids and critical habitat from this loss of benthic habitat are expected to be minor and localized.

In general, the stabilization of a stream bank and channel with RSP limits the stream's ability to generate channel sinuosity and form in-channel habitat diversity. Over time, this can result in channel incision (Schmetterling et al. 2001). As noted previously, the use of RSP for bank stabilization can also limit establishment of riparian vegetation, escape cover and food production utilized by salmonids (Schmetterling et al. 2001). The limited amount of RSP to be used in the Project is not expected to alter incision rates in a meaningful way.

Fish passage is expected to be greatly improved by the Project relative to the environmental baseline. The concrete dam and often impassable fishway will be removed. Grading will be used to create a channel through the large amount of sediment built up behind the dam. Stream simulation material will be used to reconfigure the channel in some places. Provided there is sufficient streamflow, these actions will allow adult salmonids access spawning habitat above the dam that was often prevented by the dam and fishway. Juvenile salmonids are also expected to have greater success surviving downstream migration without having to navigate the dam or the often unusable fishway. These actions will also allow for natural processes to once again control flow patterns year-round, potentially providing more consistent flow that would benefit salmonids ability to move within the creek.

### 2.5.7 Mindego Creek Diversion Intake

Water diversion intakes can be a major source of potential injury or mortality of fishes (Spencer 1928; Bell 1991). Entrainment, impingement, and delay/predation are the primary contributors to the injury or mortality of juvenile salmonids. Entrainment occurs when fish are drawn into the diversion, and impingement occurs when a fish is not able to avoid contact with a screen surface, trash rack, or debris at the intake. This may cause bruising, descaling and other injuries. Impingement, if prolonged, repeated, or occurring at high velocities, also causes direct mortality. Delay at intakes increases predation risk by stressing or disorienting fish and/or by providing habitat for predators.

Repositioning of the Mindego Creek Diversion intake will meet NMFS' guidelines on intake structure placement, alignment, and screening materials (NMFS 1997a). The new fish screen is designed to provide a maximum approach velocity of 0.083 feet per second (ft/sec), equivalent to one-quarter of the of 0.33 ft/sec maximum approach velocity for self-cleaning screens (SMRCD 2020). The design approach velocity of 0.083 ft/sec will allow steelhead and coho salmon fry and juveniles to safely swim away from the screen face without impingement. Given the proposed design, NMFS does not expect injury or mortality of steelhead or coho salmon from impingement or entrainment at the new screened intake.

### 2.5.8 Diversion Operations

San Francisco proposes to continue operating the Mindego Creek diversion in accordance with their existing water rights (and bypass flow requirements), as enumerated and described in Section 1.3.4 (Table 1). As part of the 1993 water right permit granted to San Francisco by the

SWRCB, minimum bypass flows were defined for fish and wildlife in Mindego Creek (to be measured at the USGS San Gregorio Creek gage) during November-May, which coincides with most of the salmonid migration time period. Under San Francisco's other rights in November-May, they could divert 0.015 cfs (November-March) and 0.03 cfs (April and May) without providing minimum bypass flows. The new intake (weir plate and pump) may constrain diversion rates at times during these months, as it is not designed to operate at flows in Mindego Creek of less than 2 cfs (i.e., operational limit).

NMFS expects the minimum bypass flows and operational limit flow rate of the new intake (hereafter, bypass flows and the operational limit flow rate are referenced as "passage flows") will be sufficient to provide suitable passage conditions for salmonids year-round in Mindego Creek. Mean flow for San Gregorio Creek and Mindego Creek during some months is below these passage flows (Table 2 and Table 3). Such low flows are expected to reduce migration capabilities of salmonids. However, in most years within each month in November-June, streamflow is expected to increase above passage flows for days or weeks as a result of precipitation events. These intermittent periods of higher flows are when fish are expected to migrate.

As an example of potential reductions in Mindego Creek flow due to San Francisco's diversion (i.e., impairment), NMFS calculated the percentage of NFD mean P90 flows that could be diverted at the maximum diversion rate for each month (Table 4). If the flow in Mindego Creek drops below the mean P90 and the diversion is operated at the maximum rate, impairment could be higher than NMFS's estimates; however, the operational limit for the new intake (2 cfs) was the minimum streamflow used to calculate potential impairment. Conversely, it is expected the intake will operate below the maximum diversion rate at times, which would result in lower impairment rates than those estimated in Table 4. Given these stipulations, operation of the diversion between November and June would impair streamflow by 1.5% or less if passage flows are not achieved, and 3.5% or less when above passage flows (Table 4). Such a small impairment from operating the diversion is not expected to result in streamflow dropping below the minimum flow necessary to provide fish passage for an extended period of time, especially if flows are above passage flows. NMFS expects operation of the diversion will have negligible effects on salmonid spawning and migration and PBFs of critical habitat.

In addition to potential impacts on fish passage/movements, the operation of the diversion has the potential to affect the rearing habitat space and fish abundance downstream of the diversion. In general, surface water diversions reduce the amount of water in a stream, which results in some loss of habitat space and can increase water temperatures and reduce dissolved oxygen. If surface inflow to pools where fish can find refuge ceases altogether, dissolved oxygen in the pools can become limited and fish health and survival are at a greater risk of being adversely impacted. As the operational limit of the new intake is 2 cfs, baseflows of 2 cfs or less would be unimpacted by the diversion. Studies indicate that baseflow of 2 cfs is sufficient for salmonid rearing. Over-summer survival of juvenile coho salmon within pools of Green Valley Creek (a tributary to the Russian River in northern California) was 90% at average daily streamflow of 0.2 cfs, 88% at 0.19 cfs, 80% at 0.05 cfs, and 2% with 0 cfs flow. Additionally, five coastal streams

in Santa Cruz County were evaluated to determine appropriate minimum instream flows for salmonid migration and rearing based on natural hydrologic characteristics, field observations, and modeling (City of Santa Cruz Water Department et al. 2021). The lowest minimum flow for fish rearing developed from this latter study, was 0.25 cfs for two creeks. Although these studies suggest juvenile salmonids may survive at flows of 0.25 cfs in some creeks, such extreme low flows are not optimal for growth and survival if they extend for weeks or months. Further, periods of extreme low flows occurring in subsequent years may result in long-term impacts to salmonid population health. NMFS expects operation of San Francisco's diversion at flows of 2 cfs or greater will maintain suitable rearing baseflows and have a negligible effect on salmonids and critical habitat.

