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

June 2, 2021 **Refer to NMFS No:** WCRO-2021-01261

David White
California Supervisor
NOAA Office of Habitat Conservation, Restoration Center
777 Sonoma Avenue, Suite 325
Santa Rosa, California 95404

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Coho Salmon and Steelhead Drought Contingency Plan at Pescadero Creek Lagoon

Dear Mr. White:

Thank you for your letter of May 21, 2021, 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 Coho Salmon Drought Contingency Plan at Pescadero Creek Lagoon. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

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

In the enclosed biological opinion, NMFS concludes the proposed action is not likely to jeopardize the continued existence of endangered Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*) or threatened CCC steelhead (*O. mykiss*), 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 that take of CCC steelhead and CCC coho salmon will occur due to poor water quality caused by mechanical and/or manual breaching of the Pescadero Creek lagoon sandbar. An incidental take statement with non-discretionary terms and conditions is included with the enclosed biological opinion.

Regarding EFH, NMFS has reviewed the proposed project for potential effects and determined that the proposed project would adversely affect EFH for species managed under the Pacific Coast Groundfish and Coastal Pelagics FMPs, and EFH for CCC coho salmon, which are managed under the Pacific Coast Salmon FMP. However, the anticipated effects are minor, temporary, and localized. Therefore, we have no practical EFH Conservation Recommendations to provide and no EFH Conservation Recommendations are included in this document.

Please contact William Stevens, North-Central Coast office in Santa Rosa at (707) 575-6066, or William.Stevens@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: Joe Pecharich, NOAA Restoration Center, Joe.Pecharich@noaa.gov
Tim Hyland, California Department of Parks and Recreation, Tim.Hyland@parks.ca.gov
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Coho Salmon and Steelhead Drought Contingency Plan at Pescadero Creek Lagoon

NMFS Consultation Number: WCRO-2021-01261

Action Agency: NOAA Restoration Center

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 (*Oncorhynchus 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
Pacific Coast Groundfish	Yes	No
Coastal Pelagic	Yes	No

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

Issued By:

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: June 2, 2021

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1. INTRODUCTION

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

1.1 Background

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

In October 2020, 10,000 passive integrated transponder (PIT)-tagged juvenile endangered Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*) were released by the NMFS Southwest Fisheries Science Center into the Pescadero Creek watershed. As of May 4, 2021, a total of 15 PIT-tagged juvenile coho salmon were detected at the PIT tag antenna on lower Pescadero Creek just above tidal influence of the lagoon, and one was captured during seining efforts in the lagoon on May 3 (Patrick Samuel, personal communication 2021).

On January 28, 2021, the Pescadero Creek lagoon sandbar was manually breached to improve water quality conditions in the lagoon to reduce the likelihood of water quality induced salmonid mortalities. The sandbar started to reform in late February, closed in March, naturally opened on March 18, and closed on April 14. California began experiencing drought like conditions in late-winter 2021.

As of May 4, 20201, 41 adult steelhead were captured during California Department of Fish and Wildlife (CDFW) seining in the lagoon—11 upstream of the Highway 1 bridge and approximately 30 downstream of the Highway 1 bridge, which is just upstream of the sandbar (Sean Cochran, personal communication 2021). In mid-March 2021, the NOAA Restoration Center (RC), CDFW, and NMFS began discussing options to facilitate coho smolts and adult steelhead movements from the closed lagoon to the Pacific Ocean.

On May 25, 2021, we received the NOAA RC's request for consultation and consultation was initiated.

1.3 Proposed Federal Action

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

The NOAA RC proposes to mechanically breach the Pescadero lagoon sandbar in June 2021 (summer 2021) up to three times. The goal of the breaches are to ensure coho salmon smolts, steelhead smolts, and adult steelhead (kelts) are able to enter the Pacific Ocean to continue their life cycle. Based on existing hydrologic and climatic conditions, NOAA RC, CDFW, and NMFS do not expect the sandbar to breach naturally until the fall or winter.

CDFW, NOAA RC, NMFS and California Department of Parks and Recreation (State Parks) have agreed that the risk of not allowing these fish to complete their life cycle by not implementing a mechanical breach is greater than the risk of potentially poor water quality conditions in the lagoon later this summer (as will be described later).

The sandbar will be breached with an excavator by constructing an outlet channel through the sandbar that will connect to the ocean and slowly reduce the water surface elevation of the lagoon. Hand-shoveling an outlet channel may also occur. The connection to the ocean will allow cooler, well oxygenated ocean water to enter the lagoon and improve existing water quality conditions and allow smolts and kelts to enter the ocean. Stockpiling of sand adjacent to the outlet channel will be avoided by spreading and smoothing the excavated sand to minimize any visual impact.

The outlet channel will be dug to the approximate following dimensions: 240 feet long, 10 feet wide, and 6 feet deep. The work area would be accessed from Highway 1 and Pescadero State Beach, about 350 feet north of the Highway 1 bridge crossing over Pescadero Creek. The excavator will access the sandbar from the north side of the beach.

1.3.1 Monitoring

Water surface elevation of the lagoon is monitored weekly by visually observing the staff plate at the Highway 1 bridge southern abutment when a closed sandbar phase is achieved.

Water quality (dissolved oxygen [milligrams per liter], salinity [parts per thousand], temperature [Celsius], depth [meters]) has been monitored weekly since January 6, 2020 in 0.25-meter increments weekly. Water quality monitoring ceases in the winter after high flows and full tidal action occurs in the lagoon. Water quality will also be monitored during breaching activities. When feasible, water quality will be measured with the use of continuing monitoring devices, such as Sonde units. When this is not feasible, water quality measurements will be collected using a hand-held YSI Pro 2030. In addition to vertical profiles, visibility measurements will be taken at each monitoring site as an indication of turbidity; visibility will be documented utilizing a basic 30 centimeter diameter secchi disk. Water quality data will be collected at six locations as described in NMFS (2018).

During and following mechanical breaching, CDFW staff will conduct surveys searching for dead and/or moribund salmonids. Search efforts will focus on the area downstream of Butano Channel. This is the vicinity where dead and/or moribund steelhead have been observed in the past after natural and mechanical breaches.

1.3.2 Avoidance and Minimization Measures

- The sandbar will be breached at the beginning of an outgoing tide. This is expected to: (1) minimize head differential between the lagoon and the ocean, and therefore reduce the draining effect; and (2) minimize loss of water volume in the lagoon so that sufficient habitat quantity is maintained. Depending on tides and water quality conditions, an attempt will be made to avoid breaching during an incoming mean higher high tide that is followed by a mean lower low tide.
- The mechanical breach will occur during daylight hours when surface dissolved oxygen is at its highest and when wind conditions are calm (but not following windy conditions) to ensure wind mixing has not caused the bottom of the lagoon to mix and/or turnover the water column. These measures are expected to maintain dissolved oxygen in the estuary above or near hypoxic levels following the breach.
- Only California State Parks vehicles will be driven on the beach.
- NOAA (NMFS and/or NOAA RC) and CDFW staff will be on-site during breaching activities to supervise work crews and to conduct monitoring via instruments and observation.
- Work crews will be given a safety and listed species briefing prior to breaching activities.
- If any dead animals are observed they will be collected and the standard metrics collected.
- No trash will be left on-site.
- NOAA (NMFS and/or NOAA RC) staff will remain on-site during breaching activities to ensure upland habitat disturbance is minimized.
- Direct access routes, staging area limits, and total area of construction activities will be limited to the minimum necessary to achieve the proposed project.

We considered, under the ESA, whether or not the proposed action would cause any other activities 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 provide 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 as a whole for the conservation of a listed species" (50 CFR 402.02). The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or

indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

2.2.1 Species Description and Life History

This biological opinion analyzes the effects of the proposed action on the following listed species Distinct Population Segment [DPS] or Evolutionarily Significant Unit [ESU]) and their designated critical habitats:

Endangered Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*)
Listing determination (70 FR 37160; June 28, 2005)
Critical habitat designation (64 FR 24049; May 5, 1999);
Threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*)
Listing determination (71 FR 834; January 5, 2006)
Critical habitat designation (70 FR 52488; September 2, 2005).

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 artificial propagation program: the Don Clausen Fish Hatchery Program.[1] 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[2], and the Southern Coho Salmon Captive Broodstock Program.[3]

[1] Kingfisher Flat Hatchery previously had a small CCC steelhead hatchery program that released steelhead smolts into Scott Creek and the San Lorenzo River. That program was terminated in 2014.
[2] Formerly referred to as the Don Clausen Fish Hatchery Captive Broodstock Program.
[3] Formerly referred to as the Scott Creek/King Fisher Flats Conservation Program and the Scott Creek Captive Broodstock Program.

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 Coho Salmon Life History

The life history of the coho salmon in California has been well documented (Shapovalov and Taft 1954; Hassler 1987; Weitkamp et al. 1995). In contrast to the life history patterns of other anadromous salmonids, coho salmon in California generally exhibit a relatively simple three year life cycle. 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, optimal habitats for coho salmon include adequate quantities of: (1) deep complex pools formed by large woody debris; (2) adequate quantities of water; (3) cool water temperatures [when maximum weekly average water temperatures exceed 18°C coho salmon are absent from otherwise suitable rearing habitat (Welsh et al. 2001); temperatures between 12-14° C are preferred; and the upper lethal limit is between 25-26°C.]; (4) unimpeded passage to spawning grounds (adults) and back to the ocean (smolts); (5) adequate quantities of clean spawning gravel; and (6) access to floodplains, side channels and low velocity habitat during high flow events. Numerous other requirements exist (i.e., adequate quantities of food, dissolved oxygen, low turbidity, etc.), but in many respects these other needs are generally met when the six freshwater habitat requirements listed above are at a properly functioning condition.

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).

2.2.1.2 Steelhead Life History

Steelhead are anadromous forms of *O. mykiss*, spending some time in both freshwater and saltwater. Steelhead young usually rear in freshwater for one to three years before migrating to the ocean as smolts, but rearing periods of up to seven years have been reported. *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).

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.

Migration to the ocean usually occurs in the spring. Steelhead may remain in the ocean for one to five years (two to three years is most common) before returning to their natal streams to spawn (Busby et al. 1996). The distribution of steelhead in the ocean is not well known. Coded wire tag recoveries indicate that most steelhead tend to migrate north and south along the continental shelf (Barnhart 1986).

Steelhead can be divided into two reproductive ecotypes, based upon their state of sexual maturity at the time of river entry and the duration of their spawning migration: stream maturing and ocean maturing. Stream maturing steelhead enter fresh water in a sexually immature condition and require several months to mature and spawn, whereas ocean maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry (i.e., summer [stream maturing] and winter [ocean maturing] steelhead). The timing of upstream migration of winter steelhead, the ecotype most likely encountered during the proposed action, is typically correlated with higher flow events occurring from late October through May. In central and southern California, significant river outflow is also often required to breach sandbars that block access from the ocean; for this reason, upstream steelhead migration in these areas can be significantly delayed, or precluded entirely during extremely dry periods. Adult summer steelhead migrate upstream from March through September; however, there is no known run of summer steelhead in Pescadero Creek. In contrast to other species of Oncorhynchus, steelhead may spawn more than one season before dying (iteroparity); although one-time spawners represent the majority.

Because rearing juvenile steelhead reside in freshwater all year, adequate flow and temperature are important to the population at all times (California Department of Fish and Game 1997). Outmigration appears to be more closely associated with size than age. In Waddell Creek, Shapovalov and Taft (1954) found steelhead juveniles migrating downstream at all times of the year, with the largest numbers of young-of-year and age 1+ steelhead moving downstream during spring and summer. Smolts can range from 5.5 to 8 inches in length. Steelhead outmigration timing is similar to coho salmon (NMFS 2016).

Suspended sediment concentrations, or turbidity, also can influence the distribution and growth of steelhead (Bell 1973, Sigler et al. 1984, Newcombe and Jensen 1996). Bell (1973) found suspended sediment loads of less than 25 milligrams per liter (mg/L) were typically suitable for rearing juvenile steelhead.

2.2.2 Status of Listed Species

NMFS assesses four population viability[4] 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). Recent estimates for the Russian River are

[4] 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).

on the order of 4,000 fish (NMFS 1997). 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). 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 condition has likely also depressed genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see Busby et al. 1996; NMFS 1997b; Good et al. 2005; Spence et al. 2008; Williams et al. 2011; and Williams et al. 2016.

A recent viability assessment of CCC steelhead concluded that populations in watersheds that drain to San Francisco Bay are highly unlikely to be viable, and that the limited information available did not indicate that any other CCC steelhead populations were demonstrably viable (Spence et al. 2008). The scarcity of information on steelhead abundance in the CCC steelhead DPS continues to make it difficult to assess whether conditions have changed appreciably since the previous assessment of Williams et al. (2011), which concluded that the population was likely to become endangered in the foreseeable future (Williams et al. 2016). Although there were average returns (based on the last ten years) of adult CCC steelhead during 2007/08, research monitoring data from the 2008/09 and 2009/10 adult CCC steelhead returns show a decline in returning adults across their range compared to the previous ten years.

There is little new evidence to suggest that the extinction risk for this DPS has changed appreciably in either direction since publication of the last viability assessment (Williams et al. 2016). The most recent status update concludes that steelhead in the CCC DPS remain "likely to become endangered in the foreseeable future", as new and additional information does not appear to suggest a change in extinction risk (NMFS 2016a).

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, as described above. Historically, there were 11 functionally independent populations and one 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; low abundance, range constriction, fragmentation, and loss of genetic diversity is documented, 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). Recent status reviews (Williams et al. 2011) indicate that the CCC coho salmon are likely continuing to decline in number and new information suggests there has been no change in extinction risk since 2010 viability assessments (Williams et al. 2016). CCC coho salmon have also experienced acute range restriction and fragmentation. Adams et al. (1999) found that in the mid-1990s coho salmon were present in 51 percent (98 of 191) of the streams where they were historically present, and documented an additional 23 streams within the CCC coho salmon ESU in which coho salmon

were found for which there were no historical records. 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 have not been able to provide enough immigrants for many dependent populations for several 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: Don Clausen Coho Salmon Conservation Program on the Russian River in Sonoma County, California, and the smaller Southern Coho Salmon Captive Broodstock Program on Scott Creek, Santa Cruz County, California. While differing in size and funding, both programs were initiated in 2001 in response to severely depressed coho salmon abundances. 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. Juvenile coho salmon and coho salmon 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 abundance has improved slightly since 2011 within several independent populations (mainly north of SF 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 ESU populations, the former predominantly due to out-planting of hatchery-reared juvenile fish from the Russian River Coho Salmon Captive Broodstock Program.