**Table 4.** Percentage of mean NFD P90 flows in Mindego Creek that could be diverted by San Francisco (i.e., impairment) at the maximum diversion rate for a given month. Impairments are provided for cases when flows in San Gregorio Creek are above minimum bypass flow thresholds set for Mindego Creek and when they are not. Note that actual impairments will vary considerably from these estimates as flows will diverge from P90 means and diversion rates will likely be below the maximum at times. Water type years were characterized based on criteria as described in Table 2. Values in bold had mean P90 flows below 2 cfs for that month; the creek flow rate used to calculate impairment for these months was the operation limit of the intake (2 cfs) rather than the mean P90 flow.

| Month | Potential impairment when below minimum bypass flow thresholds | | | Potential impairment when above minimum bypass flow thresholds | | |
|---|---|---|---|---|---|---|
| | Normal Water Years | Wet Water Years | Dry Water Years | Normal Water Years | Wet Water Years | Dry Water Years |
| January | 0.1% | 0.1% | 0.2% | 0.3% | 0.2% | 0.9% |
| February | 0.1% | 0.0% | 0.3% | 0.4% | 0.1% | 0.9% |
| March | 0.1% | 0.1% | 0.3% | 0.4% | 0.3% | 1.2% |
| April | 0.3% | 0.4% | 1.2% | 0.6% | 1.0% | 2.9% |
| May | 1.1% | 0.8% | **1.5%** | 2.5% | 1.8% | **3.5%** |
| June | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** |
| July | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** |
| August | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** |
| September | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** |
| October | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** | **1.5%** |
| November | **0.8%** | 0.6% | **0.8%** | **2.8%** | 2.2% | **2.8%** |
| December | 0.4% | 0.1% | 0.2% | 1.3% | 0.5% | 0.9% |

## 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).

New diversions from Mindego Creek may be established in the action area or further upstream that could impact streamflow in the action area. However, all new appropriative or unexercised riparian diversions from Mindego Creek initiated after the Decree (1993) are subject to minimum bypass flows as noted in section 2.4.1. This requirement will reduce the effects of new diversions on the action area.

## 2.7 Integration and Synthesis

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

The action area is located within Mindego Creek, a creek within the San Gregorio Watershed, which is known to support threatened CCC steelhead (in Mindego Creek), and endangered CCC coho (in the San Gregorio Watershed). The San Gregorio Creek watershed supports a CCC steelhead population that is functionally independent and considered essential to recovering the DPS (NMFS 2016b). The San Gregorio Creek population of CCC coho salmon is a dependent population. Midego Creek is designated critical habitat for the CCC steelhead DPS and CCC coho salmon ESU.

CCC steelhead and CCC coho salmon have declined from their historic abundances due to the widespread degradation and loss of historic habitats caused by factors including hydrologic modifications (reservoir storage, surface diversions, and groundwater pumping), land use change (urbanization, timber harvest, agriculture, and mining), construction of dams and other migration impediments, channelization and disconnection from floodplains, and the introduction of non-native and invasive species. Coho salmon populations within the Santa Cruz Mountains Diversity Stratum declined substantially over the past several decades. Abundance of the CCC coho population in the San Gregorio Creek watershed is highly variable, but generally very low.

The Project includes the removal of a dam and fishway, the relocation and reconstruction of an existing surface water diversion intake, and restoration of the creek channel. The Project will

require temporary dewatering of approximately 355 feet of Mindego Creek, fish capture and relocation, and grading and other disturbances during construction. Future maintenance of the intake is expected to occur intermittently and will not include dewatering or use of equipment, aside from hand tools, within the creek. Operations will include surface water diversions from Mindego Creek in accordance with their existing water rights and bypass flow requirements. Construction will occur during the dry season (August 1- November 1). We expect juvenile steelhead will be present throughout the action area. Based on observations of juvenile coho in Alpine Creek nearby in 2008, and lack of passage barriers in Mindego Creek below the action area, there is a reasonable likelihood of coho salmon adults returning to Mindego Creek and successfully spawning. Therefore, NMFS concludes a small number of juvenile coho individuals are likely to be present in the action area during project activities.

### 2.7.1 Summary of Effects to CCC steelhead and CCC coho salmon

As described in Section 2.5, NMFS identified the following components of the project that may result in effects to CCC steelhead and CCC coho: fish collection and relocation, dewatering, temporary increases in suspended sediment, construction-related contaminants, removal of riparian vegetation, channel modification and the installation of hardscape, and diversion operations. Fish collection and relocation, as well as dewatering, are likely to result in reduced fitness, injury, and/or mortality of salmonids. Increased sedimentation and turbidity due to dewatering will cease shortly after construction is complete such that any effects to salmonids are extremely unlikely to occur. The implementation of proposed AMMs is expected to minimize the potential for fish to be exposed to pollution from hazardous materials and contaminants during and after construction. Temporary impacts to riparian vegetation due to the Project will expose salmonids to reduced cover and forage during and after construction; however, it is expected salmonids will still be able to use the action area or successfully relocate to high-quality alternative nearby habitats as needed. Loss of habitat due to addition of RSP will reduce the overall habitat for salmonids in the area, but it is expected salmonids will still be able to use the action area or successfully relocate to high-quality alternative nearby habitats as needed. San Francisco's diversion operations are unlikely to result in reduced fitness, injury, and/or mortality of salmonids in and below the action area. The Project components of removing of the dam and fishway combined with restoration of the channel, are expected to improve fish passage for salmonids. NMFS does not expect any of the aforementioned effects to combine with other effects in any significant way.

Regarding dewatering and fish relocation, NMFS estimates up to 200 juvenile CCC steelhead, 1 steelhead adult kelt, and 10 juvenile coho salmon may be present in the area to be dewatered as part of the proposed Project. Anticipated injury or mortality from capture and relocation is expected to be two percent (or less) of the fish present for each species, and injury or mortality expected from dewatering is expected to be one percent (or less) of the fish present of each species prior to relocation and dewatering (combined injury or mortality is not expected to exceed three percent of each species). NMFS expects no more than four juvenile steelhead would be injured or killed by fish capture/relocation/dewatering at the project site during construction. NMFS expects no more than one juvenile coho salmon will be injured or killed by fish capture,

relocation, and dewatering. NMFS does not expect any adult steelhead or coho salmon will be injured or killed by fish capture, relocation and dewatering.

We do not expect the proposed Project to affect the persistence or recovery of the San Gregorio Creek populations of the CCC steelhead DPS or CCC coho salmon ESU. We base this conclusion on our findings above which considered the status of the species, the environmental baseline, all of the potential effects of the action, and the cumulative effects.

### 2.7.2 Summary of Effects on Critical Habitats

Mindego Creek contains critical habitat for the CCC steelhead DPS and CCC coho salmon ESU. In our adverse modification analysis, we consider the condition of critical habitat, the potential effects of the Project on critical habitat, and whether or not those effects are expected to diminish the value of critical habitat for the conservation of CCC steelhead or CCC coho salmon.

While conditions vary, critical habitat for these salmonids throughout their ranges has been impaired by habitat loss, alteration and fragmentation, surface and groundwater extraction, land use conversion, and estuarine habitat loss. Except for estuarine habitat loss, these factors also affect CCC steelhead and CCC coho salmon critical habitat in Mindego Creek as a result of rural developments, water diversions, and historic forestry and other land use practices.

The Project will result in both temporary and permanent impacts to critical habitat. During dewatering activities, approximately 355 feet of rearing habitat that supports juvenile salmonid development will be unavailable. This will result in the temporary loss of benthic macroinvertebrates (juvenile salmonid prey) in the dewatered reach. In addition, because the temporary bypass flow structure used for dewatering will be screened to keep fish from entering the diversion structure, the movement of fish through the dewatered area will be prevented. The movement of juveniles in this area is typically low during summer months, and similar habitat exists outside the action area, so impacts to the availability of critical habitat during construction are expected to be minimal. Temporary and permanent impacts to CCC coho and CCC steelhead critical habitat will occur due to removal of riparian vegetation for construction access. However, the riparian vegetation surrounding the action area is dense and vegetation removal is anticipated to be minimal, and vegetation will regrow either naturally or through plantings, therefore impacts to critical habitat are expected to be to be minor and localized. Other impacts to critical habitat from the Project include restoration of the channel, including moving large amounts of sediment and addition of stream simulation materials. RSP will also be added within the channel for bank stabilization, including near the new intake. Effects to critical habitat from stream restoration and addition of RSP are expected to be minor and localized. Detrimental effects from stream restoration will be temporary and the Project is expected to ultimately improve habitat in the creek for salmonids. Removal of the dam and fishway, combined with channel restoration, are also expected to significantly improve the condition of critical habitat in the action area and downstream through addition of habitat features, greater sediment transport and flow dynamics, and allowing salmonids access to additional habitat above the dam.

San Francisco proposes to operate their diversion in accordance with their water rights. Because it is not clear how the diversion will be operated in future years, we assumed that it will be

operated using the maximum rates allowable under the water rights and operational limit. Operation of the diversion in November-May is unlikely to affect critical habitat due to the expected low impairment of streamflow during these months. Due to the 2 cfs operational limit for the new intake, the diversion is expected to temporarily reduce the quantity of available habitat for juvenile steelhead and coho salmon in the affected reach by a negligible amount. Therefore, we do not expect the diversion to diminish the value of critical habitat as a whole for the conservation of the species.

We do not expect the proposed Project to affect critical habitat for CCC steelhead or CCC coho salmon. We base this conclusion on our findings above which considered the status of the critical habitat, the environmental baseline, all of the potential effects of the action, and the cumulative effects.

### 2.7.3 Climate Change

Future climate change could affect CCC steelhead and CCC coho salmon and their designated critical habitats within the action area. Some potential effects of climate change on the central California coast are increases in air and water temperatures, more frequent and damaging forest fires, as well as changes in the timing and magnitude of precipitation events and dry season streamflow. Over time, climate change may alter the vegetation communities along Mindego Creek in direct ways, such as recent wildfires in adjacent watersheds, or less directly though changes in precipitation and temperature patterns. If streamflow declines in the future due to climate change, this could reduce the frequency and duration of suitable flows for adult and smolt passage throughout the San Gregorio Creek watershed. It is expected that the Project will substantially improve salmonid passage through removal of the dam and fishway. The proposed action may amplify the effects of climate change through cutting of riparian vegetation that provides shade for the creek and other benefits to salmonids; however, this would be on a very small scale given the size of the watershed and temporary as vegetation would regrow. The creek is well-shaded, which will help to keep stream temperatures lower than drainages with less riparian vegetation density and height during expected future increases in sunlight intensity. Furthermore, the creek restoration (including dam and fishway removal) will facilitate access for juvenile and adult steelhead and coho salmon to and from reaches of Mindego Creek upstream of the action area, which will enhance access to potential thermal refugia in the upper reaches of Mindego Creek.