The most recent status review (NMFS 2016a) documents conditions for CCC coho salmon have not improved since the last status review in 2011 (Williams et al. 2016). The overall risk of CCC coho salmon extinction remains high, and the most recent status review reaffirmed the ESU's endangered status (NMFS 2016a). NMFS's recovery plan (NMFS 2012) for the CCC coho salmon ESU identified the major threats to population recovery. 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:

- Freshwater spawning sites with water quantity and quality conditions and substrate

supporting spawning, incubation and larval development;

- 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;
- 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 fresh- 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 habitat types were 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. Within these areas, essential features of coho salmon critical habitat include adequate: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions (64 FR 24029).

The condition of CCC coho salmon and CCC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[5]: logging, agriculture, mining, urbanization, stream channelization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Impacts of concern include altered stream bank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality, lost riparian vegetation, and increased erosion into streams from upland areas (Weitkamp et al. 1995; Busby et al. 1996; 64 FR 24049; 70 FR 37160; 70 FR 52488). Based on NMFS familiarity with the landscapes in which these critical habitats occur, these impacts continue to persist today. 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 channelization,

[5] 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 conditions.

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 coho salmon and CCC steelhead recovery plans (NMFS 2012 and 2016b, respectively). Streambank stabilization confines stream channels and precludes natural channel movement, resulting in increased streambed incision, 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.

The CZU Lightning Complex started as a series of lightning fires on August 16, 2020 across western Santa Cruz and San Mateo counties (California Department of Forestry and Fire Protection and California Department of Conservation 2020). The fire was fully contained on September 22, 2020; a total of 86,509 acres burned. Portions of the burned area represented some of the highest quality habitat for salmonids in the Santa Cruz Mountains. Much of the burned areas in the Pescadero Creek watershed burned at low-intensities, and as a predominately redwood forest, most of the larger trees survived (Cal Fire and CDC 2020). Future winter storms may transport large quantities of ash, debris, and fine sediments into areas downslope from burned areas, including Pescadero Creek watershed, in the near future.

2.2.4 Global Climate Change

Another factor affecting the range-wide status of the steelhead, salmon, and their aquatic habitat at large is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir et al. 2013). Snow melt from the Sierra Nevada has declined (Kadir et al. 2013). However, total annual precipitation amounts have shown no discernable change (Kadir et al. 2013). CCC steelhead and CCC coho salmon may have already experienced some detrimental impacts from climate change. NMFS believes the impacts on listed salmonids to date are likely fairly minor because natural, and local climate factors likely still drive most of the climatic conditions steelhead experience, and many of these factors have much less influence on steelhead abundance and distribution than human disturbance across the landscape. In addition, CCC steelhead and CCC coho salmon in the Pescadero Creek watershed are not dependent on snowmelt driven streams and, thus, not as affected by declining snow packs.

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

In the San Francisco Bay region[6], warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan et al. 2012). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan et al. 2012).

Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002; Ruggiero et al. 2010). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008, Feely et al. 2004, Osgood 2008, Turley 2008, Abdul-Aziz et al. 2011, Doney et al. 2012). The projections described above are for the mid to late 21st Century. In shorter periods, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Santer et al. 2011).

Finally, climate change is also affecting water circulation and temperature patterns in the marine environment. 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.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for the project encompasses the Pescadero Marsh Natural Preserve (which includes the tidally-influenced portions of lower Pescadero and Butano creeks), the beach between the lagoon and the Pacific Ocean (Pescadero State Beach), and the surf zone where the outlet channel enters the Pacific Ocean.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions

[6] Both the San Francisco Bay and Monterey Bay regions exhibit similar Mediterranean climate patterns. The action areas are located within the Monterey Bay region.

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

which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The Preserve is located approximately 12 miles south of the City of Half Moon Bay, San Mateo County, California. It represents the largest estuary-coastal marsh wetland complex for approximately 78 miles between Elkhorn Slough to the south and San Francisco Bay to the north. The Pescadero Lagoon within the Preserve is an approximately 340-acre coastal wetland formed at the confluence of Pescadero Creek and Butano Creek. The Pescadero Creek watershed drains approximately 81 square miles and Butano Creek, a sub-basin of the Pescadero Creek watershed, drains approximately 21 square miles. The area typically has mild weather throughout the year. Half Moon Bay has an average maximum temperature of 66.9 degrees (September) and average minimum temperature of 43 degrees (January). Average annual rainfall (1948-2005) in Half Moon Bay is 26.98 inches with 81 percent of the precipitation occurring in November through March (Western Regional Climate Center 2018).

The marsh offers a diversity of habitats, including salt marsh, freshwater marsh, sand dune, riparian forest, and coastal scrub. The marsh changes seasonally from an open, tidal estuary to a closed lagoon, the result of a sandbar that forms across the mouth of Pescadero Creek during the spring, summer, or fall, and persists usually until late fall or early winter. After formation of the sandbar, the water level in the lagoon and throughout the marsh rises, inundating the lowland areas of the marsh. In addition to CCC steelhead and CCC coho salmon, the marsh provides habitat for Federally threatened and endangered species, including tidewater goby, San Francisco garter snake, California red-legged frog) plus other rare and special status species (i.e., Western pond turtle).

Recent anthropogenic modifications in the Preserve are generally believed to have altered the estuary/lagoon function. Highway 1 construction included modification of the stream and estuary/lagoon outlet with spits to confine the crossing to a single bridge configuration. In 1991, California Department of Transportation replaced the original Highway 1 Bridge; the old design included four abutments within the estuary/lagoon mouth and the new bridge is more open-span, consisting of two bridge abutments (NMFS 2016). In 1993, an enhancement plan was implemented on the Preserve, but was not implemented according to the intended hydrological and biological goals: the low elevation levee was constructed too low and the culverts quickly rusted and became inoperable (Smith and Reis 1997). By 1995, the sandbar began forming substantially later in the year and this continues to present day (Smith and Reis 1997, Smith 1990). Currently, there is not enough time for reduced late summer stream flow to fully convert the water column to a freshwater lagoon, and as a result the water quality in the lagoon is impaired (e.g., stratified, with anoxia in the bottom layers). Smith (1990) documented that steelhead juveniles grew very rapidly in Pescadero Lagoon in non-drought years prior to implementation of the two aforementioned projects.

Recent positive changes include the Butano Creek Channel Reconnection and Resilience Project completed in 2019 (NMFS 2018). This project reestablished unimpeded passage for salmonids to 10.1 miles of habitat in the Butano Creek watershed for the first time in more than a decade.

During the next five years of unimpaired passage conditions, salmonids will have greater opportunities for spawning and rearing in the watershed. A large wood structure towards the upstream end of the project will provide fish habitat, will help stabilize the stream bed elevation and will help facilitate future sediment deposition upstream of the project site (e.g. longevity measure).

Artificial channels and deeper ponded areas in the Lower and Middle Butano marshes that are known to be sources of anoxia/hypoxia have been filled and are expected to limit stratification and anoxia formation as well as reduce the potential transport of accumulated sulfide rich waters from within Butano Marsh during breach events. Hence, these efforts should reduce the frequency and severity of depleted dissolved oxygen levels in the lagoon following breach events that are generally understood to drive fish mortality events (cbec 2018). Reducing fish kills is expected to result in improved conditions for critical habitat and increased adult returns of CCC steelhead and CCC coho salmon to the Pescadero Creek watershed.

Pescadero Lagoon is unique compared to other California Central Coast lagoons for a variety of reasons, including the relatively little permanent infrastructure (hardscape) within the historical tidal prism, but also because it is the only one in the range of the CCC steelhead and the entire California coast where fish kills occurred nearly annually between 1995 and 2017. The Final Recovery Plan for Central California Coast Coho Salmon Evolutionarily Significant Unit (NMFS 2012) included a "Conservation Highlight" of the multidisciplinary task force that is addressing yearly fish kills of CCC steelhead in the estuary. A recovery action identified in the Coastal Multispecies Final Recovery Plan (NMFS 2015) is to address water quality issues that result in fish kills in Pescadero estuary.

Seasonal lagoons are important rearing areas for many juvenile fish and invertebrates. Often viewed as nursery habitats, estuaries are productive waters offering high growth potential and protection from predation. Juvenile anadromous salmonids move through estuarine waters during their annual migration from stream habitats to ocean waters where maturation occurs. Although estuaries might comprise a small portion of the watershed area, they are critical nursery habitat, as estuary-reared juvenile steelhead make a disproportionate contribution to the spawning adult pool (Bond 2006). Estuaries/lagoons on California's Central Coast have been extensively documented as superior rearing habitat for steelhead and can contribute a disproportionate total number of returning adults compared to stream habitats when conditions are even marginally suitable (Bond et al. 2008). Smith (1990) and Huber (unpublished data, 2012) documented that steelhead juveniles grew very rapidly in Pescadero Lagoon. The impaired condition of the lagoon is one of the most significant limiting factors to the steelhead population in Pescadero Creek (NMFS 2012).

Presently, the open lagoon in summer supports more steelhead than in previous drought years, but substantially lower numbers in wet years than an impounded freshwater lagoon (Smith 2008). Smith (1990) documented excellent juvenile steelhead survival and growth when central California coast lagoons, including Pescadero Lagoon, are open to full tidal mixing and when closed lagoons were entirely converted to freshwater. In the summer of 1989 the sandbar at Pescadero lagoon remained open for several months after artificial sandbar breaching; although the upstream portions of the estuary were shallow, stratified and warm, the well-mixed main

embayment was cool and well-oxygenated (Smith 1990). Huber (2018) demonstrated that juvenile *O. mykiss* summertime body growth rates were fastest when the lagoon was fully or partially open in 2011 and 2012 and slowest when it was completely closed in 2013. While growth of the 2013 cohort was probably limited in part by density-dependent effects, the closed lagoon nevertheless provided abundant aquatic habitat during a period when upstream habitats were heavily degraded due to drought (Huber 2018). In 2017, the period of August and September (the lagoon mouth closed on September 28) appeared to have had the best rearing conditions for juvenile steelhead (between July and November).

Pescadero Lagoon is important rearing habitat for CCC steelhead. In November 1986, Smith (1990) estimated the number of steelhead in the lagoon exceeded 17,000; the standard lengths of all steelhead measured (n = 59) were greater than 130 mm. More recent population estimates are provided by Huber (2018), Jankovitz (2015, 2016, 2017, 2018, 2020), and Jankovitz and Diller (2019) summarized in NMFS (2018). Jankovitz and Diller (2019) and Jankovitz (2020) estimated a closed population of nearly 4,000 juvenile steelhead in July 2018, and nearly 5,000 juvenile steelhead in July 2019. Some fall population estimates were higher, (approximately 9,000 juvenile steelhead were located in the lagoon in October 2019 [Jankovitz 2020]). Based on steelhead life history (Busby et al. 1996) and research conducted by Huber (2018) and Jankovitz (2016, 2018), adult steelhead[8] also may use the lagoon year-round.

To reduce the likelihood of fish kills, the NOAA RC has breached the Pescadero Creek lagoon sandbar several times since 2012; a summary is presented below. Additional information on these activities is also provided in "Section 2.4.4 Previous Section 7 Consultations and Section 10(a)(1)(A) Permits in the Action Area".

The sandbar was mechanically breached on October 23, 2012; there were no fish kills that fall or winter. The sandbar was not manually breached in 2013 due to lack of rainfall and low inflow (a fish kill occurred that winter following the initial natural breach).

The sandbar was mechanically breached in November 2017, and breached manually unsuccessfully in January 2018 (the sandbar reformed relatively quickly). The day after the breach, 12 dead or moribund steelhead were discovered. Prior to the breach, a weir was installed and the focus of the weir—similar to the failed Butano Channel Temporary Weir Project in 2006 described later – was to sufficiently stem the draining of Butano Marsh during a natural breach so that the flux of oxygen demand is slower than re-aeration and flushing rates can replenish dissolved oxygen in the water column. The weir was installed in August 2017, has functioned as designed, and is still in place.

The sandbar was mechanically breached in 2018 and 2019. The Butano Creek Channel Reconnection and Resilience Project was implemented to reduce flooding and facilitate upstream sediment deposition, improve a marsh control structure, and improve water quality in the lagoon; it was completed in 2019. The dredged areas of Butano Creek maintained deeper water, colder water, and high dissolved oxygen, potentially providing critical refugia to fish and other aquatic

[8] For this consultation, an adult steelhead is defined as being at least 400 millimeters in length (fork length).

species (Jim Robins personal communication 2020). The sandbar was manually breached in late January 2021. Zero dead or moribund fish were observed.

Another recent project in the action area –the Butano Creek Floodplain Restoration Project- reconnected approximately 100 acres of abandoned floodplain by installing a roughened ramp to send a large portion of high flows downstream into the historic channel. Additionally, four engineered large woody debris (LWD) structures were installed downstream of the roughened ramp, banks were reshaped to create floodplain connector channels and introduce LWD, and banks were revegetated.

As noted above, the CZU Lightning Complex burned 86,509 acres. Some watersheds in the burned areas drain to Pescadero Creek lagoon. The area near Pescadero Creek Road—at the upstream extent of the lagoon on Butano Creek—is subject to seasonal flooding that can be expected to be exacerbated for several years by excessive runoff from CZU Lightning Complex burned area (California Department of Forestry and Fire Protection and California Department of Conservation 2020). There has not been significant rainfall on the Pescadero and Butano Creek watersheds since these fires, and so the current exposure of listed salmonids in the action area to the effects of these fires is likely negligible. The likelihood of listed salmonids being exposed to these effects during the proposed action is unknown due to imprecise and/or dry weather forecasts between the present day and the proposed action (approximately 10-30 days). If there is a significant rain event in the next 30 days or so, there may be increased sedimentation and turbidity in the lagoon. Listed salmonids rearing in and migrating through the lagoon could experience same behavioral effects (i.e., delayed migration, reduced feeding, and displacement).