## 2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the CCC steelhead DPS, nor destroy or adversely modify its designated critical habitat.

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 CCC coho salmon, nor 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). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

### 2.9.1 Amount or Extent of Take

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

Take of listed juvenile CCC steelhead and CCC coho is likely to occur during fish relocation and dewatering of Mindego Creek between June 15 and November 1. NMFS expects that no more than two percent of the juvenile steelhead and coho within the 355 linear foot dewatering area of Mindego Creek will be injured, harmed, or killed during fish relocation activities. NMFS also expects that no more than one percent of the fish within the same dewatered area will be injured, harmed, or killed during dewatering activities. Because no more than 200 juvenile steelhead and 10 CCC coho are expected to be present within the 355 linear foot dewatered reach of Mindego Creek during the construction season, NMFS does not expect more than 4 juvenile CCC steelhead and 1 juvenile CCC coho will be harmed or killed by the project.

Incidental take will have been exceeded if, in a single construction season:

- more than 200 juvenile CCC steelhead are captured;
- more than 10 juvenile CCC coho are captured;
- more than 1 adult steelhead (kelt) is captured;
- more than 6 juvenile CCC steelhead are harmed or killed;
- more than 2 juvenile CCC coho are harmed or killed;
- more than 3 percent of the total number of each juvenile salmonid species (steelhead and/or coho) captured are injured or killed;
- Any adult steelhead are injured or killed during the Project in-water construction.

If any of these incidental take limits are exceeded, reinitiation of consultation may be needed. See section 2.11 (Reinitiation of Consultation) below.

In the opinion, we describe the anticipated effects of the diversion operations on salmonid migration and rearing. The diversion is not expected to appreciably affect adult or smolt passage success or result in take of rearing juvenile steelhead or coho salmon during the dry season unless it is operated while flows in Mindego Creek are below the operational limit for the new intake (2 cfs) or using rates above those defined in San Francisco's current water rights. If the diversion is operated in a manner that is not considered in the biological opinion, adverse effects may increase, take may occur and reinitiation of consultation may be needed. See Section 2.11 (Reinitiation of Consultation) below.

### 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 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 juvenile CCC steelhead and CCC coho:

1. Undertake measures to ensure that injury and mortality to salmonids resulting from fish relocation and dewatering activities is low;
2. Undertake measures to minimize harm to salmonids from construction of the project and degradation of aquatic habitat;
3. Prepare and submit plans and reports to NMFS regarding fish capture and relocation, dewatering, construction activities, and post-construction site-performance. Detailed plans regarding these aspects of the Project should be submitted prior to completion of consultation with NMFS.

### 2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. Caltrans or any consultant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, 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. Corps or the applicants will allow any NMFS employee(s), or any other person designated by NMFS, to accompany field personnel to visit the project sites during activities described in this opinion.

    b. Corps or the applicants will retain qualified biologists with expertise in the area of anadromous salmonid biology, including handling, collecting, and relocating salmonids; salmonid/habitat relationships; and biological monitoring of salmonids. All fisheries biologists working on this project will be qualified to conduct fish collections in a manner that minimizes all potential risks to ESA-listed salmonids. Electrofishing, if used, shall be performed by a qualified biologists and conducted according to the *NOAA Fisheries Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act, June 2000*, available at: https://media.fisheries.noaa.gov/dam-migration/electro2000.pdf.

    c. The biologist will monitor the construction sites during placement and removal of water diversions to ensure that any adverse effects to salmonids are minimized. The biologist will be on site during all dewatering events to capture, handle, and safely relocation salmonids to an appropriate location. The biologist will notify NMFS staff at 831-713-7620 or Thomas.Wadsworth@noaa.gov, at least one week prior to capture activities to provide an opportunity for NMFS staff to observe the activities. During fish relocation activities the fisheries biologist shall contact NMFS staff at the above number, if injury or mortality of federally listed salmonids exceeds three percent of the total for each species collected, at which time NMFS will stipulate measures to reduce the take of salmonids.

    d. Salmonids will be handled with extreme care and kept in water to the maximum extent possible during rescue 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 biologist will have at least two containers and segregate young-of-year from larger age classes and other potential aquatic predators. Captured salmonids will be relocated, as soon as possible, to a suitable instream location (pre-approved by NMFS – see 3a below) in which suitable habitat conditions are present to allow for adequate survival of transported fish and fish already present.

    e. If any steelhead or salmon are found dead or injured, the biological monitor will contact NMFS staff at 831-713-7620 or Thomas.Wadsworth@noaa.gov. The purpose of the contact is to review the activities resulting in take, determine if additional protective measures are required, and ensure appropriate collection and transfer of salmonid mortalities and tissue samples.

    f. All salmonid mortalities will be retained. Tissue samples are to be acquired from each mortality per the methods identified in the NMFS Southwest Fisheries Science Center Genetic Repository protocols (contact the above NMFS office at

the phone number provided) and sent to: NOAA Coastal California Genetic Repository, Southwest Fisheries Science Center, 110 McAllister Way, Santa Cruz, California95060.

g. Non-native fish that are captured during fish relocation activities shall not be relocated to anadromous fish streams, or areas where they could access anadromous fish habitat.

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

   a. Corps or the applicants will allow any NMFS employee(s) or any other person(s) designated by NMFS to accompany field personnel to visit the project site during activities described in this opinion.

   b. To ensure that the Project is built as designed and contractors adhere to construction best management practices, Corps or the applicants will ensure monitoring will be performed during construction by qualified individuals. Monitors will be knowledgeable of the Project designs, construction minimization measures, and the needs of native fish, including steelhead and coho salmon. Monitoring will be performed daily. The monitor(s) will work in close coordination with Project management personnel, the Project design team, and the construction crew to ensure that the Project is built as designed.

   c. Any pumps used to divert live stream flow will be screened and maintained throughout the construction period to comply with NMFS' Fish Screening Criteria for Anadromous Salmonids (2000).

   d. Once construction is completed, all Project-introduced material must be removed, leaving the creek as it was before construction. As an exception, trees cut during the Project should remain at the site to serve as habitat. Excess construction materials will be disposed of at an appropriate disposal site.