2.4.1 Status of CCC Steelhead in the Action Area

The Pescadero Creek steelhead population is an essential independent population[9] within the Santa Cruz Mountains Diversity Stratum (NMFS 2016). Steelhead use the action area for rearing and migration. Some juvenile steelhead migrate downstream at all times of the year, but the largest numbers migrate in the spring and summer, with a secondary migration in the late fall or early winter (Shapovalov and Taft 1954). Hayes et al. (2011) observed many summer recruits in Scott Creek lagoon (south of Pescadero Creek Lagoon) retreating upstream into the watershed when estuarine water quality declined in the fall. During the most recent summers at Pescadero marsh, the sandbar did not form and the mouth was open when the majority of downstream migration likely occurred.

Pescadero Lagoon is heavily used by steelhead for rearing despite its shallowness and warm summer water (Smith 1990). Estimates for the number of steelhead in the entire lagoon complex in 1986 exceeded 17,000 (Smith 1990). Presently, the open lagoon in summer supports more steelhead than in previous drought years, but substantially lower numbers in wet years than an impounded freshwater lagoon (Smith 2008). As noted above, the steelhead population in the lagoon fluctuates seasonally and annually.

[9] As defined in the Coastal Multispecies Recovery Plan (NMFS 2016), functional independent populations are larger populations that are likely to persist over a 100-year time scale in isolation and without the influence of migrants from neighboring populations.

There are no recent population estimates of the Pescadero Creek steelhead run. Historically, Pescadero Creek was one of four "A-1" streams noted in San Mateo County in a 1912 California Department of Fish and Game (DFG) letter and appears to have supported the largest steelhead run in the county historically (DFG 1912, *in* Becker et al. 2010). In a 1967 report, the annual steelhead run of Pescadero Creek was estimated to consist of 1,500 spawning adults (DFG 1967, *in* Becker et al. 2010). The system undoubtedly supported many more steelhead (and coho salmon) before any major degradation of the stream drainage began. For example, in 1870 a commercial fishery existed where a wagon load of steelhead and coho weighing 1-14 kg each was taken daily from Pescadero Creek between October and March (Skinner 1962, *in* Titus et al., 2010). It is reasonable to assume that the anadromous fish populations were previously even larger than the ones which supported the commercial fishery in 1870 (Titus et al. 2010). Based on recent seining efforts in the lagoon and visual observations, there are rearing juvenile steelhead, steelhead smolts, and adult steelhead (kelts) in the lagoon (Sean Cochran, personal communication 2021).

2.4.2 Status of CCC Coho Salmon in the Action Area

The Pescadero Creek population of CCC coho salmon is an independent population[10] (NMFS 2012). On November 16 and 17, 2020, approximately 10,000 juvenile coho salmon were released in the Pescadero Creek watershed upstream of the action area (Joel Casagrande personal communication 2020). They were all PIT-tagged. In December 2019, two adult and one jack coho salmon were detected at the PIT tag antenna on lower Pescadero Creek just above tidal influence of the lagoon; all three were from released as juveniles into Scott Creek (Santa Cruz County) from the Southern Coho Salmon Captive Broodstock Program (SCSCBP) (Patrick Samuel, personal communication 2020). As of May 4, 2021, 15 PIT-tagged juvenile salmon were detected at the PIT tag antenna and one was captured during seining efforts in the lagoon on May 3, 2021. Nonetheless, coho salmon in the Pescadero Creek watershed are nearly extirpated (NMFS 2012). During the 2014-2015 spawning season, three coho salmon carcasses were recovered in Pescadero Creek—all three were from the SCSCBP and were coded-wire tagged (Brian Spence, personal communication 2016). In the summer of 2015, snorkel surveys were conducted in mainstem Pescadero Creek, as well as a tributary, but were unable to confirm successful reproduction. Given that adult returns to Scott Creek were extremely low in 2015-2016 compared to 2014-2015 despite the release of over 32,000 smolts in Scott Creek and San Vicente Creek in spring 2013 (Brian Spence, personal communication 2018), the likelihood of appreciable numbers of adult coho that may have returned to the Pescadero Creek watershed is very low (Brian Spence, personal communication 2016). One jack was captured in the lagoon in October 2017 (Jon Jankovitz, personal communication 2018)—which had been released to Scott Creek as a smolt in May 2017 (Joe Kiernan, personal communication 2018).

Besides the jack, and the 15 detections, coho salmon have not been detected during seining attempts in the lagoon between 2010 and 2019 (Huber 2018, Jankovitz 2020), nor during recent construction-related fish relocation efforts in Butano Creek (County of San Mateo Department of

[10] A population that is any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations. In other words, if one Independent population were to go extinct, it would not have much impact on the 100-year extinction risk experienced by other Independent populations. Independent populations are likely to be smaller than a whole ESU and they are likely to inhabit geographic ranges on the scale of entire river basins or major sub-basins.

Public Works 2016, Mike Podlech 2016). Completion of this project and other recent restoration projects aimed at restoring salmonid habitat is expected to improve conditions for coho salmon. Additionally, as noted above, 10,000 juveniles were recently released into the watershed. Thus, it is reasonably likely that coho salmon will return to the Pescadero Creek watershed in the next several years. Based on the PIT tag data, recent seine catches, and low stream flow, the number of juvenile coho salmon in the action area during project activities is anticipated to be no more than 1,000 juvenile coho salmon.

2.4.3 Status of Critical Habitat in the Action Area

The action area is designated critical habitat for CCC steelhead and CCC coho salmon, and supports 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.

Human-induced changes in sedimentation rates and the natural lagoon/marsh configuration has degraded conditions for salmonids in the action area. Recent anthropogenic modifications in the Preserve are generally believed to have altered the estuary/lagoon function. By 1995, the sandbar began forming substantially later in the year and this continues to present day (Smith and Reis 1997, Smith 1990). Following fall closure, water quality values in the upper sections of the lagoon begin to deteriorate at depth. Temperatures in the bottom saline stratum can be high (i.e., 26.5 degrees Celsius) and dissolved oxygen concentrations often decline to anoxic conditions at several sites (Jankovitz and Diller 2019). Currently, there is not enough time for reduced late summer stream flow to fully convert the water column to a freshwater lagoon, and as a result the water quality in the lagoon is impaired (e.g., stratified, with anoxia in the bottom layers). Late seasonal closures of the mouth, paired with low freshwater input eliminates the potential for freshwater conversion of the stratified lagoon, and increases the likelihood for fish kills if the sandbar is not actively managed (Jankovitz 2018).

Fish kill events occur in the lagoon during anoxic-hypoxic events following the natural breaching of the lagoon sandbar after an extended closure in late summer or fall. The proximal cause of death is unknown, but it is related to the lack of oxygen—and it is thought be directly due to the lack of oxygen (Largier et al. 2015). These annual fish kills are caused by a mechanism of high chemical oxygen demand (COD) due to prolonged anoxia, which is released and mixed spatially throughout the water column during turbulent sandbar breach events (Smith 2009). The mixture of high COD effectively depletes the dissolved oxygen and distributes toxic compounds (e.g. hydrogen sulfide) throughout the estuary (Jankovitz 2020). Aside from the potential for fish kills, the Pescadero Creek lagoon is a highly productive complex for steelhead. See NMFS (2018a) for further discussion regarding the record of fish kills.