3. The following terms and conditions implement reasonable and prudent measure 3:

   a. Fish Capture and Dewatering Plans – The Corps or applicants must submit a fish capture/relocation and channel dewatering plan to NMFS for review, including but not limited to suitable instream locations where any captured salmonids will be relocated in which suitable habitat conditions are present to allow for adequate survival of transported fish and fish already present. The plan shall be submitted electronically to NMFS biologist Tom Wadsworth at Thomas.Wadsworth@noaa.gov at least 30 days prior to the planned start of these activities.

   b. A draft of the revegetation monitoring plan must be submitted to NMFS biologist Tom Wadsworth at Thomas.Wadsworth@noaa.gov for review and approval prior to the beginning of the in-stream work season.

   c. Annual Reporting – The Corps or the applicants must prepare and submit annual reports to NMFS for Project activities as outlined below. The reports must be submitted electronically to NMFS biologist Tom Wadsworth at Thomas.Wadsworth@noaa.gov by January 15 of the year following dewatering activities. Reports prepared for compliance with other agency requirements that

contain the information requested below would be acceptable. The report must contain, at minimum, the following information:

d. Annual reports must contain, at minimum, the following information:

   i. Fish relocation – The report(s) must include a description of the location from which fish were removed and the release site(s) 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 ESA-listed fish 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.

   ii. Construction related activities – The report(s) must 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 action; and photographs taken before, during, and after the activity from photo reference points.

   iii. Post-Construction Vegetation Monitoring and Reporting - Caltrans must develop and submit for NMFS' review a plan to assess the success of revegetation of the site. Reports documenting post-project conditions of vegetation installed at the site will be prepared and submitted annually on January 15 for the first five years following project completion, unless the site is documented to be performing poorly, then monitoring requirements will be extended. Reports will document vegetation health and survivorship and percent cover, natural recruitment of native vegetation (if any), and any maintenance or replanting needs. Photographs must be included. If poor establishment of vegetation is documented, the report must include recommendations to address the source of the performance problems and improve conditions at the site.

## 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 as this time.

## 2.11 Reinitiation of Consultation

This concludes formal consultation for the Mindego Creek Fish Passage Improvement Project.

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

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the Corps (Podlech 2020) and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

## 3.1 Essential Fish Habitat Affected by the Project

Pacific Coast Salmon EFH may be adversely affected by the proposed action within the action area. The Project action area is located in a freshwater area that contains spawning and thermal refugia Habitat Areas of Particular Concern (HAPCs) for coho salmon managed within the Pacific Coast Salmon FMP (PFMC 2014). Historical temperatures measured in Mindego Creek by CDFG (1973, 1974) and CCC/WSP (1996) during June-August ranged from 53°F to 65°F. These temperatures are within the optimal range for steelhead and tolerable for coho salmon. Historical flow measurement also suggest that flow is likely, although quite low, in summer month even in dry years. This evidence indicates the action area could support juvenile

salmonids even in drought years. Suitable spawning habitat for steelhead and coho salmon is found in portions of the action area.

### 3.2 Adverse Effects on Essential Fish Habitat

NMFS determined the Project would adversely affect EFH for Pacific Coast Salmon species (coho salmon). The potential adverse effects of the Project on EFH have been described in the preceding opinion and include degraded water quality, benthic disturbance, reduction in streamflow, and loss of riparian vegetation. As described in the opinion above, degraded water quality, benthic disturbance, and loss of riparian vegetation effects are anticipated to be temporary and minor. Permanent adverse impacts will include minor reductions in streamflow caused by the operation of the diversion, and the addition of RSP. The Project is expected to improve the habitat and accessibility of the action area for salmon, therefore the value of this HAPC will also increase due to the Project.

### 3.3 Essential Fish Habitat Conservation Recommendations

Based on information developed in our effects analysis (see preceding opinion), NMFS has determined that the proposed action would adversely affect EFH for CCC coho salmon, which are managed under the Pacific Salmon FMP. Although adverse effects are anticipated as a result of the Project, the proposed minimization and avoidance measures, and best management practices described in the accompanying biological opinion are sufficient to avoid, minimize, and/or mitigate for the anticipated effects. Therefore, no additional EFH Conservation Recommendations are necessary at this time that would otherwise offset the adverse effects to EFH.

### 3.4 Supplemental Consultation

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

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

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

### 4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps. Other interested users could include SLVWD, CDFW, City of Santa Cruz, and other local stakeholders. Individual copies of this opinion were provided to the Corps and SLVWD. The

document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

### 4.2 Integrity

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

### 4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

## 5 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.

Adams, P.B., M.J. Bowers, H.E. Fish, T.E. Laidig, and K.R. Silberberg. 1999. Historical and current presence-absence of coho salmon (*Oncorhynchus kisutch*) in the Central California Coast Evolutionarily Significant Unit. NMFS Administrative Report SC-99-02. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Tiburon, California. April, 1999.

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.

Alley, D.W. 2018. Fall Creek Salmonid Passage Study, Downstream of the Fish Ladder and Water Diversion, Santa Cruz County – Spring 2016. Prepared for the San Lorenzo Valley

Water District, Boulder Creek, California. D.W. Alley & Associates, Brookdale, California.

Baker, P. and F. Reynolds. 1986. Life history, habitat requirements, and status of coho salmon in California. CDFG unpublished report submitted to the California Fish and Game Commission. 31 pages.

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.

Beamish, R.J., editor. 2018. The ocean ecology of Pacific salmon and trout. American Fisheries Society, Bethesda, Maryland.

Becker, G.S. and I.J. Reining. 2008. Steelhead/rainbow trout (*Oncorhynchus mykiss*) resources south of the Golden Gate, California. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, California.

Bell, M.C. 1991. Fisheries handbook of engineering requirements and biological criteria, U.S. Army Corps of Engineers, North Pacific Division, Portland, Oregon.

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, Idaho.

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.

Boughton, D.A., P.B. Adams, E. Anderson, C. Fusaro, E. Keller, E. Kelley, L. Lentsch, J. Nielsen, K. Perry, H. Regan, J. Smith, C. Swift, L. Thompson, and F. Watson. 2006. Steelhead of the South-Central/Southern California Coast: Population Characterization for Recovery Planning. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-394. NOAA's National Marine Fisheries Service. Southwest Fisheries Science Center. Santa Cruz, California.

Boughton, D.A., P.B. Adams, E. Anderson, C. Fusaro, E. Keller, E. Kelley, L. Lentsch, J. Nielsen, K. Perry, H. Regan, J. Smith, C. Swift, L. Thompson, and F. Watson. 2007. Viability Criteria for Steelhead of the South-Central and Southern California Coast.

NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-407. NOAA's National Marine Fisheries Service. Southwest Fisheries Science Center. Santa Cruz, California.

Bond, M.H., S.A. Hayes, C.V. Hanson, and R.B. MacFarlane. 2008. Marine survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Canadian Journal of Fisheries and Aquatic Sciences 65: 2242–2252.

Brabb, E. E., R. W. Graymer, and D. L. Jones. 1998. Geology of the onshore part of San Mateo County, California: A digital database: U.S. Geological Survey Open-File Report 98-137, U.S. Geological Survey, Menlo Park, California. http://pubs.usgs.gov/of/1998/of98-137/

Brewer, P.G., and J. Barry. 2008. Rising Acidity in the Ocean: The Other $CO_2$ Problem. Scientific American. October 7, 2008.

Brown, L.R., P.B. Moyle, and R.M. Yoshiyama. 1994. Historical decline and current status of coho salmon in California. North American Journal of Fisheries Management. 14(2):237-261.

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.

Bryant, G.J. 1994. Status review of coho salmon populations in Scott and Waddell Creeks, Santa Cruz County, California. National Marine Fisheries Services Southwest Region, Santa Rosa, California.

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.

California Department of Water Resources. 2021. Water year 2021: an extreme year. Available at: water.ca.gov/drought

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.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117(1):1-21.

City and County of San Francisco. 1993. Petition for Approval of Proposed Water Transfer. Number 355792. Superior Court of the State of California County of San Mateo.

City of Santa Cruz Water Department, Ebbin Moser + Skaggs LLP, Hagar Environmental Science, Gary Fiske and Associates, Balance Hydrologics, Inc., Alnus Ecological. 2021. City of Santa Cruz anadromous salmonid habitat conservation plan for the issuance of an incidental take permit under section 10(a)(1)(b) of the Endangered Species Act.

Coble, D.W. 1961. Influence of water exchange and dissolved oxygen in redds on survival of steelhead trout embryos. Transactions of American Fisheries Society 90:469-474.

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

County of San Mateo. 1993a. Order granting city and county of county San Francisco's petition for approval of proposed water transfer. No. 355-792. Superior Court of the State of California. September 13, 1993.

County of San Mateo. 1993b. In the Matter of the determination of the rights of the various claimants to the water of San Gregorio Creek Stream System in San Mateo County, California. No. 355-792. Superior Court of the State of California. January 29, 1993.

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.

Crozier LG, McClure MM, Beechie T, Bograd SJ, Boughton DA, Carr M, et al. (2019) Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. PLoS ONE 14(7): e0217711. https://doi.org/10.1371/journal.pone.0217711

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.

Diffenbaugh, N.S., D. L. Swain, and D. Toumaa. 2015. Anthropogenic warming has increased drought risk in California. Proceedings of the National Academy of Sciences, 112 (13): 3931-3936. https://doi.org/10.1073/pnas.1422385112

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. Sydeman, J., and L. D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. Annual Review of Marine Science 4:11-37.

Dolman, B., J. Green, M.A. King, M. Obedzinski, S. Nossaman, and K. Robbins. 2019. Upper Green Valley Creek Streamflow Improvement Plan. The Russian River Coho Water Resources Partnership. December 2019. 109 pages.

Eisler, R. 2000. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 1, Metals. Lewis Press. Boca Raton, Florida.

Everest, F.H., R.L. Beschta, J.C. Schrivener, K.V. Koski, J.R. Sedell, and C.J. Cederholm. 1987. Fine sediment and salmonid production: A paradox. *In*: Salo, E.O., T.W. Cundy, editors. Streamside Management. Forestry and Fishery Interactions. University of Washington, Institute of Forest Resources. Contribution No. 57. P. 98-142.

Exponent. 2019. Water Availability Assessment for San Lorenzo River Watershed Conjunctive Use Plan. Prepared for San Lorenzo Valley Water District, Boulder Creek, California.

Feely, R.A., C.L. Sabine, K. Lee, W. Berelson, J. Kleypas, V.J. Fabry, F.J. Millero. 2004. Impact of anthropogenic $CO_2$ on the $CaCO_3$ system in the oceans. Science 305:362-366.

Frölicher, T. L., E. M. Fischer, and N. Gruber. Marine heatwaves under global warming. Nature, Vol 560.

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.

Goin, M.D. 2015. Escapement Estimates for Central California Coast Coho Salmon (*Oncorhynchus kisutch*) and Steelhead (*Oncorhynchus mykiss*) in Coastal San Mateo and Santa Cruz Counties for 2013-2014. 65 pages.