Current streamflow entering the lagoon is critically low. On May 11, 2021, stream flow at the USGS gauge was 2.37 cfs. At this rate, Pescadero Creek flows are likely to become disconnected by early summer. These low streamflows may have caused a cessation in downstream salmonid migration.

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

Pursuant to section 7 of the ESA, NOAA has conducted the following the following interagency consultations within the action area of the Project:

In 2006, the Butano Channel Temporary Weir Project, with funding from the NOAA RC, was implemented. The temporary weir was constructed of inflatable bladders in Butano Channel. The reasons for building the weir were to examine the effect of runoff from Butano Channel on the water quality in the lagoon during the natural breaching of Pescadero Lagoon. The goal of isolating the side channel was to allow NOAA and the California Department of Fish and Game to evaluate whether rapid drainage from the floodplain through the side channel was depressing water quality and contributing to an annual fish kill of steelhead and other marine fish and invertebrates in the main lagoon. The project, permitted by the U.S Army Corps of Engineers and covered under the NOAA RC programmatic biological opinion[11] (ARN 151422SWR2006SR00190), was implemented, but did not function as proposed because the bladders could not be properly installed due to site conditions.

In 2012, NMFS completed informal consultation with the NOAA RC on the Pescadero Creek Lagoon Ecological Function Project (151422SWR2012SR01843; 2012/03720). The NOAA RC proposed to implement a series of measures (i.e. sandbar breaching) to minimize water quality degradation in the Pescadero Creek Lagoon marsh complex intended to prevent or greatly reduce the likelihood of fish kill events. The proposed project included sandbar breaching up two times per year for two years. NMFS concluded the action was not likely to adversely affect CCC steelhead or the designated critical habitats for CCC steelhead or CCC coho salmon.

In 2015, NMFS completed informal consultation again with the NOAA RC on the Pescadero Creek Lagoon Ecological Function Project (151422SWR2012SR01843; WCR-2015-3518). The NOAA RC proposed to manually breach the Pescadero Lagoon sandbar with an excavator up to two times per year (in 2015 and 2016) between late August and early December depending on when the sandbar forms and the mouth closes. NMFS concluded the action was not likely to adversely affect CCC steelhead or the designated critical habitats for CCC steelhead or CCC coho salmon.

In July 2016, NMFS completed formal consultation with the U.S Army Corps of Engineers (151422SWR2015SR00266; WCR-2015-3616) for their authorization to the County of San Mateo to remove up to approximately 1,445 cubic yards of sediment from within Butano Creek beneath the Pescadero Creek Road Bridge, and the area 30 feet immediately upstream and 40 feet downstream of the bridge for the next five years (2016-2020), but no more than once per year. The last time the County dredged this area was in 2016. NMFS concluded the proposed action was likely to adversely affect ESA-listed fish species and critical habitat.

In August 2016, with funding from the NOAA RC to the RCD, the Butano Creek Floodplain Restoration Project was implemented. The project reconnected approximately 100 acres of

[11] NMFS completed programmatic consultation for salmonid habitat restoration actions that include the action area of this project. This consultation anticipated a limited amount of take for juvenile salmonids during instream work conducted in the summer months. NMFS determined these restoration actions are likely to improve habitat conditions for listed species and that the limited amount of take anticipated is unlikely to affect future adult returns.

abandoned floodplain. Project construction was completed in October 2016 and permitted by the U.S Army Corps of Engineers and covered under the NOAA RC programmatic biological opinion (151422WCR2015SR00285; WCR-2018-9227).

In 2017, NMFS completed informal consultation with the NOAA RC on the Pescadero Lagoon Interim Solutions Projects (151422WCR2017SR00174; WCR-2017-7270). The NOAA RC proposed to manually breach the Pescadero Lagoon sandbar with an excavator up to two times per year (in 2017 and 2018) and install a weir comprised of UV polyethylene bags beneath the Butano Channel footbridge. NMFS concluded the action was not likely to adversely affect CCC steelhead or the designated critical habitats for CCC steelhead or CCC coho salmon.

In 2018, NMFS completed formal consultation with the NOAA RC on the Pescadero Lagoon Interim Solutions Projects (151422WCR2017SR00174; WCR-2018-10403) to address unanticipated incidental take and formal consultation with the NOAA RC on the Butano Creek Channel Reconnection and Resilience Project (151422WCR2018SR00110; WCR-2018-9858).

In 2020, NMFS completed formal consultation with the NOAA RC on the Pescadero Lagoon Interim Solutions Projects (151422WCR2020SR00245; WCR-2020-03294). The NOAA RC proposed to manually breach the Pescadero Lagoon sandbar in December 2020-January 2021 up to three times to prevent or greatly reduce the likelihood of fish kill events. NMFS concluded the proposed action was likely to adversely affect ESA-listed fish species and critical habitat.

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

2.5.1 Species Effects

Since 2021, there have been seven (November 3, 2017, December 14, 2017, November 26, 2018, December 4, 2018, December 27, 2018, December 2, 2019 and January 28, 2021) successful mechanical sandbar breaches (i.e., reinstating full tidal activity). Dead steelhead were found each year following mechanical breaches except for 2021. Although, natural breaches instead of mechanical breaches during these time periods likely would have resulted in more fish dying. Fish ended up dying during the mechanical breaches because anoxic sediment with high

chemical oxygen demand was mobilized which lead to the spreading/exacerbating hypoxic/anoxic conditions in sections of the lagoon (Jankovitz 2018). Although all of these breaches occurred in the fall or winter, and the proposed action will occur in the spring, we still expect the proposed action will result in the death of a small number of steelhead and coho salmon, primarily juveniles, by the same phenomenon observed during past breaches. However, by breaching the sandbar before lagoon head reaches it maximum, and with the functioning weir in Butano Channel, and with the Butano Creek Channel Reconnection and Resilience Project completed, the likelihood of a large fish kill is reduced. Further, there is ample evidence of large fish kills (e.g., Huber 2018, Jankovitz 2017) if no action is taken.

The breach(es) will be controlled and conducted under similar conditions present before and during breaching in 2017, 2018, 2019 and 2021 (i.e., prior to water quality conditions completely deteriorating). Therefore, in order to estimate the number of fish of each lifestage that may be killed by the proposed action, we considered lagoon water quality conditions, steelhead population estimates, coho salmon PIT tag data, and the number of fish killed during past breaches. We estimate the lagoon steelhead population will be between 750-9000 individual steelhead based on Smith (1990) and Jankovitz (2020) estimates. Past mechanical breaches resulted in 0-12 steelhead killed and 0 coho salmon killed (it is likely zero coho salmon were killed because they were likely not present). In 2011, during a natural breach, 6 of 235 dead steelhead (2.56 percent) were adults (at least 400 mm). Considering some dead steelhead may not have been observed following past breaches, and recognizing the variability in the lagoon steelhead population, we conservatively estimate up to 24 steelhead and 24 coho salmon may be killed as a result of each mechanical breach; and up to approximately 2.56 percent of these fish may be adults (1 steelhead and 0 coho adults). Because the NOAA RC may breach the sandbar up to three times in summer 2021, we expect up to 69 juvenile steelhead, 3 adult steelhead, 72 juvenile coho salmon, and 0 adult coho salmon may be killed as a result of three mechanical breaches.