Goin, M.D. 2016. 2014-2015 Escapement Estimates for Central California Coast Coho Salmon (*Oncorhynchus kisutch*) and Steelhead (*Oncorhynchus mykiss*) in Coastal San Mateo and Santa Cruz County streams. 54 pages.

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.

Grantham T. E., D. M. Carlisle, J. Howard, B. Lane, R. Lusardi, A. Obester, S. Sandoval-Solis, B. Stanford, E. D. Stein, K. T. Taniguchi-Quan, S.M. Yarnell, J. K. H. Zimmerman. 2022. Modeling Functional Flows in California's Rivers. Frontiers in Environmental Science, volume 10. https://www.frontiersin.org/articles/10.3389/fenvs.2022.787473

Gregory, R.S., and 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.

Hassler, T.J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) coho salmon. U.S. Fish and Wildlife Service, Biological Report. 82(11.70). U.S. Army Corps of Engineers.

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.

Hayes, S.A., M.H. Bond, C.V. Hanson, E.V. Freund, J.J. Smith, E.C. Anderson, A.J. Ammann, and B.R. MacFarlane. 2008. Steelhead growth in a small Central California watershed: Upstream and estuarine rearing patterns. Transactions of the American Fisheries Society 137: 114-128.

Hayhoe, K., D. Cayan, C.B. Field, P. C. Frumhoff, E.P. Maurer, N.L. Miller, S.C. Moser, S.H. Schneider, K.N. Cahill, E.E. Cleland, L. Dale, R. Drapek, R.M. Hanemann, L.S. Kalkstein, J. Lenihan, C.K. Lunch, R.P. Neilson, S.C. Sheridan, and J.H. Verville. 2004. Emissions pathways, climate change, and impacts on California. Proceedings of the National Academy of Sciences of the United States of America, 101(34):12422-12427.

Hokanson, K.E.F., C.F. Kleiner, and T.W. Thorslund. 1977. Effects of constant temperatures and diel temperature fluctuations on specific growth and mortality rates of juvenile rainbow trout, *Salmo gairdneri*. Journal of the Fisheries Research Board of Canada 34:639-648.

Holtby, L.B., B.C. Anderson, and R.K. Kadowaki. 1990. Importance of smolt size and early ocean growth to interannual variability in marine survival of coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 47(11):2181-2194.

Hubert, W.A. 1996. Passive capture techniques. Pages 157-192 *in* B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society. Bethesda, Maryland.

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

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

Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B.P. May, D.R. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1):26.

Lusardi, R.A., B.G. Hammock, C.A. Jeffres, R.A. Dahlgren, and J.D. Kiernan. 2020. Oversummer growth and survival of juvenile coho salmon (*Oncorhynchus kisutch*) across a natural gradient of stream water temperature and prey availability: an in situ enclosure experiment. Canadian Journal of Fisheries and Aquatic Sciences 77(2):413-424.

McMahon, T. E. 1983. Habitat suitability index models: coho salmon. United States Fish and Wildlife Service, FWS/OBS-82/10.49.

Martin, J.A. 1995. Food habits of some estuarine fishes in a small, seasonal central California lagoon. Masters of Science Thesis. San José State University. 57 pages.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. National Marine Fisheries Services, Northwest Fisheries Science Center and Southwest Fisheries Science Center.

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.

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

Myrick, C., and J.J. Cech, Jr. 2005. Effects of Temperature on the Growth, Food Consumption, and Thermal Tolerance of Age-0 Nimbus-Strain Steelhead. North American Journal of Aquaculture 67:324-330.

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

NMFS (National Marine Fisheries Service). 1997b. Status update for West Coast steelhead from Washington, Idaho, Oregon, and California. Memorandum date 7 July 1997 from the Biological Review Team to the National Marine Fisheries Service Northwest Regional Office.

NMFS (National Marine Fisheries Service). 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. National Marine Fisheries Service, Protected Resources Division, Santa Rosa, California.

NMFS (National Marine Fisheries Service). 2008. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

NMFS (National Marine Fisheries Service). 2009. Biological Opinion: Mindego Creek Road Repair along Mindego Creek, San Mateo County, California. 2009/04279. October 30, 2009.

NMFS (National Marine Fisheries Service). 2012. Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

NMFS (National Marine Fisheries Service). 2016a. 5-year Review: Summary & Evaluation of Central California Coast Coho Salmon. National Marine Fisheries Service, West Coast Region. California Coastal Office, Santa Rosa, California.

NMFS (National Marine Fisheries Service). 2016b. 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.

Nielsen, J.L. 1992. Microhabitat-specific foraging behavior, diet, and growth of juvenile coho salmon. Transactions of the American Fisheries Society 121:617-634.

NRCS (Natural Resources Conservation Service). 2009. San Mateo County soil survey. Available at: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Ohms, H.A., and D.A. Boughton. 2019. Carmel River steelhead fishery report – 2019. Prepared for California-American Water Company. Prepared by NOAA National Marine Fisheries Service Southwest Fisheries Science Center and University of California Santa Cruz Institute of Marine Science. Santa Cruz, California. 44 pages.

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.

Osterback A.K., C.H. Kern, E.A. Kanawi, J.M. Perez, and J.D. Kiernan. The effects of early sandbar formation on the abundance and ecology of coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) in a central California coastal lagoon. Can. J. Fish. Aquat. Sci. 75: 2184-2197.

PFMC (Pacific Fishery Management Council). 2014. Appendix A to the Pacific Coast Salmon

Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon. Available at https://www.pcouncil.org/fishery-management-plan-and-amendments-3/

Phillips, R.W., and H.J. Campbell. 1961. The embryonic survival of coho salmon and steelhead trout as influenced by some environmental conditions in gravel beds. Pages 60-73 in 14th annual report to Pacific Marine Fisheries Commission. Portland, Oregon.