The number of steelhead and coho salmon that may be killed as a result of the mechanical breaches in summer 2021 is expected to make up a very small portion of the lagoon population and a smaller portion of the Pescadero Creek watershed salmonid population. Based on population estimates provided by Smith (1990) and Jankovitz (2020), the 12 dead steelhead observed were a very small proportion of a population when population estimates were low (i.e, 1.6 percent of 750 steelhead) or a miniscule proportion when population estimates were high (0.13 percent of 9,000 steelhead).

2.5.2 Critical Habitat Effects

The goal of the mechanical breach(es) are to allow coho salmon and steelhead to complete their life cycles. Based on recent and historical lagoon water quality sampling, the lagoon is expected to be stratified prior to the breach: fresher water near the surface, saltier water on the bottom, and generally declining dissolved oxygen levels from top to bottom. Breaching and maintaining an open sandbar will result in full tidal mixing which NMFS expects will re-oxygenate the bottom of the water column. Based on monitoring data of previous breaches, NMFS expects suitable habitat (water quality and depth) will be maintained post-breach. Similarly, NMFS expects post-breach conditions to mimic summertime conditions in the lagoon when the sandbar is open.

Smith (1990) documented excellent juvenile steelhead survival and growth when central California coast lagoons, including Pescadero Lagoon, are open to full tidal mixing and when closed lagoons were entirely converted to freshwater. In the summer of 1989 the sandbar at Pescadero lagoon remained open for several months after artificial sandbar breaching; although the upstream portions of the estuary were shallow, stratified and warm, the well-mixed main embayment was cool and well-oxygenated (Smith 1990). Huber (2018) demonstrated that juvenile *O. mykiss* summertime body growth rates were fastest when the lagoon was fully or partially open in 2011 and 2012 and slowest when it was completely closed in 2013. While growth of the 2013 cohort was probably limited in part by density-dependent effects, the closed lagoon nevertheless provided abundant aquatic habitat during a period when upstream habitats were heavily degraded (Huber 2018) due to drought. In 2017, the period of August and September (the lagoon mouth closed on September 28) appeared to have had the best rearing conditions for juvenile steelhead (between July and November). However, due to current drought conditions, streamflow entering the lagoon will be low, likely rendering water quality and quantity in the lagoon marginal as the water temperature warms after the initial cold ocean water enters and the bar closes. In the days following the mechanical breaches, poor water quality (i.e. hypoxia and/or anoxia) typically lingers in several areas within the Preserve, but improves (cool and oxygenated) as tidal action is reestablished (Jankovitz 2017, 2018, 2020, and Jankovitz and Diller 2019). Based on the above observations, NMFS does not anticipate changes in water chemistry in the lagoon during the open sandbar condition following a managed breach to result in harm, injury, or behavioral impacts to salmonids that survive the immediate breach events. Furthermore, NMFS expects water quality and quantity in the lagoon after the breach(es) to remain suitable for salmonid rearing and holding. Regarding overall changes to habitat capacity, based on the three years of recent mechanical breaches, we expect water surface elevation will not be reduced by more than approximately three feet. This elevation loss equates to minor temporary reductions to rearing PBFs for salmonids in the action area.

2.6 Cumulative Effects

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

NMFS does not anticipate any cumulative effects in the action area other than those ongoing actions already described in the Environmental Baseline above. Given current baseline conditions and trends, NMFS does not expect to see significant changes in habitat conditions in the near future due to existing development and use of water in the watershed. NMFS assumes the rate of such development and water use would be similar to that observed in the last decade. Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

2.7 Integration and Synthesis

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

The Project action area is located in the Pescadero Lagoon, the terminus of the Pescadero Creek watershed. The Pescadero Creek watershed supports threatened CCC steelhead. NMFS identified the Pescadero Creek watershed as a historically independent population for the CCC steelhead DPS (NMFS 2016). The Pescadero Lagoon is also known to support endangered CCC coho salmon. NMFS identified the Pescadero Creek watershed as one of two historically independent CCC coho salmon populations within the Santa Cruz Mountains Diversity Stratum (NMFS 2012). Pescadero Lagoon is designated critical habitat for both 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 diversity stratum have declined substantially over the past several decades and now are only occasionally found in the Pescadero Creek watershed—usually the result of straying from hatchery releases.

Salmonid habitat in the action area is impaired by an enhancement plan not implemented as designed and by poor water quality in the lagoon. As a result, habitat functionality and potential is limited and there are frequent fish kills. NMFS finds it reasonable to expect that the frequent steelhead kills are adversely affecting the run. This expectation is based on the life stage and size of fish dying, and the existing poor conditions of four habitat attributes in the Pescadero Creek watershed: estuary, habitat complexity, sediment transport, and water quality (NMFS 2012). The loss of these steelhead that could have returned and spawned, coupled with habitat conditions in the watershed are limiting steelhead productivity in the Pescadero Creek watershed. Similarly, impaired habitat conditions in the watershed have likely contributed to the functional extirpation of coho salmon in the watershed.

The project includes mechanically breaching the lagoon sandbar up to three times in summer 2021. The goal of the breaches are to allow coho salmon and steelhead to complete their life cycles by reinstating ocean connectivity and tidal mixing. Juvenile steelhead, juvenile coho salmon, and adult steelhead (kelts) are expected to be present in the action area during project implementation.

2.7.1 Summary of Effects to CCC steelhead and CCC coho salmon

The project may result in injury and mortality of CCC steelhead adults and juveniles and CCC coho salmon juveniles during sandbar breaching. However, NMFS expects relatively few CCC steelhead adults and juveniles and even fewer CCC coho salmon juveniles may be injured or killed following a mechanical breach because the sandbar breach(es) will be controlled and conducted before water quality conditions become lethal, under similar conditions in which previous mechanical breaches occurred and few fish were killed. NMFS estimates no more than 24 steelhead (23 juveniles and 1 adult) and 24 coho salmon will be injured or killed by each mechanical breach. Because the NOAA RC may breach the sandbar up to three times in summer 2021, NMFS estimates no more than 69 juvenile steelhead, 3 adult steelhead, and 72 juvenile coho salmon may be killed as a result of 3 mechanical breaches. The number of steelhead and coho salmon that may be adversely affected or killed during project activities is expected to make up a very small portion of the salmonid population in the action area and a smaller portion of the Pescadero Creek watershed salmonid population and a subsequently smaller portion of the CCC DPS and ESU.

It is likely that the adult steelhead trapped in the lagoon will not survive the summer and fall in the lagoon due to warm water temperature. By allowing steelhead and coho salmon access to the ocean, the project will improve survival of steelhead and coho in the lagoon, thus increasing CCC steelhead and CCC coho salmon population resilience and persistence over time.

NMFS does not expect any of the aforementioned effects to occur simultaneously with other effects in any significant way. Due to the relatively large numbers of juveniles produced by each spawning pair of adult steelhead and coho salmon, spawning in the Pescadero Creek watershed in future years would be expected to produce enough juveniles to replace any juveniles or an adult that may killed as a result of the mechanical breach. It is unlikely that the small potential loss of juveniles and adults due to a mechanical breach would impact future adult returns.. Therefore, we do not expect the proposed project to affect the persistence or recovery of the Pescadero Creek population of steelhead or coho salmon.

2.7.2 Summary of Effects on CCC steelhead and CCC coho salmon Critical Habitat

The action area 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 directly or indirectly diminish the value of critical habitat for the conservation of CCC steelhead or CCC coho salmon.

Critical habitat for the CCC steelhead DPS and CCC coho salmon ESU has been impaired. While conditions vary, critical habitat has been impaired by habitat loss, alteration and fragmentation, surface and groundwater extraction, land use conversion, and estuarine habitat loss. These factors also affect CCC steelhead and CCC coho salmon critical habitat in the Pescadero Creek watershed, which has been impaired by historical logging, channel incision, and water diversions. Both watershed-wide factors and action area-specific factors affect critical habitat in the action area—incised channels deliver excessive amounts of sediment to Butano Creek which impedes fish passage, and the enhancement plan implemented in 1993 has affected habitat and water quality in the lagoon.

The project will result in temporary impacts to critical habitat from mechanical breach(es). We expect water surface elevation will not be reduced by more than approximately 3 feet. Based on monitoring data from recent breaches, we expect suitable habitat (water quality and depth) will be maintained post-breach. The mechanical breaches may result in the mobilization of anoxic sediment with high chemical oxygen demand, which will lead water quality to decrease in sections of the lagoon into hypoxic/anoxic levels (Jankovitz 2018). The water quality impacts will be temporary; aquatic habitat in the lagoon will return to ambient conditions in a few weeks following sandbar reformation. NMFS does not expect these temporary reductions in critical habitat quality will diminish the value of critical habitat as a whole for the conservation of the species.

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 consequences of climate change in the Monterey Bay region are increases in both air and water temperatures, and changes in the timing and magnitude of storms, their runoff, and dry season streamflow. These projections further highlight the importance of providing suitable streamflow conditions for fish passage, spawning and rearing in the streams of the CCC steelhead DPS and CCC coho salmon ESU. In the action area, these projections also highlight the need to restore the function of the lagoon, especially remedying the unnatural water management structures in the Preserve.

In the Pescadero Lagoon, increases in summer temperatures could lead to reduced growth rates and lower survival for stream and estuary rearing juveniles. Similarly, lower precipitation could lead to reduced stream flows, increased stream drying (e.g., reduced spawning habitat), and less food availability via invertebrate drift. Over the long-term (beyond the summer 2021 project timeframe) conditions may be further degraded than current conditions in the lagoon and in the upper watershed. Short-term effects of climate change may exacerbate these conditions as well, however, the effects of climate change are not expected to significantly degrade existing conditions over the time frame (approximately 40 days) considered in this biological opinion.

2.8 Conclusion

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

After reviewing and analyzing the current status of the critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of 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). "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 incidental take statement.

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 CCC steelhead and CCC coho salmon may occur during mechanical sandbar breaching in summer 2021. The number of threatened CCC steelhead or endangered CCC coho salmon that may be killed or injured during each mechanical breach is expected to be small. NMFS expects no more than 69 juvenile steelhead, 3 adult steelhead, and 72 juvenile coho salmon to die if there is a fish kill following 3 mechanical breaches in summer 2021 (see 2.7 Integration and Synthesis). Take will have been exceeded if these estimates are exceeded.

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 CCC steelhead or CCC coho salmon or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

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

1. Ensure sandbar breaching methodology is properly implemented while breaching.
2. Conduct post-sandbar breaching reconnaissance in the lagoon for dead or moribund salmonids to ensure sandbar breaches resulted in minimal take of CCC steelhead and CCC coho salmon.
3. Prepare and submit a report to document the effects of mechanical breaching activities, including water quality monitoring.

2.9.4 Terms and Conditions

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

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

    a) The NOAA RC shall 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 biological opinion.

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

    a) The NOAA RC, or their designee, shall walk the margins of the main lagoon embayment, lower Butano Channel, lower Butano Creek, and the western edge of Delta Marsh, and/or use a boat, to search for dead or moribund salmonids.

    b) If any salmonids are found dead or injured, the biological monitor will contact NMFS biologist, William Stevens, by phone immediately at (707) 575-6066 or the NMFS North Central Coast Office (Santa Rosa, California) at 707-575-6050. The purpose of the contact is to review the activities resulting in take, determine if additional protective measures are required, and to ensure appropriate collection and transfer of salmonid mortalities and tissue samples. All salmonid mortalities will be retained. Tissue samples are to be acquired from each salmonid mortality per the methods identified in the NMFS Southwest Fisheries Science Center Genetic Repository protocols (contact the above NMFS staff for directions) and sent to: NOAA Coastal California Genetic Repository; Southwest Fisheries Science Center; 110 McAllister Way; Santa Cruz, California 95060.

    c) Species, fork length, and condition of collected salmonids shall be recorded and the information provided to NMFS biologist (see contact above).

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

    a) NOAA RC must provide a written report to NMFS by February 15, 2021. The report must be submitted to NMFS North Central Coast Office, Attention: William Stevens, 777 Sonoma Avenue, Room 325, Santa Rosa, California, 95404-6528. The report must contain, at a minimum, the following information:

        (1) **Breaching related activities --** The report(s) must include the dates mechanical breaching occurred; 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.

(2) **Water Quality Monitoring --** The report must include data collected as described in section 1.3 (Monitoring) of the biological opinion.

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).

The NOAA RC has programs that support salmonid restoration and is a valued partner of NMFS West Coast Region. To facilitate the recovery of listed species and to enhance critical habitat, NMFS recommends the NOAA RC provide funding towards implementation of the Pescadero Marsh Habitat Restoration and Resilience Project.

2.11 Reinitiation of Consultation

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

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

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

can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]

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

3.1 Essential Fish Habitat Affected by the Project

EFH managed under the Pacific Coast Salmon Fishery Management Plan (FMP), Pacific Coast Groundfish FMP, and Coastal Pelagic FMP will be adversely affected by the proposed action. The Project action area is located in a Habitat Areas of Particular Concern (HAPCs) for Pacific Coast Salmon and groundfish (PFMC 2020; PFMC 2021).

3.2 Adverse Effects on Essential Fish Habitat

The potential adverse effects of the project on Pacific Coast Salmon EFH have been described in the preceding biological opinion and included degraded water quality and benthic disturbance. The effects to species managed under the Pacific Coast Groundfish and Coastal Pelagic FMPs are expected to be similar to the effects to coho salmon. As described above, degraded water quality and benthic disturbance are anticipated to be minor and temporary.

3.3 Essential Fish Habitat Conservation Recommendations

Based on information developed in our effects analysis (see preceding biological opinion), NMFS has determined that the proposed action would adversely affect EFH for species managed under the Pacific Coast Groundfish and Coastal Pelagic FMPs, and EFH for CCC coho salmon, which are managed under the Pacific Coast 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 NOAA RC must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. Data Quality Act Documentation and Pre-Dissemination Review

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the NOAA RC. Other interested users could include the California State Parks, Department of Fish and Wildlife, U.S. Fish and Wildlife Service, San Mateo Resource Conservation District, the Regional Water Quality Control Board, and Pescadero residents. Individual copies of this opinion were provided to the NOAA RC. 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, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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