Podlech, M. 2020. Fall Creek Fish Ladder Improvement Project Biological Assessment and Essential Fish Habitat Assessment. Prepared for the San Lorenzo Valley Water District, Boulder Creek, California. April, 23, 2020. 73 pages.

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. American Fisheries Society. Bethesda, Maryland.

Reiser, D.W., and T.C. Bjornn. 1979. Habitat Requirements of Anadromous Salmonids. *In*: Meehan, W.R., Technical Editor. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in the Western United States and Canada. United States Department of Agriculture, Forest Service GTR PNW-96. 54 pages.

Robinson, M.A. 1993. The distribution and abundance of benthic and epibenthic macroinvertebrates in a small, seasonal Central California Lagoon. Master's Thesis, San José State University. 77 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, and 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.

Sandercock, F.K. 1991. Life history of coho salmon. Pages 397-445 *in* C. Groot, and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, B.C.

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., J.C. Field, B.F. Boesch, R.W. Buddemeier, V. Burkett, D.R. Cayan, M. Fogarty, M. A. Harwell, R.W. Howarth, C. Mason, D.J. Reed, T.C. Royer, A.H. Sallenger, and J.G. Titus. 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. May 22, 2007. Environmental Protection Agency.

Schmetterling, D.A., C.G. Clancy, and T.M. Brandt. 2001. Effects of riprap bank reinforcement on stream salmonids in the Western United States. Fisheries 26(7):6–13.

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. Fish Bulletin 98.

Shirvell, C. 1990. Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) cover habitat under varying streamflows. Canadian Journal of Fisheries and Aquatic Sciences 47(5):852-861.

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.

Simenstad, C.A., K.L. Fresh, and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. *In* Estuarine comparisons. Edited by V.S. Kennedy. Academic Press, New York. pp. 343–364.

Smith, D.M., S. Cusack, A.W. Colman, C.K. Folland, G.R. Harris, and J.M. Murphy. 2007. Improved surface temperature prediction for the coming decade from a global climate model. Science 317:796-799.

Smith, J.J. 1990. The effects of sandbar formation and inflows on aquatic habitat and fish utilization in Pescadero, San Gregorio, Waddell, and Pomponio creek estuary/lagoon systems, 1985-1989. Prepared for California Department of Parks and Recreation. Report Interagency Agreement 84-04-324, San José State University.

SMRCD (San Mateo Resource Conservation District). 2020. Biological Resources Evaluation: Mindego Creek Fish Passage Project. 45 p.

Sogard, S.M. T.H. Williams and H. Fish. 2009. Seasonal Patterns of Abundance, Growth, and Site Fidelity of Juvenile Steelhead in a Small Coastal California Stream. Transactions of the American Fisheries Society 138:549–563.

Spence, B., G. Lomnicky, R. Hughes, and R. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. Technical Environmental Research Services Corp., Corvallis, Oregon. 356 pages.

Spence, B.C., E. P. Bjorkstedt, J.C. Garza, J.J. Smith, D.G. Hankin, D. Fuller, W.E. Jones, R. Macedo, T.H. Williams, and E. Mora. 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, California.

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. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division. March 2012.

Spencer, J., 1928. Fish Screens in California Irrigation Ditches, California Fish and Game 14(3), 208-210 pp.

Stillwater Sciences, Stockhold Environment Institute, and San Gregorio Environmental Resource Center. 2010. San Gregorio Creek Watershed Management Plan. Prepared for the Natural Heritage Institute. 210 p.

Swain, D. L., B. Langenbrunner, J. D. Neelin, and A. Hall. 2018. Increasing precipitation volatility in twenty-first century California. Nature Climate Change, Vol 8: 427–433

SWRCB (State Water Quality Control Board). 1993. Permit for Diversion and Use of Water. Granted to San Francisco City and County. Permit #20698 – Mindego Creek. December 30, 1993.

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.

Thompson, K.E. 1972. Determining streamflows for fish life. pp. 31-50 *in* Proceedings of the Instream Flow Requirement Workshop. Pacific N.W. River Basins Commission. Portland, Oregon.

Turley, C. 2008. Impacts of changing ocean chemistry in a high-$CO_2$ 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.

Wagner, C.H. 1983. Study of Upstream and Downstream Migrant Steelhead Passage Facilities for the Los Padres Project and New San Clemente Project, Report prepared for the Monterey Peninsula Water Management District.

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. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-24. 258 pages.

Welsh, H., G.R. Hodgson, B.C. Harvey, and M.E. Roche. 2001. Distribution of juvenile coho salmon in relation to water temperatures in tributaries of the Mattole River, California. North American Journal of Fisheries Management 21:464-470.

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. Climatic Change 109:(Suppl 1):S445–S463.

Williams, T.H., S.T. Lindley, B.C. Spence, and D.A. Boughton. 2011. Status Review Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Southwest. 20 May 2011, update to 5 January 2011 Report to Southwest Region National Marine Fisheries Service from Southwest Fisheries Science Center, Fisheries Ecology Division.

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.

Williams A.P., J. T. Abatzoglou, A. Gershunov, J. Guzman-Morales, D. A. Bishop, J. K. Balch, and D. P. Lettenmaier. 2019. Observed Impacts of Anthropogenic Climate Change on Wildfire in California. Earth's Future, 7: 892–910. https://doi.org/ 10.1029/2019EF001210

Williams A.P., B. I. Cook, and J. E. Smerdon. 2022. Rapid intensification of the emerging southwestern North American megadrought in 2020–2021. Nature Climate Change, Vol. 12: 232–234.

Wurtsbaugh, W.A., and G.E. Davis. 1977. Effects of temperature and ration level on the growth and food conversion efficiency of *Salmo gairdneri*, Richardson. Journal of Fish Biology 11:87-98.

Zatkin, R. 2014. Compendium of California DFG Documents – Coastal San Mateo County. San Gregorio Creek, Book 2 of 3.